




2009-2010 Academic Year

# E<sup>3</sup>S Year in Review

## Department of Environmental Engineering and Earth Sciences

### Chair's Corner

#### Dear Colleagues and Friends:



I am very pleased to present you a brief summary of the accomplishments and activities of our Department during the past academic year. More detailed information can be found on our web page. Despite challenges around the country and in our state, the department had an exceptional year. The new research awards of our faculty reached \$3.1M in the past year, several of which are from keen national competitions. This is very impressive for a group of 16 faculty. We listed a few of the selected projects in this summary. We added two new faculty, Drs. Finneran and Ladner, who just joined us. Dr. Grady was selected to receive 2010 Industrial Water Quality Lifetime Achievement Award from Water Environment Federation. This is an impressive honor reflecting his significant career and contributions to our profession. Several of our faculty have continued to serve on editorial boards of journals and national assignments. We are also very proud of the accomplishments of our students; several of them have received impressive national awards and recognitions. We started a new undergraduate degree in Environmental Engineering. The first cohort of 20 students just began this Fall. This is the only program degree of its kind in South Carolina. We had a large incoming graduate student class, bringing the total number of graduate students in the Department to 100. We organized another very successful Hydrogeology Symposium with over 300 attendees and 20 exhibitors. Special thanks to our dedicated staff for continuing to support the mission of the department. Overall, I continue to be amazed with the exemplary work ethics and productivity of our immensely talented faculty, students and staff.

Tanju Karanfil, Ph.D., P.E., BCEE

### Faculty Research

Our department is a vibrant academic community with focus areas in environmental process engineering, hydrogeology, environmental health physics and radiochemistry, environmental chemistry, and sustainable systems:

**Dr. Carraway's** recent work includes the environmental behavior of metal oxide nanoparticles, measuring metals in SC streams, abiotic reduction of uranium, and photochemical transformations of mercury. **Dr. Castle's** research group investigates treatment of energy-produced waters for the purpose of increasing opportunities for beneficial use of these waters. **Dr. DeVol's** research centers on in-situ and field-portable instruments and methods for environmental radiation measurements, environmental health physics, radiation monitoring statistics, and nuclear forensics/homeland security. **Dr. Elzerman's** has been working on sustainability education for diverse groups as well as his traditional environmental chemistry research on contaminants in surface and groundwater systems. **Dr. Falta** is investigating CO<sub>2</sub> sequestration, subsurface thermal energy storage, thermal remediation of fractured rocks, probabilistic simulation of groundwater remediation, and aerobic biodegradation of CVOCs. **Dr. Finneran's** research focuses on biodegradation/bioremediation and biofuel production; the projects emphasize basic microbial physiology and anaerobic microbial ecology, and how these can be adapted for specific applications. **Dr. Freedman's** current research includes development of enrichment cultures for halorespiration of chlorinated ethenes in low pH groundwater,  $\gamma$ -hexachlorocyclohexane, 1,2-dichloroethane, and ethylene dibromide. **Dr. Karanfil's** research group investigates the formation and control of disinfection by-products in drinking water, wastewater effluents, and swimming pools, and the behavior of nanomaterials in engineered and natural systems. **Dr. Ladner** is finding ways to make membrane separations sustainable for water treatment and biofuels using novel membrane materials, advanced module design, and renewable-energy-driven techniques. **Dr. Lee's** research uses enantioselective analytical techniques to understand behavior of chiral pollutants such as PCBs, pesticides, and pharmaceuticals in natural and engineered systems. **Dr. Molz**, Research Professor and Distinguished Scientist Emeritus, is working with 2 teams of colleagues: one studying plutonium in soils; the other developing geothermal heat pumps. **Dr. Stephen Moysey** applies geophysical imaging and geostatistics to study earth processes with current applications in biogeochemistry, carbon sequestration, land mine detection, and water resource sustainability. **Dr. Murdoch's** current research involves field investigations and theoretical analyses to improve understanding of aquifer geomechanics, environmental remediation, transport through fractured media, and CO<sub>2</sub> sequestration, **Dr. Overcamp's** research is primarily in air pollution. Currently, he has a project assessing air quality in Southeast Asia using satellite data. **Dr. Powell's** current research focuses on understanding radionuclide and nanoparticle environmental behavior, radioactive waste disposal performance assessment, characterization of solid-water interfacial reactions, and nuclear forensics. **Dr. Schlautman** investigates the reactivity, fate and transport of metal and organic contaminants; carbon cycling in soils and streams; and impacts of land use on water quality. **Dr. Warner's** teaching and research is in the area of mineralogy-petrology-geochemistry as well as undergraduate creative inquiry.



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# Student News

## *Student National Awards*

**Jose Alfaro, EE&S MS**, received the National Science Foundation 3-year graduate research fellowship for students in science, engineering, mathematics, technology and social sciences.

**Ben Sharp, EE&S PhD**, was selected as one of the recipients of the prestigious 2010 EPA STAR Fellowship.

**Darryl Jones, EE&S MS**, received the best student thesis award from the American Water Works Association at its Annual Meeting in Chicago. Darryl was recognized with a plaque and a \$3,000 check.

**Ting Shao, EE&S PhD**, received the best paper award in 2009 from the Water Environment Federation Student Paper Competition in the Masters Division.

**Kelly Grogan, EE&S PhD**, received the 2010-2011 Robert S. Landauer Fellowship for graduate studies in health physics. The award will be in the amount of \$6,000 for the purpose of supporting his graduate work at Clemson University this coming academic year.

**John Kroon, Hydrogeology MS**, has been selected as the 2010 recipient of the Donald A. and Mary O'Nesky Named Grant of the American Association of Petroleum Geologists. This AAPG Grants-in-Aid award is made in support of John's thesis research, "Molecular Biogeochemistry of Lower Huron and Cleveland Shales in Eastern Kentucky and Southern West Virginia."

**Christopher Patterson, Hydrogeology MS**, has been named as one of the seven students nationally selected as outstanding teaching assistants for 2010 by the National Association of Geosciences Teachers.

*Congratulations!*

## Student News and Accomplishments

**Amy Hixon** and coauthors published a manuscript titled "Influence of Iron Redox Transformations on Plutonium Sorption to Sediments" in the international journal *Radiochimica Acta*. She also presented at The Savannah River Health Physics Society Technical Seminar in April, 2010.

**Viet Dang** presented some of the results from his PhD research at the First International Conference on Environmental Pollution, Restoration and Management at Ho Chi Minh City, Vietnam in March, 2010. He was awarded one of the student prizes for his platform presentation.

**Arika Bridhikitti**, Thomas J. Overcamp, and Patrick D. Gerard, presented two papers: "Ozone Measurement Instrument (OMI) Sensor for Biomass Aerosol Optical Properties" and "Remote Sensing Observations of SE Asian Forest-Fire Aerosols' Optical Properties and Their Limiting-Factors", 2010 Air & Waste Management Assoc. Annual Meeting in Calgary, Alberta, June 22-25.

**Jose Alfaro, Ben Sharp and Jim Chamberlain** attended the Gordon Research Conference on Industrial Ecology, July 10-16. Jose's poster presentation won a student poster award. His poster was entitled: "Benefits of Using Industrial Ecology in Community Development Projects: A Case Study in Liberia West Africa".

**Tara Matheny, Kelly Grogan and Derick Kopp** gave presentations at the annual Health Physics Society in Salt Lake City in July.

**Shannon Thompson** presented his research "Correlations between the uptake of Fe and Pu in corn (*Zea mays*)" at the American Chemical Society National Meeting in San Francisco.

**Dr. Brian Powell's** Research Group gave presentations at the 2010 Goldschmidt Conference. This is an annual international geochemistry conference which was held in Knoxville, TN.

**Zimmerman, T. N.**, Powell, B. A., "Plutonium Humic-Acid Stability Constant Determination and Subsequent Surface Complexation Studies".

**Lilley, M. S.**, Powell, B. A., Kaplan, D. I., "Sorption of Np, Pu, Tc, and I to Saltstone and Cement Formulations under Oxidizing and Reducing Conditions".

**Miller, T. J.**, Powell, B. A., Kaplan, D. I., "A Simplified Quantitative and Conceptual Model of Np Sorption to Natural Sediments".

**Dr. Tanju Karanfil's** Research Group made several presentations at the 2010 International Carbon Conference in Clemson in July:

Zhang, S., **Shao, T.** and Karanfil, T. "Adsorption Site Analysis for Carbonaceous Adsorbents,"

**Shao, T.**, Zhang, S. and Karanfil, T. "Adsorption of Organic Chemicals on Carbon Nanotubes in Aquatic Environment"

**Kose, S.**, Zhang, S. and Karanfil, T. "Pore Structure and Adsorption Affinity of Activated Carbon,"

## 2010 EEES Student Awards



**A. Ray Abernathy Fellowship:** Christina Anderson

**Linvil G. Rich Fellowship:** Andrea Hicks

**Environmental Scholars:** Shanna Estes, Adam Mangel, Ting Shao

**Thomas F. Logan, Jr. Geology Merit Award:** James Christopher Ryan

**Jean G. Stillwell Award:** Chaquetta Denise Green, Austin Matthew Hodge

# Department/Faculty News

## Environmental Engineering Undergraduate Degree

EEES now offers an Environmental Engineering degree. We offer a BS degree with two concentrations: Process Engineering and Natural Systems. This is the only program of its type in South Carolina. The degree is generating a lot of interest with students. The first cohort of 20 students began the degree in the Fall. Watch our video on our website about the new degree, <http://www.youtube.com/watch?v=1wBQ09zZgQA>



**Dr. David Ladner** joined EEES in the Fall of 2010. He received his PhD in Civil and Environmental Engineering from the University of Illinois at Urbana-Champaign in October 2009, working with Mark Clark. His dissertation topic was membrane fouling in desalination facilities facing Red-Tide algal blooms. His research is making membrane-based water treatment processes more sustainable.

**Dr. Kevin T. Finneran** also joined EEES in the Fall of 2010. He received his PhD in Microbiology at the University of Massachusetts at Amherst in 2001. His research focuses on bioremediation of organic and inorganic contaminants, biofuel production by altering microbial metabolic pathways, and sustainable remediation. He is a co-Editor in Chief of the International Journal of Soil, Sediment, and Water. Before coming to EEES, he was an assistant professor in the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign.



**Dr. Leslie Grady** was selected as the recipient of the 2010 Industrial Water Quality Lifetime Achievement Award from the Water Environment Federation. This award is an excellent and well-deserved recognition for all of the work his research group did in trying to understand the factors controlling the biodegradation of synthetic organic compounds as well as the work the industrial water quality group at Ch2MHILL did in putting this knowledge into practice. This is only the second year that this award has been given. Les will receive his award at the 2010 WEFTEC meeting in New Orleans.

## Faculty National Activities

### Editorial Board or Editorial Advisory Board

**Dr. Jim Castle**, Editor in chief, Environmental Geosciences

**Dr. Alan Elzerman**, Editorial Advisory Board, Environmental Science and Technology

**Dr. Ron Falta**, Associate Editor, Vadose Zone Journal

**Dr. Tanju Karanfil**, Editorial Advisory Board, Journal of American Water Works Association

**Dr. Kevin Finneran**, co-Editor-in-Chief, International Journal of Soil, Sediment, and Water.

**Dr. Cindy Lee**, Associate Editor, Environmental Toxicology and Chemistry

**Dr. Tom Overcamp**, Associate Editor, Journal of Air and Waste Management Association

### Committee or Board Appointments and Assignments

**Dr. Alan Elzerman**, Member, Executive Committee, Council of Environmental Deans and Directors

**Dr. Cindy Lee**, Member, Environmental Engineering committee of the Science Advisory Board of the US EPA

**Dr. Larry Murdoch**, Member, Board of Directors of CUAHSI, the Consortium of Universities for the Advancement of Hydrologic Sciences. The geoscientist on the Experimental Design Committee for DUSEL, The Deep Underground Science and Engineering Laboratory.

### Books Published by EEES Faculty

**Lois Breur Krause**, "How We Learn and Why We Don't: Student Survival Guide Using the Cognitive Profile Inventory" 4th Edition (2003).

**Ron Falta** "Vadose Zone: Science and Technology Solutions, Volumes I and II" (2000) with Brian Looney.

**Bob Fjeld** "Quantitative Environmental Risk Analysis for Human Health" (2007) with N. A. Eisenberg and K. L. Compton.

**Leslie Grady** "Biological Wastewater Treatment, Second Edition Revised and Expanded" (1999) with Glen Daigger and Henry Lim.

**Tanju Karanfil** "Disinfection By-Products in Drinking Water: Occurrence, Formation, Health Effects and Control" (2008) with Stuart Krasner, Paul Westerhoff and Yuefeng Xie.

## Selected Faculty Research Awards

**Dr. Brian Powell** and Yuji Arai will lead a \$1.18 M project entitled "Development of a Self-Consistent Model of Plutonium Sorption: Quantification of Sorption Enthalpy and Ligand-Promoted Dissolution" funded by the DOE Office of Science, Biological and Environmental Research Program.

**Drs. Larry Murdoch and Stephen Moysey** have received \$450K from the DOE to study CO<sub>2</sub> storage. They plan to apply reservoir deformation techniques and high performance computing to CO<sub>2</sub> sequestration and possibly oil and gas production as well.

**Dr. Tanju Karanfil** received a new award in the amount of \$320K entitled "Quantitative Structure-Adsorbability Relationships for Adsorption of Organic Chemicals by Carbon Nanotubes" from the National Science Foundation.

**Dr. Stephen Moysey** has received two new grants from the Department of Defense to improve land mine detection using ground-penetrating radar.

**Drs. Ron Falta and Fred Molz** received an award entitled "Subsurface Thermal Energy Storage for Improved Heating and Air Conditioning Efficiency from DoD in the amount of \$971K.

**Drs. Tim DeVol, Tanju Karanfil and Brian Powell** received a \$400K Junior Faculty Development Award from the Nuclear Regulatory Commission.

**Drs. Tim DeVol** and Brian Powell both received Department of Homeland Security awards. Dr. DeVol received \$300K to develop nuclear forensic teaching capabilities; and **Dr. Brian Powell** received a \$300K junior faculty award.



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## Engineers Without Borders Projects

### Liberia

For Clemson's chapter of Engineers Without Borders, the summer of 2010 began with two international trips to West Africa and Central America.

Jose Alfaro led a group of ten (10) students and one (1)

EWB sponsor to Liberia where they established an integrated rice-fish pond for growing tilapia and rice, repaired a rabbit nursery, built a peanut sheller, and taught local villagers how to construct an anaerobic digester for sustainable production of fuel.



### El Salvador

Jim Chamberlain led seven (7) students and six (6) EWB sponsors to El Salvador to continue design of a potable water system extension to several villages. The students surveyed for the new water

lines and drilled a test well using a manual rotary drill rig that was donated to the local villagers. Dr. Mark Schlautman is a co-advisor for the group and Christina Anderson is the graduate student coordinator for two ongoing Creative Inquiry classes that continue to offer these excellent opportunities to undergraduate engineering students.

