

The Kentucky Climate Center (kyclim.wku.edu) is a unique asset of Western Kentucky University, supporting teaching, research, and service missions of the institution. Under the direction of the State Climatologist, the Kentucky Climate Center serves as the State Climate Office for Kentucky. It participates in the National Climate Services Partnership through its affiliation with the Midwestern Regional Climate Center and the National Climatic Data Center, part of the National Oceanic and Atmospheric Administration within the U.S. Department of Commerce. The partnership also includes working relationships with the five National Weather Service forecast offices that serve portions of Kentucky.

In addition to its federal partners, the Kentucky Climate Center works in conjunction with state government. Within the Energy and Environment Cabinet of the Executive Branch, the Division of Water is tasked with implementing the Kentucky Drought Mitigation Plan, and the Kentucky Climate Center plays a major role. The state climatologist serves as co-chair of the Climate and Water Resources Data Team that advises the Governor during episodes of drought and serves as a lead point of contact for public and media inquiries when the Governor issues statements on drought status and response. In the past year, representatives of the Kentucky Climate Center were also invited presenters to the board of directors of the Cabinet's Center for Renewable Energy Research and Environmental Stewardship.

The Kentucky Division of Emergency Management (KDEM) has partnered with the Kentucky Climate Center to provide education and support to county emergency managers and first responders throughout Kentucky. The 2010 Kentucky Weather Conference was jointly sponsored by KDEM and the Kentucky Climate Center. In addition, the Kentucky Climate Center provides near-real-time weather conditions from the Kentucky Mesonet to the emergency operations center of the Division of Emergency Management.

The Kentucky Mesonet, is an automated weather and climate-monitoring network funded via an earmark secured by Senator Mitch McConnell through the National Weather Service. The network includes more than 50 stations serving people in communities throughout Kentucky. Sensors monitor air temperature, relative humidity, solar radiation, wind speed and direction, precipitation, soil moisture and soil temperature. Data are collected every five minutes, pass through quality assurance checks, and disseminated via a website, www.kymesonet.org. Basic data are freely available to the public and a wide variety of stakeholders in education, government, business and industry. Collaborating with the Commonwealth Office of Technology and the Division of Geographic Information, the Kentucky Climate Center integrated data from the Kentucky Mesonet into the Kentucky Event Mapping and Analysis Portal (KEMAP) and the Kentucky Weather Mapping website. The site provides emergency managers and other first responders with access to near-real-time weather data. This application received a Best of Kentucky Award for Best Application Serving Public Agencies.

The Kentucky Climate Center's Climate Research Laboratory conducts both basic and applied research using meso-scale models that integrate land use and land cover data with atmospheric data to model meso-scale weather and climate responses under variety of conditions. A unique aspect of the laboratory is engagement of undergraduate and graduate students who are trained to use models and conduct research that would normally be done only by doctoral students at other universities. The success of the laboratory is evident in the number of student research presentations, publications, and theses that have been produced. Over the past six years, students have authored or co-authored eight peer-reviewed publications and made 49 presentations.

Upon graduation, students engaged with the Kentucky Climate Center have been successful in landing professional positions and gaining admission to selective graduate programs. Over the past six years, two graduating students have entered doctoral programs. Two graduates started careers with the National Weather Service, and two others landed positions affiliated with the U.S. Army Lincoln Trail Area Development District, firms.

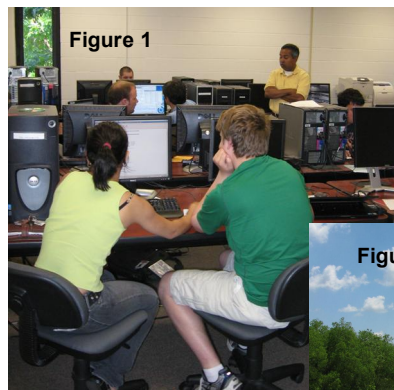


Figure 1: Students in the Climate Research Lab.

Figure 2: Photo of the drought of 2010.



Figure 3:

National Climatic Data Center. Other graduates are employed by the U.S. Army Lincoln Trail Area Development District, firms.

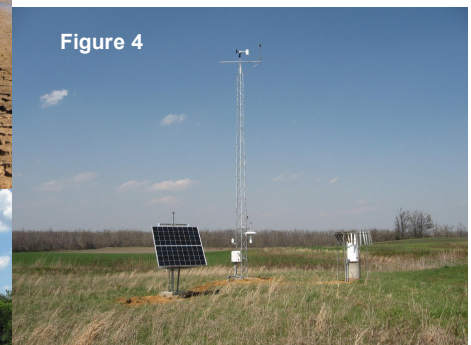


Figure 3: Photo of the flood of May 2010.

Figure 4: Photo of a Kentucky Mesonet station in McLean County.

The Beginning:

Less than half-way through its first year of inception, the Advanced Materials Institute is well on its way to extending WKU's scientific reach. A recent FIPSE grant awarded to the WKU Research Foundation has been used to acquire several key instruments that have brought critical new capabilities to the AMI. A single crystal X-ray diffractometer is capable of solving the atomic structures of disordered and frustrated crystal materials using tiny crystals ($\approx 1000\text{nm}^3$). This is of critical importance because many highly functional materials (e.g. for separation science) are disordered or are crystallographically challenged. In addition, an inductively coupled plasma optical emission mass spectrometer will give AMI the capability for atomic mass fraction analysis with isotopic resolution which will find uses in:

- 1) trace element analysis with applications in criminal forensics and material sorption properties
- 2) strategic metal characterization for application of REE or light metal separation science
- 3) isotopic analysis for radiometric dating
- 4) quantifying the concentrations of toxic metals such as arsenic and mercury in solids or liquids
- 5) determining Ca/Mg within shells for paleoclimatic studies coupled with the Raman microscope
- 6) any other applications that will require high atomic mass resolution

This is just a short overview of only two instruments recently acquisitioned, that highlight some of the work being conducted by the diverse members of AMI, but it emphasizes the broad scope of the research plans and capabilities.

Current work of the AMI:

Industrial partnerships within AMI include some coal analysis and mineralogical and chemical characterization of ore deposits. This is an area that we will be expanding and WKU graduate and undergraduate students will directly benefit by being a part of the industry. Summer internships for students have already been discussed and planned for field and lab work at REE and strategic light metal mines. In addition, planning has already begun to attract industrial scientists to WKU for experimental and instrumental training. This cooperative relationship will create future opportunities for students.



Dr. Aaron Celestian,
Director of the newly formed
ARTP Center Advanced
Materials Institute (AMI)

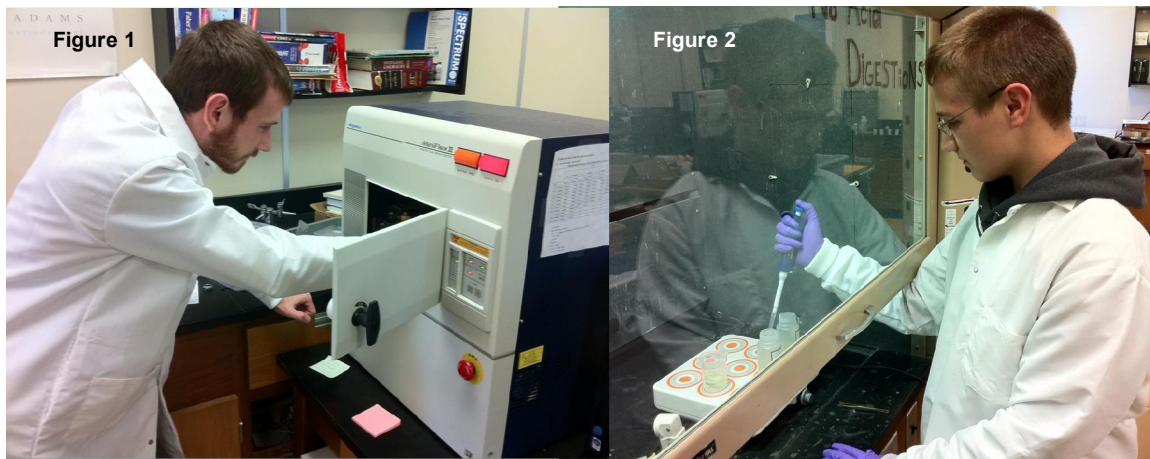


Figure 1: Geology undergraduate student Stuart Kenderes loading material into an X-ray diffractometer for structural characterization.

Figure 2: Gatton Academy student Layne Webb preparing an engineered gel for synthesis of nanoporous materials.

– Applied Research In The News –

IN 'THE NEWS' WESTERN KENTUCKY UNIVERSITY

Agriculture Research and Education Complex

Director:
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- Soils Judging Team competed in regional and national contests.
- Livestock Evaluation Team competed in regional and national contests.
- Both graduate and undergraduate students attended the American Society of Agronomy, Crop Science Society of America and Soil Science Society of America 2010 Annual Conference along with faculty advisors. All participants made scientific presentations.
- Materials were purchased for the Sustainable Grazing thesis project data collection.
- Both graduate and undergraduate students participated in Survey of US Agriculture visiting agriculture industry professionals and practitioners in South Dakota and Nebraska.

Applied Physics Institute

Director:
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- The Portable Community Infrastructure Resiliency System was developed to address a need for a light-weight, easily deployable transformer that can be utilized in disaster areas. The project is currently in the final phase of fabrication.
- The Waterborne Threat Interdiction System was recently demonstrated for personnel from the National Institute of Hometown Security who sponsored the project.
- The project Broadcast Methods for the Elimination of Random Anomalous Peak Loads is funded by the Kentucky Commercialization Fund and involves the development and commercialization of a wireless AC cycling switch and integrated stochastic prediction algorithm.

Architectural and Manufacturing Science Institute

Director:
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- There were five students employed this quarter developing 10 Architectural Design projects.
- There were nine Architectural Design Projects under construction.
- Professor Bryan Reaka and several students worked with President Carter and his family in Annapolis, Maryland on a **Habitat for Humanity** House.
- There were three **AMSI** Architectural Designs featured in this year's **Parade of Homes**.
- **AMSI** is fabricating Bike Racks for **WKU**, this is the sixth order totaling 400 units.
- **AMSI** is continuing to perform laser etching services for **WKU** and local industries.

Center for Biodiversity Studies

Director:
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- Dr. Larry Alice and Gatton Academy of Math and Science student Ruby Chang presented at the Botany Society of America annual meeting in Providence, Rhode Island, on the phylogeny and global distribution patterns of blackberries
- Atolagbe Ayodele, a graduate student from the Department of Public Health, is working in the laboratory of Dr. Carl Dick on the Batflies of Madagascar
- Dr. Scott Grubbs published a paper in the journal Aquatic Ecology on stream macroinvertebrate ecology from the Cumberland Plateau region in eastern Kentucky.
- Dr. Carl Dick presented at the American Mammal Society annual meeting in Laramie, Wyoming, on bat parasite ecology
- Justine Missik, a Gatton Academy of Math and Science student, and Danielle Racke, a Department of Biology graduate student, presented papers at the Ecological Society of America annual meeting in Pittsburgh, Pennsylvania. Both students are working in the laboratory of Dr. Albert Meier.

Biotechnology Center

Director:
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- The Biotechnology Center hosted a research symposium for its inaugural class of REU students in August.
- A Dept. of Education FIPSE Grant has allowed the Biotechnology Center to update much of its equipment: including thermo cyclers, electronic balances, incubators and a biological safety cabinet.
- The Biotechnology Center has begun training the latest cohort of students in our Biotechnology Certification Program.
- Dr. Cheryl Davis presented a paper at the Annual Meeting of the American Society of Parasitologists in Colorado Springs, CO.
- Dr. Sigrid Jacobshagen presented a paper at the biennial International meeting of Cell and Molecular Biology of Chlamydomonas in Boston, MA.
- Dr. Nancy Rice is teaching cell and molecular biology at Harlaxton University in the UK.

Bioinformatics & Information Science Center

Director:
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- The Bioinformatics and Information Science Center hosted guest speaker, Dr. Christy Gearheart, from the University of Louisville on September 7, 2010. Dr. Gearheart presented a seminar entitled "Next Generation Sequencing: From Inception to Innovation".
- The Department of Economics, the Department of Mathematics and Computer Science, and the Bioinformatics and Information Science Center welcomed workshop presenters Dr. Tom R. Bohannon and Dr. F. Michael Speed of the SAS Institute on October 18 and 19, 2010. The workshop was entitled "Getting Started with SAS Analytics Pro Using SAS Enterprise Guide Workshop". Thirty-five faculty, staff and students participated in this two-day event.

Center for Water Resource Studies

Director:
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- Collaborative research involving CWRS, HERI, and USDA was presented at the 20th International Conference on Subterranean Biology in Postojna, Slovenia by Rick Fowler in September.
- Jana Fattic gave a presentation on the Water Training Institute at the KY/TN Section American Water Works Association (AWWA) Water Professionals Conference in Nashville, TN on July 20.
- CWRS hosted a national panel of experts on drinking water distribution system decontamination in Cincinnati on July 12 to solicit input for its grant from the National Institute for Hometown Security (NIHS) titled, "Best Practice Protocols for Response and Recovery Operations in Contaminated Water Systems".
- Dr. Andrew Ernest attended the AWWA Water Security Conference in National Harbor, MD on September 20-21.

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Engineering Services Center

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- EE Seniors have begun working on: *Elephant Forage Disruption System* (with WKU Biology); a project to convert a Hybrid vehicle into a Plug-In Hybrid vehicle; a portable Solar Greenhouse project (with WKU Agriculture), and a proprietary industrial project with Heath Co.
- ME Seniors are working on: *Paper Media Separation* project for the GM Corvette plant; an *Overhead Crane Maintenance Awareness Barrier* project for Logan Aluminum.
- K. Woods and C. Byrne, "Acoustic Property Development from Wood to Carbon Composite," presented at Carbon 2010, the International Carbon Society Conference, Clemson South Carolina, July 21, 2010.
- C. Byrne, "Microstructure Evolution of Wood During Carbonization," presented at Carbon 2010, the International Carbon Society Conference, Clemson South Carolina, July 21, 2010.
- The 10th annual high school robotics competition was kicked off in September, with 19 teams from 11 local area schools beginning the design of a robotics challenge based on the NASA Lunabotics project.

Institute for Combustion Science and Environmental Technology

Director:

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- Yan Cao named as Adjunct Professor of Chemistry, and currently directs three Graduate Students:
 - Yaowen Cui - A novel Method for Preparation of Oxygen Carriers for the Development of Chemical Looping Process
 - Kelin Wang - Immobility of Trace Metals of Coal-fired Fly Ash Using Additives
 - Xu Limeimei - Speciation and Transformation of Trace Metals in Aerosols or Particulate Matters
- ICSET received \$62,500 from Kentucky Energy and Environmental Cabinet as matching funds to a DOE grant.

Hoffman Environmental Research Institute

Director:

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- Institute scientists Jason Polk and Leslie North traveled to Wuming China as invited lecturers in a workshop on environmental justice in support of a grant from the US State Department to the Vermont Law School's U.S.-China Partnership in Environmental Law.
- Institute Director Chris Groves was nominated by China's Ministry of Land and Resources for the Friendship Award, China's highest honor for foreign scientists working in the country.
- Visiting Vietnamese post-doctoral research scientist Vu Nguyet presented Seasonal Variations in Background Hydrochemistry of Epikarst Waters in Kentucky's Pennyroyal Plateau at the National Speleological Society conference in Vermont.
- In Guilin, China The Hoffman Institute signed a Memorandum of Agreement with the governments of Barbados and China for trilateral cooperation on environmental education and research efforts.
- Institute students and faculty completed reinstrumentation of water monitoring equipment at the Crump's Cave educational preserve that had been destroyed during the severe floods of May 2010.

Kentucky Climate Center

Director:

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- KCC received funding through the Governor's Agricultural Development Board to add soil monitoring capabilities at Ky Mesonet stations in Barren and Hardin Counties.
- KCC announced the addition of a new Ky Mesonet station in Pike County.

Institute for Astrophysics and Space Science

Director:

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- In July IASS Faculty members, Drs Strolger and Campbell, participated in a High Altitude Ballooning workshop held in Indiana in preparation for restarting WKU's highly successful ballooning program.
- In September Hardin Planetarium premiered a new show called 'The New Mars'. This presentation combines images of the Red planet taken by the Mars rovers and other NASA instruments with historical data and discusses recent findings which indicate that in the distant past Mars may have had many Earth-like characteristics.
- IASS Faculty, staff and students began presenting the 'Fall Public Activity Program'. For the first time this program has added a monthly Physics activity evening to the already popular monthly Astronomy viewing nights.
- IASS Faculty continue to take their students on regular observing and maintenance trips to WKU's local and national telescope facilities. This is a key component of the unique research experience available to undergraduates.
- IASS students presented short talks to the Faculty describing their summer research.
- Boy Scouts, WKU Alumni and members of the Hilltopper Astronomy Club were given private planetarium shows.

Advanced Materials Institute

Director:

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- AMI has acquired several new pieces of equipment including an optical emission mass spectrometer (Dahl), single crystal X-ray diffractometer (Celestian), thin film deposition system (Dobrokhotov), gas and liquid chromatograph mass spectrometer (Snyder), and a simultaneous thermogravimetric analyzer and differential scanning calorimeter (Celestian).
- These machines will aid in the characterization of challenged and frustrated materials which are typical of nano-, metal-organic frameworks, and other highly functional structures.
- With the efforts of Dr. Wulff and Celestian, AMI is beginning to attract industrial and academic collaborations from coast-to-coast.