

**July 2011 - June 2012
Annual Report**

and

**July 2013 - June 2014
Appropriation Request**

to the

**Tennessee Higher
Education Commission**

September 2012

 **Institute for a Secure &
Sustainable Environment**

*311 Conference Center Building, Knoxville, Tennessee 37996-4134
(865) 974-4251 Fax (865) 974-1838 email: isse@utk.edu <http://isse.utk.edu>*

Table of Contents

Introduction	1
2011-2012 Programmatic Report.....	7
Tennessee Water Resources Research Institute	8
China-US Joint Research Center for Ecosystem and Environmental Change.....	11
East Tennessee Clean Fuels Coalition.....	13
Center for International Networking Initiatives/GLORIAD.....	14
Other Initiatives.....	16
Research Accounts.....	19
Publications	21
2012-13 New Initiatives	23
Tennessee Water Resources Research Institute	24
China-US Joint Research Center for Ecosystem and Environmental Change.....	24
Center for International Networking Initiatives/GLORIAD.....	25
Other New Initiatives for 2012-13.....	25
Summary of Faculty and Student Participation	27
Faculty Actively Engaged in ISSE Research	28
Post-docs, Graduate Students, and Undergraduate Students Involved in ISSE Research	29



*Dr. Chris Cox,
ISSE Director*

This was a year of transition for the Institute for a Secure and Sustainable Environment (ISSE). Dr. Chris Cox, Professor in the Department of Civil and Environmental Engineering, was appointed as the Director of ISSE in October, replacing Dr. Randall Gentry.

With the change in leadership, ISSE has refocused its operations in three related ways. First, there is a renewed focus on increased interaction and stronger partnerships with faculty and students on campus. Increasingly, ISSE research will be led by tenured and tenure-track faculty members and their students, with ISSE staff members playing supporting roles. Second, the budget priorities of ISSE have been refocused to enable research with clear environmental and sustainability impacts. Some ISSE staff members are still and will continue to be engaged in outreach activities; however, there is an expectation that these activities will be largely self-supporting. Third, in order to be more responsive to emerging trends in the rapidly changing environmental sustainability landscape, ISSE is transitioning to a more flexible overall structure. While some of the traditionally strong centers under the ISSE umbrella will continue to function as individually recognized entities, new ISSE initiatives won't necessarily be limited to these pre-existing silos.

These changes in priorities have resulted in several structural changes in ISSE during the last year. The Community Partnership Center was discontinued because its activities were only peripherally related to the environment and sustainability missions of ISSE and it had low levels of external funding. Jack Geibig, the Director of the Center for Clean Products (CCP), resigned his position in order to enter private practice. Beginning in the 2012-13 fiscal year, a majority of the financial support for the China-US Joint Research Center for Ecosystem and Environmental Change will shift from ISSE to the UT System and UT Institute of Agriculture to achieve better alignment of its support and its research mission. Finally, the financial management of ISSE became more efficient by the reduction of one staff member through retirement.

Resources previously supporting the above activities are being redirected to engage tenure and tenure-track faculty and their students in the ISSE research program in a variety of ways as described in the future initiatives section of this report. In order to build successful partnerships, resource allocation must be coupled with the building of strong relationships between ISSE, the faculty, and their home academic units. This is a continuous and dynamic process targeted at opportunities occurring at the intersection of emerging environmental sustainability priorities and the interests and expertise of the faculty.

INTRODUCTION

2011-12 Programmatic Report

2011-2012 Programmatic Report

Tennessee Water Resources Research Center (TN WRRC)

Faculty-led research

Significant progress was made in integrating campus faculty into the activities of the TN WRRC during 2011-2012. Through a 50/50 partnership with the University of Tennessee Knoxville (UTK) Office of Research, funding totaling \$140,000 for faculty-led projects was committed for seed projects aimed at gathering preliminary data that can be used as the basis for external research proposals. Projects will be conducted during 2012-2013 and are described in the future initiatives section of this report. In addition to seed funding, the TN WRRC teamed with campus faculty to organize and host the 2nd Annual Watershed Symposium at the University of Tennessee, to be held September 18, 2012. The symposium was an opportunity for faculty, students, and water resource professionals in the community to present their research and learn of new emerging technologies and issues related to watersheds and their management.

USGS Water Resources Research Institute Program

The TN WRRC is one of 54 state-level Water Resources Research Institutes of the US Geological Survey (USGS) and administers several state-level USGS grants through this program. In order to increase the level of faculty and student engagement, the number of projects receiving funding through this program was doubled from two to four this year. Funded grants include:

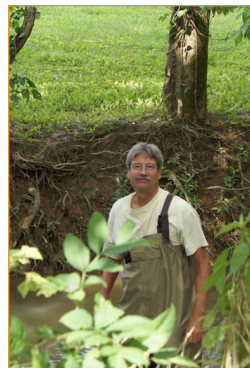
- *Evaluation of Bioretention Practices for Effective Stormwater Management and Treatment: A Laboratory to Field Study* (PIs: Andrea Ludwig and Daniel Yoder, Biosystems Engineering and Soil Science)—This project will examine the effectiveness of stormwater bioretention systems by monitoring the performance of an installed demonstration site in the Beaver Creek watershed as a function of design variables and incorporate the findings into a best management practice database that can eventually be used to make data-driven recommendations to stormwater designers.
- *An Evaluation of Floodplain Forest Land Use Dynamics, Ecosystem Services, and Conservation Policies in West Tennessee Watersheds* (PIs: Donald Hodges, Forestry, Wildlife, and Fisheries; and Christopher Bridges, Research and Education Center at Milan)—This study seeks to develop an understanding of how historic watershed management policies have contributed to the degradation of forest ecosystems in the floodplains of channelized rivers in West Tennessee. The investigators will integrate National Envi-

ronmental Policy Act assessments, historical records of land use, and ecosystem service values. The result of the study will inform ecosystem restoration policies and practices throughout the Southeast.

- *Rainwater Harvesting as part of a Sustainable Urban Water Management Strategy* (PI: Kevin Robinson, Civil and Environmental Engineering)—This study investigates the feasibility and impact of rainwater harvesting for use in cooling towers in an urban setting. The feasibility study will assess rainwater harvesting equipment needs, water quality issues, and potential savings in potable water.
- *Determining Channel Protection Flows in Urban Watersheds Through Effective Strategies for Stormwater Management and Stream Restoration* (PI: John Schwartz, Civil and Environmental Engineering)—The goal of this project is to understand the interactions of urbanization and stream bed morphology on channel protection. Data will be collected from several pilot streams in order to calibrate EPA's SUSTAIN model for stormwater management to provide simplified site-specific design recommendations for channel protection and impaired stream restoration design throughout the nation.

Beaver Creek Task Force

Roy Arthur of the TN WRRC facilitates the Beaver Creek Task Force, which includes partners at the federal, state, and local levels including the US Environmental Protection Agency (EPA), Tennessee Department of Environment and Conservation (TDEC), Tennessee Department of Agriculture (TDA), Knox County Stormwater, Knox County Parks and Recreation, Legacy Parks Foundation, the Hallsdale Powell Utility District, the Metropolitan Planning Commission, the Lower Clinch Watershed Council, the Tennessee Yards and Neighborhoods program, and the Shopper News. The



Dr. John Schwartz in Beaver Creek during stakeout of the stream restoration project.

overall goal of the task force is to improve water quality in the Beaver Creek watershed through a broad range of on-the-ground projects combined with community engagement and education events.

TN WRRC involved faculty and students in three separate Beaver Creek projects in FY12. Using a TDA 319 grant, the Center funded a 1,600 foot stream rehabilitation project in the Halls Community Park. The project was designed by Dr. Kiel Neff as part of his doctoral research

2011-2012 Programmatic Report



Jessica Johnson, Master's student under Dr. Andrea Ludwig in the Department of Biosystems Engineering and Soil Science, poses with an ISCO automatic sampler installed in the Cedar Crossing subdivision.

under Dr. John Schwartz in the Department of Civil and Environmental Engineering. The basis of the design was to re-create pool/riffle/run sequences in a low-gradient, channelized reach of the creek in order to create habitats suitable for fish in the stream and otherwise increase its biodiversity. Pre- and post-monitoring will determine if the project was successful in achieving these goals. Potentially, the design concepts can be exported to low-gradient, channelized urban streams nationwide. Dr. Andrea Ludwig designed a monitoring program to assess performance of a bio-retention project in the Cedar Crossing subdivision (located in Beaver Creek watershed) with funding provided by TN WRRC. This project, designed to quantify the effectiveness of the bio-retention facility's ability to reduce quantity and pollutants, funded Dr. Ludwig's master's student, Jessica Johnson in the Department of Biosystems Engineering and Soil Science. Dr. Kiel Neff designed a 2,400 foot stream restoration project with funds from TN WRRC's 319 grant. In FY13 TN WRRC will construct the bio-retention facility in Cedar Crossing, the stream restoration project on Beaver Creek, and continue work on a Stormwater Practices Demonstration Park in the lower portion of the watershed.

Training Activities

Tim Gangaware of the TN WRRC coordinates two statewide training and certification programs for TDEC: the Tennessee Erosion Prevention and Sediment Control Training and Certification Program (TNEPSC) and the Tennessee Hydrologic Determination Training Program (TN-HDT).

TNEPSC is comprised of three basic courses:

- Level I: Fundamentals of Erosion Prevention and Sediment Control for Construction Sites is a one day foundation-building course for individuals involved in all aspects of land-disturbing activities. In 2011-2012 this course was offered 16 times in eight communities across the state with 1,340 persons attending.
- Level II: Design Principles for Erosion Prevention and Sediment Control for Construction Sites is an intensive two-day course for engineers and other design professionals, focused on engineering technology needed to design controls and practices for preventing erosion and managing sediment and other stormwater pollutants at construction sites. In 2011-2012 this course was offered four times in three communities across the state with 141 persons attending.

- A half-day Level I recertification course is offered for those needing to renew their Level I certification three



years after successfully completing the Level I training. In 2011-2012 this course was offered 21 times in 11 communities across the state with 1,613 persons attending.

TN-HDT is the second training program coordinated by TN WRRC for TDEC. The TN-HDT program consists of a three-day course designed to provide participants with a basic understanding of the underlying scientific principles, legal jurisdictional ramifications, and the practical investigative techniques related to the determination of wet weather conveyances versus stream and other surface water features. In 2011-2012 this course was offered three times with 66 people attending.



Knox County Adopt-A-Watershed Program.

Ruth Anne Hanahan (TN WRRC) leads the Knox County Adopt-A-Watershed (AAW) Program, which is sponsored by Knox County Stormwater and the Water Quality Forum. This program involved approximately 1600 middle and high school students in service-learning projects over the course of the 2011-2012 school year. Students were engaged in five hours or more of hands-on learning activities to prepare them to deliver a meaningful service project that would improve the well-being of their school's watershed. Student proj-

2011-2012 Programmatic Report

ects ranged from conducting stormwater awareness campaigns to the application of stormwater best management practices. For example, Karns High Environmental Science students helped to install stormwater drain inserts and monitored their debris collecting performance over the course of the year. West Valley Middle 7th grade students learned about erosion control impacts and then began a long-term project of applying erosion control measures on eroding campus hillsides draining to Ten Mile Creek. In addition, AAW continued to support the expansion of campus outdoor



Halls High Ecology students prepare rain barrels for installation in the Halls Outdoor Classroom.



West Valley Middle 7th grade students take erosion control measurements in preparation for installing erosion control matting on campus hillside.

classrooms through its multidisciplinary approach of integrating these spaces into curricula. Through these efforts, Halls Outdoor Classroom received its official Department of Forestry Level I Arboretum certification and rain barrels were installed on an Eagle Scout-built pavilion. In total, AAW worked in 12 middle and high schools across nine Knox County watersheds.

Tennessee Yards & Neighborhoods (TYN)



2011 TYN Shelby Co. Six-Hour Homeowner Landscape Workshop conducted in partnership with the City of Bartlett Stormwater Program.

Tennessee Yards & Neighborhoods (TYN), a statewide initiative headed by TN WRRC (Ruth Anne Hanahan) and UT Extension (Dr. Andrea Ludwig), brought to a close its three-year pilot involving Knox, Hamilton, Shelby, Cumberland, Da-

vidson, and Montgomery counties. The primary intent of this pilot was to develop and test an instructional delivery model that involved local municipal stormwater staff and County Extension agents team-teaching sustainable landscaping workshops to homeowners. Over 400 homeowners participated in the six-hour landscape workshops with additional homeowners participating in TYN rain barrel workshops. Feedback from a comprehensive program evaluation revealed substantial impacts on homeowner behaviors. For example, of those who participated in the TYN Landscape Workshops, over one-half subsequently planted trees and about one-third installed rain barrels. Strategic plans for statewide expansion are now being developed based on evaluation results and input from local TYN coordinators and statewide TYN board members. Such plans will include the development of additional curricula, the incorporation of new communities, and the expansion of on-line services.



TYN demonstration rain garden, located on the UT Agriculture Campus, in action.

2011-2012 Programmatic Report

China-US Joint Research Center for Ecosystem and Environmental Change (JRCEEC)

In 2011, the US-China EcoPartnership for Environmental Sustainability (USCEES) was established by the US State Department. Key members in the partnership include Purdue University, the University of Tennessee, Oak Ridge National Laboratory, and the Chinese Academy of Sciences. This EcoPartnership was built on the ground work laid by the JRCEEC and was formed to address environmental issues common to the US and China. Key leaders of this activity are Jie Zhuang, Biosystems Engineering and Soil Science; and Gary Sayler, Microbiology.

JRCEEC 2011 Annual Conference

The fifth annual China-US workshop (and 1st annual symposium of the EcoPartnership) was held on September 26-29, 2011 at Purdue University in West Lafayette, Indiana. The theme of the workshop was “Global Sustainability Issues in Energy, Climate, Water, and Environment.” Presentations included eight keynote addresses, two lunch speakers, and 45 technical presentations. Workshops/panel discussions included the development of the bio-based economy and the future of the EcoPartnership. Also on the program were evening sessions that included a Discovery Lecture Series

presentation and entertainment provided by the Confucius Institute at Purdue and Purdue University Chinese Students and Scholars Association. Post symposium activities included networking session with Purdue’s Chinese students and an NSF-funded biofuels workshop. Participants from UT and ORNL included Martin Keller, Barry Bruce, He Qiang, Gary Sayler, Jie Zhuang, Steven Brown, Charles Kwit, Paul Frymier, and Esther Parish.

Ecopartnership Planning Meetings

Planning events to further develop the EcoPartnership were held in Beijing, China, in January and at the University of Tennessee in April. Participants at the Beijing meeting developed action plans and agreed to establish two councils (academic and business) to serve the needs of all constituencies. The UT EcoPartnership meeting focused on institutional relationships of the US partners, goals of the organization, and development of action plans. The meeting was convened by UT’s Interim Vice Chancellor for Research, Lee Riedinger, and participants included leaders and faculty of UT (Gary Sayler, Bill Brown, Matt Murray, Chris Cox, Tim Rials, Larry McKay, Carol Harden, Alex Miller, and Eric Drumm), ORNL (Tony Palumbo and Ian Anderson), and Purdue University (Jon Harbor, John Bickham, Otto Doering, Tim Filley, Guofan Shao, Mark Van Fleet, and Holly Wang). A web site (<http://www.purdue.edu/>)



Group Picture of the 2011 China-US Joint Symposium at Purdue University, West Lafayette, Indiana

2011-2012 Programmatic Report

discoverypark/ecopartnership/) was developed to post information about the activities and accomplishments of the EcoPartnership. The web site is in both English and Chinese.

Other Activities

The JRCEEC organized a special session focusing on water resource issues in Northwest China at the 2012 Tennessee Water Resource Symposium, held at Montgomery Bell State Park, on April 11-13, 2012. The session featured eight speakers and 12 participants from the College of Water Resources and Hydropower Engineering of Xi'an University of Technology, one of the top ranked water resource engineering programs in China. Talks covered a diverse range of topics including water resource management, sediment transport and modeling, eco-environmental risk assessment, reservoir management, nutrient cycling, and pollutant transport and fate modeling. The visit and session was coordinated by UT faculty member Dr. Qiang He (Civil and Environmental Engineering) in collaboration with Sherry Wang, manager of the pollution control program of TDEC. After the conference, the Chinese delegation visited the Tennessee Valley Authority (TVA) and expressed strong interest in developing substantial collaborations with UT, TDEC, and TVA in research, education, and technical training.

JRCEEC researchers were featured in a special issue of *Plant Science*, "Bioenergy Plants in the United States and China" (see *Plant Science* 181(6): 621-716, Decem-

ber 2011). The special issue was developed based on the presentations at the 2010 China-US Joint Workshop on Biotechnology of Bioenergy Plants with Dr. Neal Stewart of UT and Dr. Gong-She Liu of the Institute of Botany, Chinese Academy of Sciences, serving as guest editors.

The JRCEEC hosted several visiting scholar exchanges during 2011-2012:

- During July and December of 2011, Xiang-Hua Xu (Associate Professor at Nanjing University of Information Technology) performed experimental research on mercury bioreporters at UT's Center for Environmental Biotechnology (CEB), guided by Steven Ripp, Alice Layton, Gary Sayler, and Jie Zhuang.
- From July 2011 through June 2012, Dr. Xiu-Li Dang (Assistant Professor at Shenyang Agricultural University) conducted biochar research at UTIS's Biosystems Engineering and Soil Science, guided by Amy Johnson and Mark Radosevich.
- In October 2011, Dr. Xiao-Dong Ren (Associate Professor at Jilin University) started a year-long visiting research project on bioenergy production from cellulose at CEB and UTIA's Plant Science, guided by Gary Sayler and Joe Bozell.
- In January 2012, Dr. Zhong-Qiang Wang (Associate Professor at Northeast China Normal University) started a year-long research project on water pollution at ISSE, guided by Jie Zhuang.

2011-2012 Programmatic Report

East Tennessee Clean Fuels Coalition (ET Clean Fuels)

ET Clean Fuels is a nonprofit, 501(c)(3) organization founded to promote alternative transportation fuels in the East Tennessee region. It is led by Jonathan Overly and Kristy Keel.



Project PI Jonathan Overly speaks with the media during the grand opening of the Crossville Eco Travel Plaza.

ET Clean Fuels completed the construction and grand opening of Tennessee's first solar-powered, multi-product Truck Stop Electrification (TSE) project in Crossville, Tennessee, at the Eco Travel Plaza, through a \$520,000 ARRA grant.

The city of Kingsport, Tennessee, now has 18 propane-powered vehicles and its own propane refueling system as the result of grants and direct assistance from ET Clean Fuels.

ET Clean Fuels built and now maintains a map for the entire eastern half of Tennessee that shows where all types of electric vehicle (EV) recharging equipment is located; they also manage a Facebook page for East Tennessee EV owners to share stories, information, and questions (see www.ETE.V.info).

ET Clean Fuels partnered with UTK's Department of Mechanical Engineering (through the US DOE

EcoCAR2 collaborative competition) to assist in a number of outreach events and initiatives.

A major, statewide partnership initiative with the Tennessee Gas Association and ET Clean Fuels allowed the collaboration required to put together Tennessee's first Natural Gas Vehicle (NGV) Expo in Nashville on April 4, 2012 that was attended by over 400 people.

The 2011 annual survey of ET Clean Fuels partners in the East Tennessee region (compiled for the US Clean Cities program) shows that, through the use of alternative fuels and advanced transportation technologies, 3,500,000 GGEs (gasoline gallon equivalents) of total, combined petroleum use has been offset this year. These petroleum-use offsets equal almost 28,000 tons of CO₂ reductions.

Additionally, ET Clean Fuels managed numerous events throughout the year and collaborated on others. One of these was Genera Energy, LLC's Biomass Field Days, which was held in October 2011.



Project Facilitator Kristy Keel-Blackmon speaks with students during the 2011 Biomass Field Days held in Vonore, TN at the site of the Biomass Innovation Park.

Four full editions of *Southeastern Fuels Fix* were produced this year. *Southeastern Fuels Fix* is the only ezine in the US focusing on Clean Cities coalitions and their partners' actions and accomplishments.

2011-2012 Programmatic Report

Center for International Networking Initiatives/GLORIAD

The US National Science Foundation (NSF) and US Agency for International Development (USAID) have provided a total of \$22M in funding for the Global Ring Network for Advanced Application Development (GLORIAD, PI Greg Cole) to build and manage cyber-infrastructure (especially advanced network services) connecting science and education communities across the globe; GLORIAD's international partners have invested over \$220M cumulatively. GLORIAD enables global open science collaboration via carefully organized collaboration and co-funding with public and private sectors in Europe, Asia, and Africa. The countries served by the GLORIAD program, funded since 1997, now encompass half the globe. Partners include Russia, China, Korea, the Netherlands, Canada, the five Nordic countries, Egypt, India, and Singapore. The GLORIAD network serves every knowledge discipline—from high-energy physics to atmospheric and climate change science to renewable energy research to nuclear nonproliferation to genomics and medicine to economics and history.

After almost two years of intense planning for new advanced science communication services for Egypt-US collaboration, on December 7, 2011, the Egyptian Ministry of Science “switched on” the new high-speed GLORIAD network connecting scientists, educators, and students across the US and Egypt. Immediately, Egyptian universities, researchers, and students gained access to a vastly increased speed of data transfer with thousands of universities and science facilities across the US, Europe, Asia, and the rest of the world. The US-Egypt partnership is also working to engage our future scientists. In December 2011, GLORIAD hosted the first ever school-to-school exchange over the new network, involving the STEM Academy High School, a technology magnet elementary school (both in Knoxville, Tennessee), and GLORIAD's partners in Cairo.

In June 2012, GLORIAD along with its partners in India launched a one Gbps link for science and education as part of the “GLORIAD Taj” project. The link connects research and education institutions in Bangalore, the science hub of India, with counterpart institutions and collaborators around the globe. The new facility, called “BixLight” (pronounced “BiLight”), is

modeled after the “StarLight” facility based in Chicago, which revolutionized global high-performance networking in the 90s. During the first days of its operation, the new link supported flows as large as 3.5 terabytes between US and India scientists.

GLORIAD also completed huge upgrades of existing circuits with long-term partners as well as capacity increases achieved ahead of schedule with its newest partners. Also included in the past year of activity was deploying a new 10G circuit supporting US-Nordic cooperation, increasing total US-Nordic capacity to 22.5 Gbps. The new US-Southeast Asia/Singapore capacity was increased to 1G, and the Egypt circuit, (now funded by the Egyptian government after Tata Communications provided, *gratis*, the initial network link) was increased to a full 1G. The circuit with India is now 1G across the Pacific and soon will be 1G across the Atlantic. In addition to these enormous advances in network capacity, GLORIAD's US team also made significant improvements to the US network infrastructure in Seattle, Chicago, and Knoxville, developed a new platform and interface for the Distributed, Virtual Network Operations Center (dvNOC), which uses social media technologies for shared planning and network operations, and launched a new measurement/monitoring system.

In January, 2012, GLORIAD hosted the “GLORIAD in Asia” workshop in Hong Kong, working with key networkers from across the US, China, Korea, India, Singapore, and Vietnam on planning out new infrastructure supporting Asian researchers—and new services connecting Asia and Europe.

In the past year, GLORIAD has been working on a new customer-based system for measuring and monitoring global network infrastructure and performance, focused more on addressing needs of individual R&E network users and less on performance of the network circuits. To address its goal of actively improving global infrastructure for individual scientists, educators, and students, the new system is designed to (1) understand the network needs and requirements of a global customer base by actively studying utilization; (2) identify poor performance of individual applications by constantly and in near-real-time analyzing information on such “per-flow” metrics as load, packet loss, jitter, and routing asymmetries; (3) mitigate poor performance of applications by identifying weaknesses in the global fabric and actively sharing that information with global partners; and (4) provide rich visual analysis applications to help make sense of the sizable volume of data. To realize this new model of measurement and monitoring, GLORIAD recently moved from its netflow-based system (used since 1998 and storing

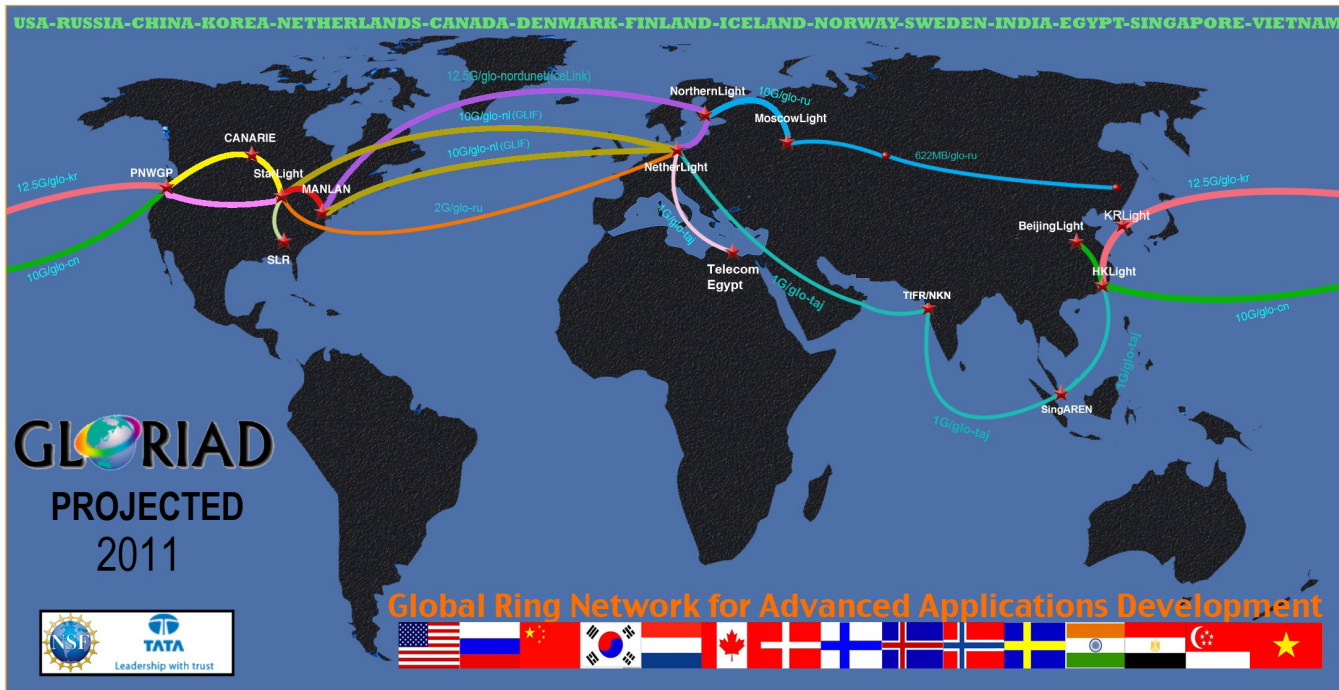


First Egypt-US schools video conference across new GLORIAD US-Egypt network

2011-2012 Programmatic Report

approximately one million records per day) to a new, more precise system—collecting, storing, and analyzing over 400 million network utilization records per day—based on open-source Argus software across its infrastructure (www.qosient.com/argus). In Febru-

ary 2012, GLORIAD’s PI, Greg Cole, gave a talk at the Asia-Pacific Advanced Network (APAN) conference in Colombo, Sri Lanka, for the global community of high performance network professionals on the benefits and technical challenges of this quickly evolving work.



2011-2012 Programmatic Report

Other Initiatives

Remediation Model Development

Drs. Jack Parker (Civil and Environmental Engineering), Phil Jardine (Biosystems Engineering and Soil Science), and Ungtae Kim (Civil and Environmental Engineering) are developing models for optimizing the remediation of non-aqueous phase liquid (NAPL) contamination at Department of Defense sites. The models include a variety of NAPL remediation technologies including thermal, chemical oxidation, and bioremediation methods applicable to NAPL sources and the dissolved plume. The models will allow remediation operators to incorporate monitoring data to adjust strategies as remediation progresses. The models can potentially reduce remediation costs by 10 to 30%, representing enormous cost savings when applied over the entire DOD complex.

Sustainable Tennessee Report

ISSE coordinated UT's contribution to a report commissioned by Sustainable Tennessee titled *Sustaining Tennessee in the Face of Climate Change: Grand Challenges and Great Opportunities*. The report outlines the widespread impact of climate change on Tennessee and also describes opportunities to offset the effects through proactive management of decisions and infrastructure improvements. The report was prepared by scientists from Oak Ridge National Laboratory, University of Tennessee, Vanderbilt University, University of Memphis, and the Tennessee Department of Health. Contributing authors from UT included Rachel Chen, Daniel De La Torre Ugarte, Joshua Fu, Qiang He, and

John Schwartz. The report is available at the following link: <http://sustainabletennessee.org/>

2012 Leadership Summit on Sustainability

ISSE's Center for Sustainable Business and Tourism (CSBT) hosted the 2012 Leadership Summit on Sustainability, which was held April 10 and April 12, 2012 on the campus of the University of Tennessee. Dr. Rachel Chen, Director of CSBT and Professor in Retail, Hospitality, and Tourism Management, the University of Tennessee, was the event organizer.

On April 10 a Commissioners' Panel was held, featuring four State of Tennessee Commissioners: Julius Johnson, Commissioner of Agriculture; Bob Martineau, Commissioner of the Tennessee Department of Environment and Conservation; John Schroer, Commissioner of Transportation; and Susan Whitaker, Commissioner of Tourist Development. UT Chancellor, Dr. Jimmy Cheek, welcomed the commissioners and Dr. Bill Fox (UT Professor of Economics and Director of UT's Center for Business and Economic Research) moderated the panel. Each commissioner was presented a "Leader in Sustainability" honorary award from Chancellor Cheek. On April 12, a CEO/VP's Leadership Summit on Sustainability was held, featuring three panelists: Bruce Karas, Vice President of Environment and Sustainability for Coca-Cola Refreshments; Steve McMillen, Vice President of Talent Management, Tennessee Valley Authority; and Hugh Morrow, Jr., President of Ruby Falls, LLC. UT's Vice Provost for Faculty Affairs, Dr. Sarah Gardial, welcomed the panelists and moderated the session.

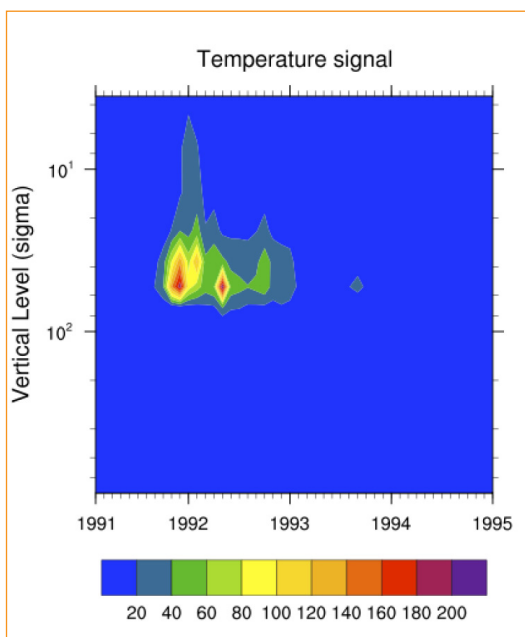


Pictured, from left to right: Bill Fox, Julius Johnson, John Schroer, Susan Whitaker, Jimmy Cheek, Bob Martineau, and Rachel Chen.

2011-2012 Programmatic Report

Global Climate Model Validation

Doctoral candidate Abigail Gaddis (Civil and Environmental Engineering) is using volcanic eruption events to benchmark the response of the climate to perturbations and determine how well climate models follow this response. The largest volcanic eruptions send tons of particles high into the atmosphere, blocking and absorbing sunlight so the energy available to the earth's climate system changes. In particular, the June 1991 eruption of Mt. Pinatubo in the Philippines is of interest since it was the largest aerosol perturbation to the stratosphere in the twentieth century and the most intensely observed eruption on record. Therefore, many observations are available for validation of models. The response of climate variables to the volcano is simulated over many independent runs in the Community Earth System Model, CESM1.0, using the Jaguar supercomputer at ORNL. The response of all atmospheric climate model variables is quantified using a unitless signal to noise ratio. Ultimately, the predicted climate response to the eruption event can be compared to the



Globally averaged temperature signal to noise ratio by vertical level in the atmosphere. The noise is measured using the standard deviation of the ensemble of runs with no volcano. The signal is the difference between the means of ensembles with and without the eruption. The vertical level in the atmosphere is expressed in hybrid sigma coordinates, a system that indicates vertical height. It is terrain following near the surface, and as height increases, it decreases, corresponding to pressure.

observed response to provide validation of the model simulations.

Ms. Gaddis's doctoral research is supported by ISSE. Her research advisors are Dr. John Drake, a research professor in the Department of Civil and Environmental Engineering and Dr. Kate Evans in the Computational Earth Sciences group at ORNL. Dr. Chris Cox is her academic advisor in the Department of Civil and Environmental Engineering.

Center for Clean Products

In Fiscal Year 2012, several important projects were completed or undertaken by Catherine Wilt, Director of ISSE's Center for Clean Products. Examples of projects include:

- Development of North America's first green toy standard—Over the past two years, Wilt led an expert advisory committee, developing the scientific and social underpinnings of a certification standard for greener toys. The advisory committee also took public comments from more than 150 stakeholders from the United States and Canada. Those collaborations resulted in a robust standard that will recognize green environmental leaders in the toy industry. The standard was released in February 2012, and is managed by UL Environment in the United States and Ecologo in Canada. Referred to as "UL 172," it requires testing and verification to ensure that toys do not contain measurable carcinogens, certain neurotoxins, reproductive toxins, anti-microbial agents, heavy metals, or added fragrances. Its criteria meet or exceed US and European Union requirements for toy toxicity. The standard also places strict limits on emissions of volatile organic compounds, a key contributor to childhood asthma, and helps minimize pollution generated by the production, use, and disposal of toys and their packaging. Announcement of this standard's availability generated substantial interest, with ISSE's role in the development being picked up on AP wires. It was also highlighted in a story in UT's *Alumnus* magazine.
- Evaluation of DOE's Weatherization Assistance Program—Wilt has been working with a team of researchers led by Oak Ridge National Laboratory to analyze the effects of the US Department of Energy's Weatherization Assistance Program (WAP), which provides energy efficiency improvements to low-income homes across the country. WAP is believed to deliver significant benefits beyond the reduction in energy usage, including improved health and safety and improved energy bill affordability. The evaluation will attempt to quantify these and many other types of non-energy benefits. Wilt's participation in the project is related to

2011-2012 Programmatic Report

identifying potential non-energy benefits to occupants from these home improvements, such as increased comfort, fewer illnesses, and reduced injuries.

- **SunShot Rooftop Solar Challenge**—Wilt is part of a multidisciplinary team that was awarded a grant from DOE's SunShot Rooftop Solar Challenge program, one of 22 teams across the country that received this award. Administered by UT's Howard H. Baker Jr. Center for Public Policy, and with researchers from ISSE and the Tennessee Solar Institute, this \$700,000 DOE grant is identifying best practices in financing, permitting, and zoning in four jurisdictions—Knoxville, Franklin, Nashville, and Memphis/Shelby counties. Wilt's role is working with stakeholders in Knoxville and Knox County to identify opportunities to streamline and improve access to rooftop solar systems.

NSF Carbon Sequestration Award

Dr. Jie Zhuang (Biosystems Engineering and Soil Science) received a National Science Foundation grant for a two-year collaboration with UT's Plant Science Department and the Chinese Academy of Sciences on soil carbon sequestration in organic farming systems. The collaboration includes both research and education components.

Sustainability.utk.edu

ISSE constructed a web page, sustainability.utk.edu, to publicize all UT-related sustainability efforts, researchers, and research centers.

2011-2012 Programmatic Report

Research Accounts

Account Number	PI	Title	Start End	Award Amount	FY12 Expenditures
R012531077-Racheff Environment Fund	Cox, Chris	Unrestricted Research Support	5/31/85 12/31/47	\$	\$25,477
R012550098-TVA Release No. 25	Gangaware, Timothy	Watershed Improvement Initiative Revision No. 6	10/1/01 12/31/11	\$136,500	\$(51)
R012550100-TVA Release No. 55	Gangaware, Timothy	Beaver Creek Public Education and Awareness Initiative	10/1/03 12/31/11	\$107,000	\$10,044
R013101002-NSF SCI-0441102	Cole, Gregory	Global Ring Network for Advanced Applications Development - GLORIAD	1/1/05 7/31/12	\$4,423,183	\$(6,694)
R013190034-ARRA-NSF-OCI-0943314	Cole, Gregory	The Taj: A New Model for Global Federated Network Infrastructure for Science and Education	8/1/09 7/31/12	\$2,293,378	\$393,073
R013601030-ISSE Support Fund	Cox, Chris	Unrestricted Research Support	4/15/07 12/31/47	\$	\$(1,284)
R013601041-UT-B 4000060337	Parker, John	DOE-ERSP FRC Multiscale Investigations of Immobilization and Natural Attenuation	6/19/07 9/30/12	\$240,186	\$47,289
R013601058-RD-83334701-0	Geibig, Jack	Testing Sustainable Building Materials and Practices During Gulf Coast Reconstruction	7/16/07 7/15/11	\$295,970	\$(1,121)
R013601075-ED-08-23630-00	Gangaware, Timothy	Beaver Creek Restoration Initiative	12/16/07 12/15/12	\$919,385	\$273,907
R013601083-EPA-OPPT-08-01	Wilt, Catherine	Electronic Standards Development	9/1/08 4/29/12	\$418,361	\$(356)
R013601088-East TN Clean Fuels Coalition	Bell, Larry	Administrative Support for East Tennessee Clean Fuels Coalition 2009	7/1/08 7/31/11	\$272,230	\$363
R013601093-CR-19121-430344	Parker, John	Verification of Methods for Assessing the Sustainability of Monitored Natural Attenuation	6/19/08 4/30/12	\$173,535	\$21,009
R013601098-ED-09-26773-00	Hanahan, Ruth Anne	Tennessee Yard and Neighborhood Program	10/16/08 10/15/13	\$92,000	\$5,418
R013601101-P O #41501730-T 1&2	Geibig, Jack	Eastman Chemical Company-Task Order 1 & 2	10/23/08 12/31/14	\$27,880	\$(191)
R013601106-UTN-001-Task Order 2	Geibig, Jack	Terrachoice-Task Order 2	5/15/09 7/31/11	\$60,000	\$(2,448)
R013601108-UTN-001-Task Order 3	Geibig, Jack	Terrachoice-Task Order 3	5/15/09 7/31/11	\$60,000	\$(1,753)
R013601111-Sigma Space Corporation	Bell, Larry	Sigma Space-NASA/LBA	8/1/09 12/31/11	\$341,288	\$80,611
R013601116-ARC CO-16505-09	Ezzell, Timothy	Evaluation of Strategies for Economic Improvement in Appalachia's Distressed Rural Counties	10/1/09 8/31/11	\$125,594	\$(2,202)
R013601118-Sigma Space Corp.-Travel	Bell, Larry	Sigma Space-NASA/LBA	1/1/11 12/31/11	\$2,153	\$1,351
R013601121-DOE-DE-EE0001709	Overly, Jonathan	I-75 Green Corridor Project	10/1/09 12/31/13	\$818,091	\$308,562
R013601126-UT-B 4000088499	Sheffield, John	The Role of Developing Countries in Fusion Energy	12/14/09 9/30/13	\$50,010	\$14,528
R013601128-ARRA TDEC EG1030582	Gangaware, Timothy	ARRA: TDEC Stream Determination Training and Certification Program	12/1/09 8/31/11	\$115,192	\$32,240
R013601129-ARRA TDEC EG1030588	Gangaware, Timothy	ARRA: Rev. of TN Erosion Prevention and Sediment Control Handbook and Training Program	12/1/09 8/31/11	\$110,601	\$26,486

2011-2012 Programmatic Report

Research Accounts

Account Number	PI	Title	Start End	Award Amount	FY12 Expenditures
R013601132-LERDWG	Fulkerson, William	Secretariat to the Laboratory Energy R&D Working Group	7/1/10 12/31/13	\$42,000	\$18,152
R013601136-NSF OCI-0963058	Cole, Gregory	IRNC:ProNet: GLORIAD	8/1/10 7/31/15	\$1,907,541	\$897,511
R013601137-NSF OCI-0963058	Cole, Gregory	IRNC:ProNet: GLORIAD - Participant Support Costs	8/1/10 7/31/15	\$40,000	\$608
R013601138-NSF OCI-0963058	Cole, Gregory	IRNC:ProNet: GLORIAD - Equipment & Maintenance	8/1/10 7/31/15	\$13,000	\$29,083
R013601139-Ruby Falls CSBT Fund	Chen, Jui-Chi	Unrestricted Research Support for Center for Sustainable Business and Tourism	9/17/10 12/31/14	\$25,000	\$14,068
R013601140-UT-B 4000099518	Bell, Larry	Bioconversion of Fuels and Chemicals	10/1/10 12/31/11	\$97,165	\$39,836
R013601141-NPETE	Webster, Sheila	Worker Training at Department of Energy Facilities	9/1/10 8/31/11	\$107,500	\$14,468
R013601143-USDI-USGS-G11AP20107	Gangaware, Timothy	FY2011 WRRIP Application for TN Water Resources Center	3/1/11 2/28/13	\$59,247	\$33,460
R013601146-USDI-USGS-G11AP20135	Gangaware, Timothy	Development of Water Quality Model for Regional Loadings	4/13/11 4/12/14	\$113,399	\$10,135
R013601147-Knox County 10-370	Gangaware, Timothy	CAC AmeriCorps Water Quality Forum - Adopt-A-Watershed	12/1/10 11/30/12	\$97,000	\$64,176
R013601148-ARRA UT-B 4000105475	Ezzell, Timothy	Technical Assistance to EECBG and SEP grantees	5/1/11 10/17/11	\$27,164	\$16,901
R013601149-TN Dept. of Tourism Dev.	Chen, Jui-Chi	Tennessee Green Certification Program: Industry Survey	6/6/11 10/3/11	\$1,500	\$1,492
R013601150-ETSU 220011-11	Ezzell, Timothy	Appalachian Teaching Project 2011	7/1/11 6/30/12	\$4,000	\$3,737
R013601151-UTN-001-Task Order 3a	Wilt, Catherine	Terrachoice-Task Order 3a	5/15/09 12/31/11	\$21,801	\$21,645
R013601152-SERDP W912HQ11C0067	Parker, John	Assessing the potential consequences of subsurface bioremediation: Fe-oxide bioreductive processes and the propensity for contaminant-colloid co-transport and media structural breakdown	7/7/11 7/6/12	\$56,341	\$56,255
R013601154-East TN Clean Fuels Coalition	Cox, Chris	Administrative Support for East Tennessee Clean Fuels Coalition - 2012	7/1/11 8/31/12	\$143,346	\$116,046
R013601155-USAID-AID-OAA-A-11-00018	Cole, Gregory	GLORIAD in Africa	8/26/11 8/24/13	\$1,420,000	\$826,834
R013601159-NSF OCI-0963058	Cole, Gregory	IRNC:ProNet: GLORIAD - Equipment & Maintenance	8/1/10 7/31/15	\$15,000	\$3,302
R013601160-NPETE	Webster, Sheila	Worker Training at Department of Energy Facilities	9/1/11 8/31/12	\$107,500	\$83,825
R013601161-TN Dept. of Agriculture 25926	Hanahan, Ruth Anne	Tennessee Yards & Neighborhoods (TYN) Framework: Retooling for an Enduring Program	4/16/11 4/15/14	\$11,140	\$7,706
R013601163-UT-B 4000110499	Wilt, Catherine	Tech support to the ORNL's Energy Program Eval. Projects	12/1/11 12/31/12	\$76,376	\$34,134
R013601164-Purdue University JRCEEC	Redus, Sharon	China-US Joint Research Center for Ecosystem and Environmental Change (JRCEEC)	3/15/12 8/31/12	\$26,650	\$12,185

2011-2012 Programmatic Report

Publications

- Barnett, M.O., D.W. Kilgour, O.K. Hartzog, **J. Zhuang**, Y. Wang, and P.M. Jardine. 2011. Formation of chloropyromorphite during the physiologically based extraction test: An experimental artifact? *Environmental Engineering Science* 28: 719-724.
- Chen, R.J.C.** 2011. Effects of Climate Change in North America: An Overview. *Journal of Sustainable Development* 4(3): 32-50.
- Chen, R.J.C.** 2011. Review of "Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage." *Journal of Sustainable Tourism* 19(6): 789-792.
- Chen, R.J.C.** 2011. The Facts of the Weather Extreme Events in the United States: Is There a Trend? *Journal of Sustainable Development* 4(4): 14-21.
- Dai, Yuan-Shun, Seung Hyun Baek, Alberto Garcia-Diaz, Bai Yang, Kwok-Leung Tsui, **Jie Zhuang**. 2011. An enhanced engineering perspective of global climate systems and statistical formulation of terrestrial CO₂ exchanges. *Theoretical and Applied Climatology* 107(3-4): 347-359.
- Gihring, Thomas, Thomas M., Gengxin Zhang, Craig C. Brandt, Scott C. Brooks, James H. Campbell, Susan Carroll, Craig S. Criddle, Stefan J. Green, **Phil Jardine**, Joel E. Kostka, Kenneth Lowe, Tonia L. Mehlhorn, Will Overholt, David B. Watson, Zamin Yang, Wei-Min Wu, and Christopher W. Schadt. 2011. A limited microbial consortium is responsible for longer-term bioreduction of uranium in a contaminated aquifer. *Appl. Environ. Microbiol.*
- Hunter, M.** and **R.J.C. Chen.** 2011. From Management to Sustainability: Strategies for Producers, Consumers, and Small Businesses. *Journal of Management and Sustainability* 1(1): 99-111.
- Jardine, P.M.**, T.L. Mehlhorn, W.B. Bailey, S.C. Brooks, S. Fendorf, **R.W. Gentry**, T.J. Phelps, and J.E. Saiers. 2011. Geochemical Processes Governing the Fate and Transport of Cr(III) and Cr(VI) in Soils. *Vadose Zone Journal* 10: 1058-1070.
- Jetter L. and **R.J.C. Chen.** 2011. Destination Branding and Images: Perceptions and Practices from Tourism Industry Professionals. *International Journal of Hospitality and Tourism Administration* 12(2): 174-187.
- Kim, U.**, **J. Parker**, P. Kitanidis, M. Cardiff, X. Liu, and J. Gillie. 2012. Stochastic Cost Optimization of DNAPL Site Remediation: Field Application. *Environmental Modeling and Software* .
- Knappett, Peter S., Larry D. McKay, Alice Layton, Daniel E. Williams, Md. J. Alam, Md. R. Huq, Jacob Mey, John E. Feighery, Patricia J. Culligan, Brain J. Mailloux, **Jie Zhuang**, Veronica Escamilla, Michael Emch, Edmund Perfect, Gary S. Sayler, Kazi M. Ahmed, and Alexander van Geen. 2012. Implications of fecal bacteria input from latrine-polluted ponds for wells in sandy aquifers. *Environmental Science and Technology* 46(3): 1361-1370.
- Lee, J., X. Liu, P. K. Kitanidis, **U. Kim**, **J. Parker**, A. Bloom, and R. Lyon. 2012. Cost optimization of DNAPL Remediation at Dover Air Force Base Site. *Ground Water Remediation and Monitoring*.
- Liu, X., J. Lee, P. K. Kitanidis, **J. Parker**, and **U. Kim.** 2012. Value of Information as a context-specific measure of uncertainty in groundwater remediation. *Water Resources Management* 26(6): 1513-1535.
- Meeks, M.** and **R.J.C. Chen.** 2011. Can Walmart Integrate Values with Value?: From Sustainability to Sustainable Business. *Journal of Sustainable Development* 4(5): 62-67.
- Mayes, M.A., K. Heal, K., C.C. Brandt, J.R. Phillips, and **P.M. Jardine.** 2012. Relation between soil order and sorptive capacity for dissolved organic carbon. *Soil Science Society of America* 76:1027-1031.
- Parker, J.**, **U. Kim**, P. Kitanidis, M. Cardiff, X. Liu, and G. Beyke. 2012. Stochastic Cost Optimization of DNAPL Site Remediation: Method Description and Sensitivity Studies. *Environmental Modeling and Software* 38:74-88.
- Sullivan, T.S., N.R. Gottel, N. Basta, **P.M. Jardine**, and C.W. Schadt. 2012. Firing range soils yield a diverse array of fungal isolates capable of Pb-mineral solubilization. *Applied and Environmental Microbiology*.
- Tipping, E., P. Chamberlain, M. Fröberg, P.J. Hanson, **P.M. Jardine.** 2012. Simulation of carbon cycling, including dissolved organic carbon transport, in a forest soil locally enriched with ¹⁴C. *Biogeochemistry* 108:91-107.
- Yoo, J., **U. Kim**, and T-W. Kim. 2012. Bivariate Drought Frequency Curves and Confidence Intervals: A Case Study Using Monthly Rainfall Generation. *Stochastic Environmental Research and Risk Assessment*.
- Zhuang, Jie** and **Randall W. Gentry.** 2011. Environmental application and risks of nanotechnology: A balanced view. In S. Ripp and T. B. Henry (ed.) *Biotechnology and Nanotechnology Risk Assessment: Minding and Managing the Potential Threats around Us*. American Chemical Society: Washington, DC: 41-67 .

2012-13 New Initiatives

2012-2013 New Initiatives

New initiatives for 2012-2013, especially those involving reallocated resources, are strongly oriented toward stimulating external research among the tenured and tenure-track faculty. Additional initiatives beyond those described below are likely to be started later in this fiscal year.

Tennessee Water Resources Research Center (TN WRRC)

In a 50-50 partnership with the UTK Office of Research, ISSE will fund \$140,000 in interdisciplinary seed projects related to water research in 2012-2013. Seed projects were initiated by faculty with the goal of building collaborations and generating preliminary data that can be the basis of future external funding.

TVA database mining and development of long-term research watersheds

This project involves data mining of TVA's long-term water quality and biological databases to characterize linkages between land use, weather, climate, water quality, and biodiversity. UT, with its proximity to TVA, is in a unique position to exploit this largely untapped resource. The database analysis will be used to identify three watersheds in close proximity to Knoxville representing a diversity of land uses (agricultural, forested, and urban systems). The data mining and identified research watersheds will be leveraged for interdisciplinary research proposals across all theme areas of the TN WRRC. For example, these resources will reveal impacts of anthropogenic disturbances to watersheds that may take years to be observed, potentially highlighting subtle climate signal trends, and providing opportunities to examine responses of watersheds to Best Management Practice (BMP) implementations and restoration practices in a comparative way. TVA watersheds also provide the unique opportunity to consider various river management constraints within the context of a complex energy system (hydro, coal, nuclear—all involve water resources). The research watersheds and databases would be unique resources providing the opportunity to link changes in land-use patterns, climate, water quality, and ecology, over multi-decade time spans, thereby providing a competitive advantage to TN WRRC researchers. The project involves Drs. John Schwartz (Civil and Environmental Engineering), Carol Harden (Geography), Richard Strange (Forestry, Wildlife, and Fisheries), and Larry Wilson (Forestry, Wildlife, and Fisheries).

Preliminary demonstration of waterborne transmission of rotavirus

In collaboration with Columbia University, UTK researchers Drs. Larry McKay (Earth and Planetary Sci-

ences) and Alice Layton (Microbiology) have detected rotavirus in surface and ground waters in Bangladesh, suggesting a potential waterborne mode of disease transmission, in contradiction to prevailing scientific opinion. In the next year or so, a fortuitous opportunity exists to specifically demonstrate rotavirus transmission due to a planned large-scale vaccination of children against rotavirus. This rotavirus vaccine is derived from an attenuated rotavirus with a diagnostic genotype, which is shed in high concentrations in the feces of vaccinated children. Thus if rotavirus transmission into surface or ground water occurs, they expect to detect the specific strain using molecular methods currently used in their laboratory. The simple detection of the vaccine strain in surface or ground water in Bangladesh will aid in the development of proposals for numerous aspects of water and sanitation.

Linkages between watershed and drinking water quality

Microorganisms present in drinking water represent poorly understood public health risks despite their low concentrations. Indeed, data on waterborne disease outbreaks suggest that drinking water continues to be one of the most important media for infectious diseases worldwide, including in developed countries. A major knowledge gap in the design of effective control strategies is the lack of understanding of the mechanisms underlying microbial survival and persistence in drinking water. A preliminary study under the direction of Dr. Qiang He (Civil and Environmental Engineering) is proposed to explore the linkages between watershed characteristics, distribution systems, and water quality.

China-US Joint Research Center for Ecosystem and Environmental Change (JRCEEC)

Annual symposium

The 2012 China-US Joint Symposium, "Land Use, Ecosystem Services, and Sustainable Development," will be held on September 17-19, 2012, in Shenyang, China. More than 200 participants from partnering institutions and networked universities will present the results of research projects, prepare policy briefs, share methods and best practices, explore new research and policy directions, network, and provide cultural exchanges. In addition to the extensive academic exchange with Chinese scientists, the US participants will visit China Agricultural University to exchange research in biomass energy sustainability and discuss collaboration in student education and technical training.

2012-2013 New Initiatives

Faculty and student exchanges

A framework agreement is expected to be signed with a number of Chinese universities to establish a 100-PhD student program, which aims to provide academic training to 100 outstanding students in five years in the areas of agriculture, environment, and energy with China supporting travel and stipends for students enrolled at UTK. The agreement is expected to be signed in the spring of 2013. In October, Dr. Jing-Kuan Wang (Professor at Shenyang Agricultural University) will arrive at UT to conduct a three-month study in soil fertility. In January 2013, Dr. Xin-Yu Zhang (Assistant Professor at CAS's Institute of Geographic Science and Natural Resources Research) will join BESS research teams for a six-month study of carbon-nitrogen biogeochemistry.

Industry partnerships

JRCEEC and the Ecopartnership program will work together to identify 10 Tennessee companies with marketability in China and connect at least five with corporate or government entities in China. A technology business meeting will be held with the Municipal Government of Shenyang, Liaoning province, in September 2012 to explore strategies for developing effective China-US partnerships in clean and sustainable technology.

New JRCEEC funding support

During the first six years of its existence, the JRCEEC has been largely funded by ISSE. Beginning in 2012-2013 a broader funding base for JRCEEC activities was established including the University of Tennessee System, the University of Tennessee Institute Of Agriculture, and the Chinese government. ISSE will remain an active partner in the JRCEEC, but with a financial commitment at about one-eighth of the previous level.

Center for International Networking Initiatives/GLORIAD

The GLORIAD team is committed to seeing R&E infrastructure deployed across the African continent. Building on GLORIAD's success in establishing a network hub in Egypt, as the first-ever NSF-supported high-speed R&E connection to Africa, the GLORIAD project was awarded \$3.5M by USAID for a two-year project. On this project GLORIAD is working in collaboration with Egyptian partners who led the African Ministerial Conference on Science and Technology (AMCOST). Currently the project is providing a digital science library platform in several African countries and focusing on needed cyberinfrastructure to support it. The first new links should be funded and operational during

the next 1-2 years in North Africa and East Africa, and an important new StarLight-type facility developed with partners in Ghana.

In addition to broadening service in Africa, GLORIAD's plans for 2012-2013 include organizing our partners from Europe, the Gulf States, India, Singapore, Vietnam, China, and Korea to address next steps for implementation of a 10G infrastructure connecting Amsterdam-Cairo-Fujairah-Bangalore-Singapore-Hong Kong, which would be cooperatively shared and managed by all GLORIAD partners. The GLORIAD-US team is also developing the new ASEANA project focused on science communities in Southeast Asia. GLORIAD will continue to work in close collaboration with NOR-DUnet, GLIF, TransLight, and SURFnet, to develop multi-layer, multi-domain Dynamic Circuit Provisioning consistent with the GLIF framework, working with all partners to ensure majority of partner networks and managed links (with optical equipment) are capable of this network service by end of year three.

The exchange program will continue and GLORIAD will host engineers/software developers from partnering institutions to spend three months in residence in Knoxville, and GLORIAD will continue work to further develop partnerships for cyberinfrastructure expansion with appropriate countries, NRENs, etc. The US-GLORIAD program is working with various partners on a major new international cybersecurity program and facility—designed to “crowd-source” security operations of global networks; a major proposal will be submitted in early 2013 to facilitate this work—partnering with public and private sectors and with all international partners.

Other New Initiatives for 2012-13

Initiation of the International Center for Air Pollution and Energy Study (ICAPES)

ICAPES will develop solutions to complex problems in air pollution control and energy strategies that have been presented by the US EPA and other agencies through the development of innovative and sustainable energy and air pollution control/prevention practices. The center will integrate theoretical advances, air quality monitoring data, and air quality models to develop sustainable energy strategies via interdisciplinary collaboration. The center will promote implementation of these strategies through community collaboration, leadership, and education to facilitate climate change adaptation. ICAPES will [1] conduct modeling assessments of climate and air quality interactions as well as the impacts of hemispheric transport of air pollutants to regional air quality and regional climate over the

2012-2013 New Initiatives

continental US and Asia; [2] utilize scientific information in order to develop integrated control strategies beneficial to addressing the issues associated with international transport of air pollutants and its climate effects across studied countries/regions; [3] support the US EPA in organizing international workshops/conferences in the US and China; [4] develop decision support systems and real-time control/response tools to assist in designing cost-effective control strategies for reducing air pollutants and greenhouse gases (GHG) in the studied countries/cases; [5] develop a next-generation Environmental Benefit Mapping and Analysis Program (BenMAP); and [6] develop an integrated Air Benefit and Cost Assessment System (ABaCAS). ICAPES will be led by Dr. Joshua Fu (Civil and Environmental Engineering) with additional collaborators from the departments of Geography, Agriculture Economics, Electrical Engineering, and Computer Science.

Renewable production of chemical feedstocks and value-added chemicals

This initiative, a 50-50 partnership with UT's Sustainable Energy and Education Research Center (SEERC), seeks to provide seed funding for collaborative projects related to the production of chemical feedstocks and value-added chemicals from renewable technologies. The US is seeking to develop renewable energy sources for the transportation sector to reduce the impacts of imported oil in the areas of climate change, resource availability, and energy security. The recent availability of domestic natural gas may provide an economically viable near-term alternative energy source to further reduce the demand for imported oil. The ability to produce platform chemical intermediates and value-added chemicals from renewable feedstocks is complementary to the focus of reducing dependence on imported oil in the energy sector and would foster the creation of a sustainable industrial economy.

Most broadly, this initiative seeks to utilize photosynthetic processes to convert CO₂ and water into platform chemical intermediates and value-added chemicals by leveraging existing expertise of the faculty in areas such as biomass production, biomass processing, plant genetics, photosynthetic microorganisms, chemical catalysis, metabolic engineering, and synthetic biology. The initiative seeks to support multiple technological pathways toward achieving this goal that best capitalizes on the expertise of the faculty. Platform intermediates can be defined as low-cost, high-purity, low-molecular-weight organic compounds. Such compounds can likely be converted to higher-value end products through existing chemical processing and biochemical pathways. The diversity of plant genetics capable of facilitating biosynthetic conversions that yield high-value end products will also be exploited. Seed proposals have been submitted from teams involving faculty from Chemistry; Chemical and Biomedical Engineering; Civil and Environmental Engineering; Microbiology, Biosystems Engineering and Soil Science; and Forestry, Wildlife and Fisheries. They are currently being evaluated.

Biofuels research

This project is a continuation work conducted under DOE's Bioenergy Science Center (BESC) and will provide bridge funding for two of Dr. Cox's PhD students to complete their research in the area of biofuels research. Both students are working on aspects of gene regulation in the model cellulosic ethanol bacterium *Clostridium thermocellum*. Jessica Linville has developed a mutant strain of *C. thermocellum* that is tolerant to inhibitory compounds that result from pretreatment of popular wood feedstock. She is currently analyzing the genome and gene expression patterns of the mutant in an attempt to understand the mechanism of the tolerance. Jinlyung Choi is investigating a protein in *C. thermocellum* that may potentially regulate many other genes in the organism, including many of those responsible for the conversion of cellulosic biomass into fermentable sugars.

Summary of Faculty and Student Participation

Faculty Actively Engaged in ISSE Research

Name	Affiliation	FY
John Buchanan	Biosystems Engineering and Soil Science	2011-2013
Rachel Chen	Retail, Hospitality and Tourism Management	2011-2013
Chris Cox	Civil and Environmental Engineering	2011-2013
John Drake	Civil and Environmental Engineering	2011-2013
Joshua Fu	Civil and Environmental Engineering	2012-2013
Randall Gentry	Civil and Environmental Engineering	2011-2012
Carol Harden	Geography	2012-2013
Qiang He	Civil and Environmental Engineering	2012-2013
Don Hodges	Forestry, Wildlife and Fisheries	2011-2013
Phillop Jardine	Biosystems Engineering and Soil Science	2011-2013
Ungtae Kim	ISSE, Civil and Environmental Engineering	2011-2013
Alice Layton	Microbiology	2012-2013
Andrea Ludwig	Biosystems Engineering and Soil Science	2011-2013
Larry McKay	Earth and Planetary Sciences	2012-2013
Keil Neff	Civil and Environmental Engineering	2011-2013
Jack Parker	Civil and Environmental Engineering	2011-2013
Kevin Robinson	Civil and Environmental Engineering	2011-2013
Gary Saylor	Microbiology	2011-2013
John Schwartz	Civil and Environmental Engineering	2011-2013
Richard Strange	Forestry, Wildlife and Fisheries	2012-2013
Larry Wilson	Forestry, Wildlife and Fisheries	2012-2013
Daniel Yoder	Biosystems Engineering and Soil Science	2011-2013
Jie Zhuang	Biosystems Engineering and Soil Science	2011-2013

Post-docs, Graduate Students, and Undergraduate Students Involved in ISSE Research

Name	Affiliation	Role	FY
Anthony Celebucki	Civil and Environmental Engineering	Graduate student researcher	2011-2013
Binod Chapagain	Forestry, Wildlife and Fisheries	Graduate student researcher	2011-2013
Jinlyung Choi	Chemical & Biomolecular Engineering	Graduate student researcher	2012-2013
Joshua Freriches	Civil and Environmental Engineering	Graduate student researcher	2012-2013
Abigail Gaddis	Civil and Environmental Engineering	Graduate student researcher	2011-2013
Yang Gao	Civil and Environmental Engineering	Graduate student researcher	2012-2013
Andrew Hartsell	Forestry, Wildlife and Fisheries	Graduate student researcher	2011-2013
Ryan Hodges	Biosystems Engineering & Soil Science	Undergraduate student researcher	2011-2013
Bob Hunter	Biosystems Engineering & Soil Science	Graduate training assistant	2011-2013
Jessica Johnson	Biosystems Engineering & Soil Science	Graduate student researcher	2011-2013
Jason Kaufman	Geography	Graduate student researcher	2012-2013
Benjamin Keck	Ecology and Evolutionary Biology	Post-Doc researcher	2012-2013
Jessica Linville	Civil and Environmental Engineering	Graduate student researcher	2012-2013
Daniel Reed	Forestry, Wildlife and Fisheries	Graduate student researcher	2011-2013
Robert Woockman	Civil and Environmental Engineering	Graduate student researcher	2012-2013
Wesley Wright	Biosystems Engineering & Soil Science	Research associate & grad student	2011-2013

