

KANSAS

EPSCoR

Partners in Science
& Technology



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Climate Change and Energy: Basic Science, Impacts and Mitigation

Discoveries in energy, climate change help highlight Year Two

In the second year of the Kansas NSF EPSCoR major initiative, *Climate Change and Energy*, teams of researchers have made excellent strides in advancing the science of renewable energy resources and also in understanding how agriculture will be affected by climate change.

The project got its official start October 1, 2009, when Kansas NSF EPSCoR was awarded \$20 million over 5 years from the National Science Foundation, along with an additional \$4 million in matching funds from the University of Kansas (KU), Kansas State University (K-State) and the former Kansas Technology Enterprise Corporation (KTEC).

More than 60 Kansas senior researchers (along with about 60 graduate students and 60 undergraduate students), are collaborating on global climate change and renewable energy research as part of this project. The scientists are working in teams on interrelated research initiatives, representing many disciplines including agronomy, anthropology, biology, chemistry, computer science, economics, engineering,

geography, mathematics, microbiology, physics and sociology.

Making solar cells greener

Research led by Stefan Bossmann, professor of chemistry at Kansas State University, is exploring protein based solar cells.

The potential of solar energy is impressive. According to the Department of Energy's report *Basic Needs for Solar Energy Utilization*, harnessing just one hour of all of the sun's energy that reaches the earth's surface would fuel the world's energy needs for one year.

Bossmann and the students in his lab have developed solar cells using MspA, a bacterial protein that is inexpensive and grows easily in sunlight (in algae, for example).

Finding ways to collect solar energy with inexpensive materials, such as MspA, is key to the widespread adoption and utilization of solar energy.

When mixed with other components, MspA assists in collecting (harvesting) solar energy much like the chlorophyll pigment that

occurs in plant functions in photosynthesis. Ultimately the light is converted to electrons and electricity, resulting in a solar cell.

An important benefit of this method is that the protein can be grown in close proximity to where it will be used, rather than manufactured and shipped, making this process truly "green."

Does crop irrigation cool surface temperatures?

Atmospheric scientists have long questioned whether the effects of crop irrigation impact the local temperature and more recently they have wondered if this cooling effect is masking regional warming signals in the Great Plains.

A study conducted as part of the major initiative is helping climate scientists better understand how agricultural irrigation practices affect the local climate and, possibly, how agriculture will be affected by climate change.

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Research on farmers' decisions leads to rural photography project

Kansas NSF EPSCoR scientists who are studying how farmers make land use decisions are also developing a fine arts component in their work.

The scientists are working with photographer Larry Schwarm, a professor of fine arts at Emporia State University.

Schwarm specializes in Kansas landscape and rural photography and his photos will help the scientists tell the story of farm life they are uncovering through extensive surveys and interviews with Kansas farmers.

The land-use scientists hosted their 2nd Annual External Advisory Board Meeting

and Symposium at The Commons, KU, August 24-26. Many of Schwarm's photos were on display at an evening reception on August 25 at the Spencer Museum of Art, KU, where scientists, members of the community and Schwarm had a chance to discuss the project.



Photo was taken near Elkhart by Schwarm

EPSCoR PEOPLE

▶ Dartmouth recruits talented Haskell undergrad



Ma'Ko'Quah Abigail Jones, a former Haskell Indian Nations University undergraduate student and member of the Prairie Band Potawatomi Nation, was one of about 20 students selected from more than 1000 applicants as a transfer student to Dartmouth College, where she is finishing

her undergraduate degree. Her research focuses on how climate change will affect indigenous peoples who are in the path of rising seas.

Jones was also named recently as the recipient of a Udall Scholarship. The Udall scholarship recognizes future leaders in many environmental fields, including policy, engineering, science, education, urban planning and renewal, business, health, justice, and economics.

Jones was a student in the Pathways Program at the Haskell Environmental Research Studies Institute (HERS). The Pathways Program is funded by Kansas NSF EPSCoR.

▶ K-State soil scientist featured in CSA article



Ganga Hettiarachchi, assistant professor of soil and environmental chemistry at K-State, was recently featured in an article "Advanced Spectroscopy in Soil Biogeochemical Research" in the *CSA News* (CSA stands for Crop Science of America).

Hettiarachchi is a Kansas NSF EPSCoR scientist. Her most recent synchrotron radiation-based (SR-based) research has focused on phosphorus and no-till farming methods.

The article in *CSA News* discussed the use of SR-based research to help scientists design more efficient fertilizers and predict the soil conditions in which they will give plants the best boost. To read the article on the web, go to <https://www.crops.org/publications/csa-news>.

▶ EPSCoR scientist helps launch Global Soil Partnership



Charles W. Rice, University Distinguished Professor of Agronomy at K-State, participated in the launch of the Global Soil Partnership on September 7-9, 2011 at the United Nations' Food and Agriculture Organization headquarters in Rome.

The mission of the Global Science Partnership is to support and facilitate joint efforts toward sustainable management of soil resources for food security and climate change adaptation and mitigation.

▶ EPSCoR scientist named University Distinguished Professor



Susan Sun, a K-State professor of grain science and industry and a key researcher for Kansas NSF EPSCoR, has been named a University Distinguished Professor.

Sun founded and continues to lead the Bio-Materials & Technology Laboratory at K-State and is also co-director of the Center for Biobased Polymers by Design. Her research focuses on how plant and grain molecules can be used to create materials that are safer, stronger and "green." Her work has resulted in eight patents.

▶ EPSCoR scientist named to National Research Council panel



Val Smith, a KU professor of ecology and evolutionary biology, has been appointed to the National Research Committee on Sustainable Development of Algal Biofuels. As a Kansas NSF EPSCoR scientist, Smith is studying algal biofuels grown in outdoor reactors filled with treated wastewater.

He is one of 16 U.S. scientists serving on the committee. Members are exploring the promise of algal biofuels and they are also identifying possible solutions to the challenges presented by algal biofuels.

▶ First Awardee receives Kemper Award



Christopher Depcik, assistant professor of mechanical engineering at KU, recently received a \$7,500 Kemper Fellowship for Teaching Excellence.

The Kemper fellowships recognize outstanding teachers and advisers at KU, and are provided by the William T. Kemper Foundation.

Depcik, who joined the engineering faculty in 2008, was a 2010 recipient of a First Award from Kansas NSF EPSCoR, for his project *Adaptive Lean NO Trap Kinetics for Lean Phase Operation and Cost Savings*.

The Kemper Award recognized Depcik for initiating the Eco-Hawk senior design program and club, in which students design sustainable automobiles.

▶ For the Calendar

22nd National NSF EPSCoR Conference

Monday, October 24 through Thursday, October 27, 2011
Coeur d'Alene, ID

EPSCoR PEOPLE

Kansas NSF EPSCoR helps young faculty with First Awards funding

In April, Kansas NSF EPSCoR made First Awards to seven young faculty members. An important part of the mission of Kansas NSF EPSCoR is to encourage and assist young STEM faculty in obtaining research funding, and First Awards serve this purpose. More information on the research of the seven First Awardees can be found at www.nsfepscor.ku.edu/first-awards-yr2.html.

There were 22 First Award proposals from faculty at KU, K-State and WSU. All of them were peer-reviewed, with the following seven proposals recommended for funding:



Christopher Elles, KU, assistant professor of chemistry, for *Controlling Non-Adiabatic Reaction Dynamics in Solution: One- and Two-Photon Excitation of Photochromic Molecular Switches*.



Gurpreet Singh, K-State, assistant professor of mechanical and nuclear engineering, for *Exploring the Structure, Optical, and Electromechanical Properties of Polymer-derived Si(B) CN-Multiwall Carbon Nanotube Composite Nanowires*.

Hrant Hakobyan, K-State, assistant professor of mathematics, for *Quasiconformal Geometry of Fractal Spaces*.



Robert Szoszkiewicz, K-State, assistant professor of physics, for *Nanomechanical Studies of the Secondary Structure Folding in Polypeptides Using Single Molecule AFM and Interferometry*.



Matthias Kling, K-State, assistant professor of physics, for *Attosecond Observation and Control of Electron Dynamics in Nanoparticles*.



Pingfeng Wang, WSU, assistant professor of industrial and manufacturing engineering, for *Reducing Use Phase Environmental Impacts of Wind Energy System through Sustainable Operation and Maintenance*.

K.C. Kong, KU, assistant professor of physics and astronomy, for *Search for New Physics at Hadron Colliders*.



More EPSCoR scientists featured on Ad Astra trading cards

Four additional scientists affiliated with Kansas NSF EPSCoR have been named to the list of the 150 most influential Kansas scientists by Ad Astra Kansas, a science education organization in Hutchinson.

The scientists are Caroline Chaboo, assistant professor and curator, systematic entomology at KU, who was a Kansas NSF EPSCoR First Award recipient in 2010; Mark Schneegurt, associate professor of biology at WSU, who is doing research on algal biofuels for the Kansas NSF EPSCoR major initiative; Christopher Sorensen, University Distinguished Professor of Physics at K-State, who is studying solar energy for

the project; and Janet Twomey, associate professor of industrial and manufacturing engineering at WSU, who is also exploring solar energy for Kansas NSF EPSCoR.

Ad Astra Kansas is announcing several scientists each month this year, as part of the celebration of 150 years of Kansas statehood. Each of the 150 scientists will appear on a trading card, which includes their photo and some information about their science.

Other Kansas NSF EPSCoR scientists honored with a trading card thus far in the year are Kristin Bowman-James,

University Distinguished Professor of Chemistry at KU and also Kansas NSF EPSCoR project director; Charles Rice, University Distinguished Professor of Soil Microbiology at K-State; Judy Wu, University Distinguished Professor of Physics and Astronomy at KU; and Samantha Wisely, associate professor of wildlife biology at K-State.

The cards are available as PDFs on the Ad Astra website, at www.adastra_ks.org.

RESEARCH NOTES

Summer program provides research experiences in climate change

A new Research Experiences for Undergraduates (REU) Summer Academy gave five students an intensive climate change research experience in June and July. The program was designed and administered by Chuck Rice, University Distinguished Professor of Soil Microbiology at K-State.

The REU students were matched with a faculty mentor, based on shared research interests.

"The research projects were designed to help students understand climate change issues in greater depth," said Rice.

Zane Sumpter, a WSU student, was one of the participants. He worked on a new algorithm that bounces data between climate sensors in the case of low battery levels, which could threaten stored climate data. He was mentored by Bin Tang, assistant professor in the department of electrical engineering, WSU.

Also, four K-State students participated in the REU program, mentored by K-State faculty.

Matt DeCapo explored soot in the radiation balance in the atmosphere, working with Chris Sorensen, University Distinguished Professor of Physics.

Chris Dolezal analyzed evapotranspiration rates across Kansas by examining data from several locations over a 120-year period. Chris worked with Stacy Hutchinson, an associate professor in biological and agricultural engineering.

Dorothy Menefee studied the stability of different forms of soil carbon. She conducted her research with Ganga Hettiarachchi, assistant professor of soil chemistry.

Amy Vu examined soil and nitrous oxide emissions and the effect of agricultural management practices on these emissions. She worked under the direction of Rice.



Left to right: Chris Dolezal, Dorothy Menefee, Chuck Rice, Amy Vu, Matt DeCapo (not pictured Zane Sumpter)

EPSCoR scientist gives interviews on changing weather patterns

A year of unusually extreme weather with increases in the number and severity of tornadoes and severe storms has placed the media spotlight, at times, on climate scientists. John Harrington, Jr., professor of geography at K-State, who is also the project manager for Kansas NSF EPSCoR, gave several interviews.

A local media release, <http://www.k-state.edu/media/newsreleases/may11/harrington53111.html>, led to on-air radio interviews about extreme weather,

tornadoes, jet stream patterns and climate change with WAMC (Albany, NY); WBEN (Buffalo, NY); WATR (Waterbury, CT); and KMAN (Manhattan, KS).

Harrington discussed research documenting that tornadoes, severe storms, heavy snow events and also heat waves are becoming more frequent and can be attributed to changes in atmospheric circulation patterns within the climate system. Harrington said that while the devastating tornado outbreaks

in Alabama (April) and also in Joplin, MO, (May) were not unprecedented, they were significant because two such notoriously severe and deadly storms occurred within one storm season.

ScienceDaily [and other outlets] also picked up the story and ran "Wild Winds: Changes in Weather Patterns Creating More Severe Storms" about Harrington's comments on jet stream patterns and unusual weather (www.sciencedaily.com/releases/2011/06/110607102626.htm).



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RESEARCH NOTES

NSF Scholarship grant for undergrads will focus on renewable energy

Kansas NSF EPSCoR researchers have secured a \$552,000 grant from the National Science Foundation, which will provide tuition scholarships for KU sophomores and juniors who are interested in studying renewable energy and who also have financial need.

Judy Wu, University Distinguished Professor of Physics and Astronomy, KU, and Kansas NSF EPSCoR scientist, led the effort to secure the grant. Assisting her were Val Smith, professor of ecology and evolutionary biology; Susan Stagg-Williams, associate professor of chemical and petroleum engineering; Cindy Berrie, associate professor of chemistry; and Barbara Anthony-Twarog, professor of

physics and astronomy, all of KU; and Lucas Miller, a mathematics instructor at Haskell.

The program began with awards for fall 2011 and selected students are receiving a \$10,000 annual scholarship that is renewable for up to three years. They will also be mentored by faculty and participate in seminars, field trips and outreach activities, and may also work on renewable energy research with KU faculty.

About half of the scholarships are for students who have transferred to KU from Haskell Indian Nations University or Johnson County Community College. A group of 16 to 20 students will be chosen each year for three years.

The deadline for applying for these scholarships for fall 2011 was Aug. 31st; however, more information and an online application for future awards is located at www.solarenergy.ku.edu/ssstem.



Kelda Britton, a Haskell Indian Nations University student, presents her research poster.

K-12 Science Education: Animated video will be a fun teaching tool

A video that is currently being produced with a \$150,000 grant from the National Science Foundation will help elementary and middle school students learn more about superconductors and nanotechnology. Called "Nanoscale: Adventures in Superconductivity," the video will feature appealing animated characters to teach energy and nanoscale science.

These concepts can be difficult to grasp, for children and adults alike, and that may be in part because people can't actually "see" energy and nanoscale concepts.

Yet energy and nanoscale science are at the basis of much of our everyday lives and important discoveries are being made in these areas. For example, nanotechnology research through the Kansas NSF EPSCoR major initiative *Climate Change and Energy* is developing better solar cells for more affordable and greener solar energy.

The video project is being led by Alice Bean, professor of physics and astronomy at KU, Judy Wu, University Distinguished Professor of Physics and Astronomy, KU, and Teresa MacDonald, Director of Education at the KU Natural History

Museum. Wu is part of the Kansas NSF EPSCoR research team, and Bean developed Quarked!, www.quarked.org, a physics education website with Kansas NSF EPSCoR funding in 2003. Quarked! teaches nanoscale concepts and has more than 55,000 hits each year.

Some of the same teaching concepts that have made Quarked! a popular teaching tool will be used in the video. It will be available online and will also air on KTWU, a PBS television station that is broadcast from Topeka, as a part of its children's programming.

K-State scientists receive Major Research Instrumentation award



Dan Andresen, associate professor of computing and information science at K-State, is the project's Principal Investigator.

The NSF recently made a Major Research Instrumentation (MRI) award of \$700,000 to K-State for the proposal *MRI: Acquisition*

Scientists at Kansas State University are expanding on computing capabilities in our state with a new award from the National Science Foundation.

Dan Andresen,

of a Hybrid GPU Computing Cluster High-End Applications in Science and Engineering.

This award will add to the computing capabilities that have already been greatly enhanced in Kansas by two current Kansas NSF EPSCoR awards: *Prairie Light: Next Generation Networking for Mid-continent Science* and *Oklahoma and Kansas: A cyberCommons for Ecological Forecasting.*

The new MRI award will pay for a hybrid computing cluster that will provide a much greater degree of computational power, to perform complex modeling of genomes. The new computing cluster will also assist scientists in developing new algorithms in physics, modeling and genomics. Further,

the project will integrate educational efforts in bioinformatics at the K-12, undergraduate and graduate levels.

The co-PIs, all of whom are also from K-State, are Christine Aikens, assistant professor of chemistry; Doina Caragea, associate professor of computing and information science; Jianhan Chen, assistant professor of biochemistry; Walter Dodds, University Distinguished Professor of Biology; Brett Esry, professor of physics; and David Steward, professor of civil engineering.

Once the hybrid computing cluster is complete, students and faculty at other Kansas institutions, including community colleges, will be able to access the supercomputing capabilities at no charge.

EPSCoR graduate student honored with diversity scholarship

Research focuses on Sámi reindeer herders in Norway

Paula Smith, a graduate student at KU who is a former Haskell Indian Nations University student, was not sure just a few years ago that she would pursue a graduate degree. But early spring 2011 found her on a nine-day reindeer herding expedition in Norway as part of her graduate research. And despite the cold, extreme fatigue and inexperience that led to some herding mistakes—all fixed easily, thankfully—Smith is looking forward to more such expeditions.

Smith, a member of the Sisseton-Wahpeton Oyate Nation, is studying the Northern Indigenous Sámi reindeer herders of Norway, who have herded reindeer for centuries. Her research focuses on the effects of climate change on herding practices and techniques, and the challenges Indigenous people will face during a period of rapid climate change.

Her research has been supported by Kansas NSF EPSCoR and she is currently an IGERT C-Change Trainee at KU and mentor to Haskell undergraduates. She was named a recipient of a Graduate School Diversity Scholarship from KU for the 2011-12 school year, which includes an award of \$18,000 plus tuition for the academic year. Smith is one of the “success stories” from a Kansas NSF EPSCoR Pathways Project with Haskell, which is comprised of a summer research opportunity that encourages Native Americans to pursue advanced science education.

Smith began studying the Sámi when she was an undergraduate, during a 10-week internship in 2007 at a NASA Tribal Colleges and University Project Summer Research Experience. The students studied the Indigenous Sámi and reindeer herding areas in the context of a Geographic Information System (GIS) project. That experience was key in her decision to pursue graduate studies

in geography, as was the mentorship of Jay Johnson, assistant professor of geography, KU, Dan Wildcat, Dean of the College of Arts and Sciences at Haskell, and Joane Nagel, University Distinguished Professor of Sociology, KU. Wildcat and Nagel also co-direct the Haskell Environmental Research Studies (HERS) Institute.

As a graduate student at KU, she attended the International Polar Year Conference in 2010 in Oslo, Norway. She met members of the Turi family, who are reindeer herders and who invited her to return and experience a spring reindeer migration firsthand. For her research, she also interviewed Sámi reindeer herders about their thoughts and concerns on climate change and their adaptation strategies. She is now compiling her data.



A small portion of the Turi family's reindeer herd.

Discoveries in energy, climate change help highlight Year Two

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KU researchers Johan Feddema, professor of geography; Nate Brunsell, associate professor of geography; David Mechem, assistant professor of geography; and David Huber, a graduate student in atmospheric sciences, are conducting the study. They are using computer modeling to assess the differences between an intensely irrigated area and crop land that was not irrigated. The results document how temperatures are lowered in the irrigated area and suggest that precipitation is enhanced downwind and outside the local study area.

Understanding the influence of irrigation on climate is important since it is probable that water for irrigating crops in western Kansas will decrease in availability during the remainder of the 21st century.

Planting crops earlier when the climate heats up

A team of researchers led by Scott Staggenborg, professor of cropping systems at K-State, has done extensive research in whether changes in farming practices would alleviate the crop loss that is very likely to occur as the climate changes. Scientists believe climate change will cause most of Kansas to become hotter and drier in the summer months.

George Paul, a K-State doctoral student on the team, has used data focusing on cropland that is on the Ogallala Aquifer. Using this data, which predicts how temperatures and rainfall will change, he has modeled cropping practices to determine whether planting times, for example, would increase crop yields.

So far, the research is showing that planting times will make a difference. If farmers continue to plant sorghum at the traditional time (late May), crop yield may decrease by 20 to 25 percent over a period of 25 years. Hot weather will arrive earlier as the climate changes, potentially damaging the sorghum before it is mature.

However, if the sorghum were planted about 20 days earlier, in early May, the sorghum yield would only decrease by about ten percent.

Now, the research team would like to take this knowledge and think about how further adapting crops would help farmers mitigate climate change. For example, hardier crops more resistant to drought may be part of the solution, and if climate change is relatively gradual these plant breeds can be developed over time, in response to the climate.