



Surface Water Ocean Typography Mission Could Help Predict Climate Change Effects

(www2.tntech.edu/techtimes/2008/08_10/10_03/climate.html)

“Words are cheap when it comes to saying what we should and shouldn’t do to adapt to climate change effects — but not many U.S. academic institutions can claim credit when it comes to playing an active role in capacity building of nations most vulnerable to climate change.”

That’s how Faisal Hossain, associate professor of civil and environmental engineering, describes the university’s active role in improving the structural capacity of Bangladesh to adapt to climate change this century.

Tennessee Technological University’s involvement all began with a speech. Hossain was a keynote speaker at a recent international symposium about climate change that attracted about 250 delegates from 17 countries and was endorsed and attended by the heads of state for Bangladesh and Iceland.

Experts say that global warming has already begun and predict the resulting climate change will increase temperature, decrease availability of fresh water, contribute to rising sea level, melt Himalayan glaciers, increase the frequency and intensity of extreme meteorological events and shift crop

zones in South Asia — all of which would have a global impact on agricultural, economic, social and environmental sectors, but especially in the world’s developing countries.

The International Symposium on Climate Change and Food Security in South Asia brought international experts together to address these issues and recommend possible mitigations and adaptations.

Hossain’s presentation, based on research being conducted jointly with the Ohio State University’s Douglas Alsdorf, was about how developing countries could benefit by using cost-effective, shared satellite technology to measure and better understand surface water flow and storage changes.

The Surface Water Ocean Typography (SWOT) mission plans to use satellite technology to completely cover the world’s ocean and freshwater bodies with repeated elevation measurements.

It is a collaborative international project led by NASA’s Jet Propulsion Laboratory and the French Space Agency and includes a network of participants from numerous countries and institutions.

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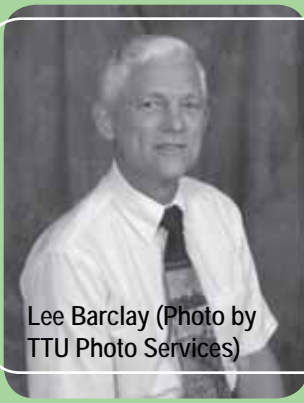
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Lee Barclay (Photo by TTU Photo Services)

"Lee's leadership of the Fish and Wildlife's Tennessee Office in Cookeville has been a tremendous asset to Tennessee and the Center."

— Dennis George, Director of the Center for the Management, Utilization, and Protection of Water Resources (Center)

Lee Barclay, a member of the Center's Advisory Board, recently retired after many dedicated years of service as the supervisor of the U.S. Fish and Wildlife Service's Tennessee Field Office in Cookeville.

Barclay's career with the Fish and Wildlife Service began in 1975 as the assistant Regional Coastal Ecosystem team leader in Galveston, Texas (for one-and-a-half years) and later in Charleston, South Carolina (five years). He then served six years as the environmental contaminants specialist in the Tennessee/Kentucky Field Office in Cookeville, Tennessee. Barclay served as the senior contaminants specialist in the Fish and Wildlife Service's Headquarters Office in Washington D.C., in 1987 and 1988, and then he was appointed as supervisor of the Mississippi/Arkansas Field Office in 1989. Barclay transferred back to Cookeville in 1991 as supervisor of the Tennessee/Kentucky Field Office.

"Lee's leadership of the Fish and Wildlife's Tennessee Office in

Cookeville has been a tremendous asset to Tennessee and the Center," said Dennis George, Center director and environmental engineer. "His expertise proved invaluable in helping guide the Center toward future initiatives that will stimulate new research funding for the Center's work. He will be missed as a part of our board."

Barclay earned a Ph.D. in aquatic ecology and fisheries in 1973 from Auburn University. Before beginning his career with the Fish and Wildlife Service, he taught ichthyology, freshwater fish ecology, aquaculture, and conservation biology at California Polytechnic State University in San Luis Obispo, California.

Barclay and his wife, Judy, reside just outside the Cookeville city limits. In addition to caring for a wide assortment of domestic animals such as dogs, cats, horses, donkeys and geese, the Barclays also operate the Upper Cumberland Wildlife Rehabilitation Center, focusing primarily on raptorial birds such as hawks and owls.

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Microbiologist Berk Hosts University of California Berkeley Visitor

Microbiology Professor Sharon Berk hosted Charlotte Smith, Ph.D. student and EPA Star Grant Fellowship recipient, in her lab last year, and that visit has led to collaborative research and joint presentations.

Smith, who has worked many years in the drinking water industry, is doing research at the University of California, Berkeley, in the bacteria that cause stomach cancer and is studying their interactions with protozoa in drinking water. She is also looking at the drinking water *E. coli* that cause life-threatening diarrhea in developing countries. Since she wanted to learn how these bacteria can be protected by living inside protozoa, she thought of Berk, whom she learned of through literature, presentations, and other colleagues.

"Smith spent almost a week in my lab," Berk said. "During that time, we spent many long hours working on protozoan and pathogenic interactions, and now we have a future of joint research to show for it."

Smith and Berk's presentation, titled "Diarrheagenic *E. coli* Survive Passage Through the Free-Living Protozoan *Tetrahymena* sp.," was made during the American Society for Microbiology Meeting held in May in San Diego, California. And Berk says that she and Smith plan to meet later again this summer to work on a joint proposal.

"It has been a pleasure working with Charlotte," Berk said, "and I consider it an honor that she requested that I officially be a part of her Ph.D. committee at Berkeley and that her wishes were approved by her committee."



From left to right: Wearing t-shirts from the opposite affiliations are Bethany Wilson, research technician I; Charlotte Smith, Ph.D. student from the University of California, Berkeley; Barbara Goodson, Ph.D. and research specialist; Sharon Berk, biology professor.

Conserving Water

With the economic crisis looming, conservation has suddenly taken a front seat in the minds of the American public, and everything from conserving money, to food, to water has become a major pastime. The following is a list of ways to conserve water (available on the Internet at <http://www.wateruseitwisely.com/100-ways-to-conserve/index.php>).

- 1 When washing dishes by hand, don't let the water run while rinsing.
- 2 Plant in the fall when conditions are cooler and rainfall is more plentiful.
- 3 Consider upgrading with air-cooled appliances for significant water savings.
- 4 Adjust sprinklers so only your lawn is watered.
- 5 Run your clothes washer and dishwasher only when full, saving up to 1,000 gallons a month.
- 6 Choose shrubs and groundcovers for hard-to-water areas.
- 7 Use your garbage disposal sparingly. Compost vegetable waste.
- 8 Water your lawn and garden in the morning or evening when temperatures are cooler to minimize evaporation.
- 9 Shorten your shower by a minute or two and save up to 150 gallons per month.
- 10 Collect the water you use for rinsing fruits and vegetables. Then reuse it to water houseplants.

Environmental Chemistry Professor Martha J.M.

For a lot of people, 21 years marks the beginning of adulthood, but for environmental chemist Martha J.M. Wells, 21 years marks a transition in her career as a professor and environmental researcher at TTU and the Center. Wells retired at the end of June to pursue other career interests, but leaves TTU with a history of accomplishments and reputation for quality research.

Wells began her career looking at pesticides and herbicides and the effects of those chemicals when they reach water supplies, but as research in that area became more established, she delved into emerging chemicals and nanoparticles, like the gold particles that are now used in medicine for imaging.

"Gold particles are now being found in hospital refuse," Wells said. A few years ago Wells and her colleagues began researching how particles like those and remnants of pharmaceuticals and personal care products being found in refuse and eventually our drinking water systems could affect the health of those drinking it.

Through her work in these areas, Wells has collaborated with researchers from across the globe and across disciplines.

"A big part of what I've enjoyed about my job is the interdisciplinary interactions," Wells said. "That's what the Water Center is about, and I've been privileged to work with all kinds of researchers across campus from the College of Arts and Sciences to Engineering to Education. Without an interdisciplinary approach, you can't tackle environmental problems."

One of the most rewarding and challenging of those environmental problems proved to be an environmental justice project in the Chattanooga Creek area. Some regions may be more at risk from environmental hazards than others because of socioeconomic conditions. When those social issues are considered, then researchers work toward providing environmental justice to the residents in those regions.

"In that instance," Wells said, "we took our science to the public and explained it to lay people. It was really rewarding to combine science and the real human aspect in such a far-reaching environmental project."



Martha J.M. Wells

Wells's career has encompassed a myriad of environmental chemistry concerns ranging from endocrine disrupting chemicals, which can lead to male fish with female reproductive organs; to disinfection by-products, including trihalomethanes and haloacetic acids (Wells and her team examine fluorescence techniques as predictors of these potentially harmful by-products); to inorganics and metals. And she has garnered hundreds of thousands of externally funded research dollars in pursuit of those interests. This research has also earned her international recognition; she was one of the first ones called by the media when an Associated Press study brought the question of whether or not our drinking water is safe to the forefront of citizens' minds.

She has also initiated and led Web conferences on the subject of microconstituents and other harmful chemicals being found in drinking water. Along with Larry Keith, of Instant Reference Sources, Inc.; and Christian Daughton and Tammy Jones-Lepp, of the National Exposure Research Lab of the U.S. Environmental Protection Agency, Wells coordinated an international webcast titled "The Virtual International Symposium on Environmental Aspects of Pharmaceuticals and Personal Care Products." The virtual symposium, which included one remote site on the TTU campus, linked audiences across the globe, and participants included representatives from the University of Toronto, governmental agencies like the U.S. Geological Survey, and the National Institute of Standards and Technology.

"In one instance," Wells said, "a question posed from a remote site in Texas was answered by a person connected from a remote site in Massachusetts."

Wells has also served the academic community through her membership in various professional organizations like the American Chemical Society (ACS), Division of Analytical Chemistry and Chromatography Subdivision, Division of Environmental Chemistry, and Agrochemical Division; International Humic Substances Society; and American Fisheries Society. Through the Executive Committee of the ACS, her roles ranged from secretary (1994-1995) to chair (2000-2001). For her work, Wells received the ACS Division of Environmental Chemistry Distinguished Service Award (2002) and an award for Outstanding Service as the 2000-2001 chair (2002).

Wells Retires from TTU after 21 Years of Service

Her scholarly service doesn't stop within the confines of society membership though. Wells has also mentored and advised several Ph.D. and master's students since her career began.

"My students have been excellent," Wells said, "and they have been drawn to TTU because of the Water Center and the research opportunities available here. I feel that I've been successful when the students are successful."

Wells will be able to continue the partnerships she's forged through students and faculty while at TTU even though she will no longer be on campus.

"I'll still be available to collaborate on research projects," Wells said. "I've enjoyed my time here and working with everybody, so I want to carry that camaraderie with me even after I've left."

Waters Farm Open House



Last fall, Waters Farm, managed by horticulturist Randy Dodson, hosted an open house to demonstrate publicly the organic growing techniques for which it was created. People ranging from middle school students to retirees visited the farm and took part in the variety of day-long activities. Kids enjoyed painting murals on the old school bus that sits on one end of the farm and taking mule-drawn wagon rides through the opposite field while others took in the band's music being played on a makeshift stage in front of bales of hay. Sorghum was made on-site, and a pig was roasted for lunch.

"It was great to see the interest in the farm from the community," Dodson said. "We hope to continue to promote sustainable and organic practices in the farming community and to be instrumental in developing the local food economy in the Upper Cumberland region."

The organic farm was established in August 2007 after Gary and Brenda Waters donated their 113-acre farm to TTU's School of Agriculture.

Organic farming practices are growing steadily in Tennessee, and Waters Farm is spearheading those techniques in the Upper Cumberland region. These techniques replace the use of traditional fertilizers and pesticides with more natural ones — like planting cover crops that will be plowed back into the ground where they will increase nutrient content and contribute to healthier soils; introducing "good" bugs like ladybugs to prey on harmful insects that kill the plants; and using more natural bug deterrents (like vegetable oils) to further eliminate the need for potentially unhealthy pesticides.

Waters Farm is being used for research to establish high-tunnel growing techniques, which help determine best practices for organic production and ultimately ensure cleaner water supplies by preventing potentially harmful pesticides and fertilizers from our water sources. These research projects are run through the Center, and many are led by soil scientist Kim Stearman, a Center core faculty member.

"Projects like those at the Waters Farm can also be important in minimizing stream degradation, which ultimately leads to a healthier environment overall," Dennis George, Center director, said.



Environmental Sciences Colloquium

Bioenergy Research: Development, Demonstration and Deployment



John Mark Downing, an agricultural economist and senior scientist at Oak Ridge National Laboratory (ORNL), presented "A U.S. Perspective from the Department of Energy Bioenergy Program" at last year's Environmental Sciences Colloquium. There are many areas of bioenergy study currently underway by many different organizations and institutions, but much of this work remains to be integrated to build a bioenergy industry.

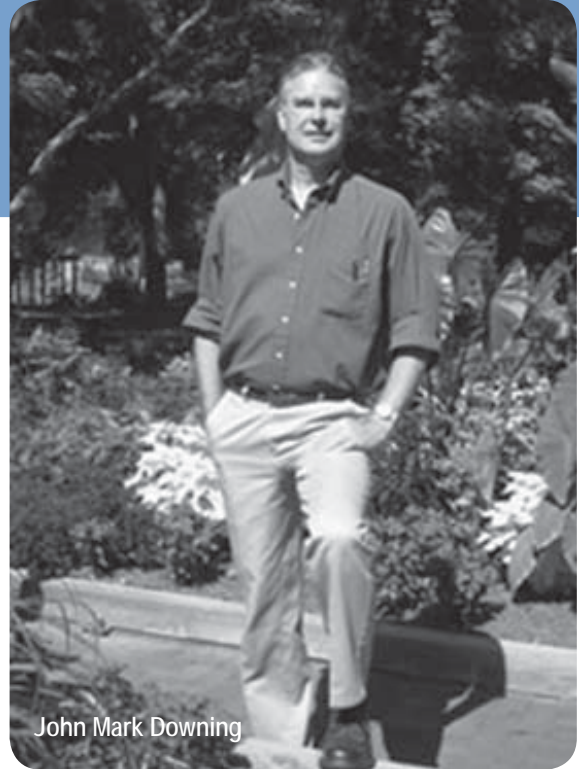
"This lecture communicated some U.S. initiatives and focused on some critical research currently funded by the U.S. Department of Energy Office (DOE) of the Biomass Program at Oak Ridge National Laboratory," said Dale Ensor, director of the TTU Environmental Sciences Ph.D. program.

Downing spoke on developing an understanding of resource analyses, engineering logistics modeling, environmental effects on sustainability research, international resource and ethanol potential studies, and the function of the Sun Grant Regional Feedstock Partnerships. In addition, information was presented on the DOE Integrated Biorefinery Projects, as well as the process of complying with the Energy Independence and Security Act (EISA 2007) and the National Environmental Policy Act (NEPA).

"This lecture communicated some U.S. initiatives and focused on some critical research currently funded by the U.S. Department of Energy Office of the Biomass Program at Oak Ridge National Laboratory."

— Dale Ensor, director of the TTU Environmental Sciences Ph.D. program

Government Industry Meetings and is a member of SAE International. He is a technical advisor to the 3 Clean Cities Coalitions in Tennessee and has an undergraduate career in horticulture, botany and forestry, with an M.S. and Ph.D. in Agricultural Economics.



John Mark Downing

Downing has worked with the ORNL Bioenergy Program for 17 years in a number of different science areas. Currently, the program is focused on providing the DOE Office of the Biomass Program with information in a number of different fields from economics and engineering to data management and GIS assessment.

Downing also serves as the DOE/ORNL representative for the Society of Automotive Engineers (SAE)

Surface Water Ocean Topography Mission Could Help Predict Climate Change Effects (cont.)



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Hossain says he expects the space mission to generate frequent estimates on river flow and lake water levels by 2015. Those estimates would then be made available to all nations, particularly developing ones.

"I think it's important to help developing countries adapt to climate change because the residents of those countries are the people who will feel its impact most directly. This technology has the potential to provide much assistance," Hossain says.

"TTU, in collaboration with the Ohio State University, has already demonstrated that the SWOT satellite technology for flow estimation of the Brahmaputra River in Bangladesh is very promising," he continues.

Without actual test results, it is usually difficult to get an agency interested in leveraging a planned mission, says Hossain.

Flow and storage are important parameters not only for forecasting but also for the management of water and ecology.

"Adequate flow prevents saline ocean water from entering the upstream land regions and helps to maintain healthy ecological and agricultural systems," Hossain says. "However, worldwide, flow and storage data are hard to get on a routine basis."

That's because the same river basin is often the source of water for different countries, but it's sometimes difficult — for various reasons — for neighboring countries to coordinate information that would be beneficial to everyone, he continues.

SWOT would collect and coordinate all of this elusive flow and storage information, leaving it up to each country only to access and implement the findings.

In Bangladesh, where the symposium was held, fresh water is provided by the Ganges and Brahmaputra rivers, both snow-fed from the Himalayan Mountains. As global warming causes more of that snow to melt and glaciers to recede, however, more fresh water will be emptied into the ocean as the sea levels are projected to rise.

"A sixth of humanity depends on these rivers for water for drinking and agricultural purposes, so global warming would reduce

the amount of surface water available in these areas," Hossain says.

Experts also estimate that a one-meter rise in sea level would submerge a fifth of low-lying country like Bangladesh, including much of its agricultural land, and displace an estimated 25 million people.

"Bangladesh already happens to be a poster child for climate change," Hossain says. "Salinity intrusion from the projected rise in sea level would decimate much of the country's cropland because plants won't grow in soil that has been flooded by salt water. There's been a lot of talk [about the issue] over the years.

"Fortunately, the president of Bangladesh is also a soil scientist, so he understands how important these issues are, not just for his country but globally," he continues.

"I felt privileged to represent TTU at such a high-profile international symposium, and I hope that, because of my demonstration of collaborative work with Ohio State's Doug Alsdorf, I'm helping to make this mission meaningful to the countries that need it most," Hossain continues.

The next step, he says, is to put the academic knowledge into application.

The Center is currently in a five-year cooperative agreement with Bangladesh's Institute of Water Modeling.

This agreement allows water specialists from Bangladesh to study at TTU for a joint master's degree in civil engineering while simultaneously learning about water-related issues and gaining state-of-the-art knowledge they can directly implement in their careers operationally in Bangladesh.

"Water is essential for life everywhere, so this is not only an opportunity for us to help a developing country through projected climate changes. It's also an opportunity for us to gain international recognition from our expertise in water-related issues," Hossain says.

Researchers Look for Cost-Effective Ways of Removing Phosphorus from Effluent Waters

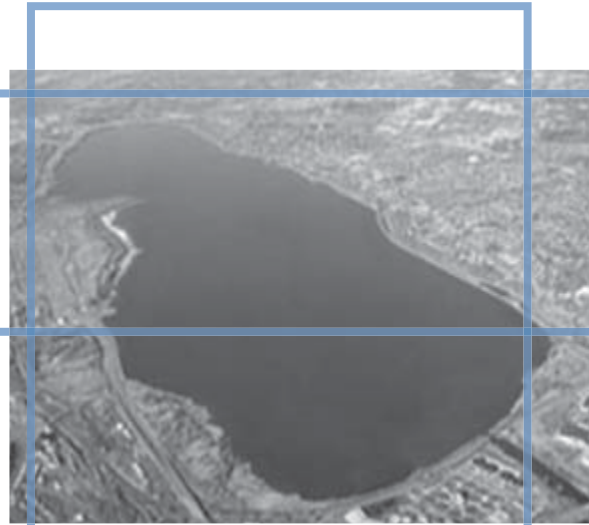
Eutrophication of fresh waters is a major issue of concern in water quality, and the primary cause is excessive nutrient loading. Detrimental effects from eutrophication include increased biotic activity, harmful cyanotoxins released by algae, dissolved oxygen depletion, fish kills, and loss of aesthetic appeal. Stringent effluent phosphorus discharge limits vary from state to state.

In this project, titled "Cost-Effective Phosphorus Removal Using Scoria and Greensand Media," researchers including former graduate student Yamini Sadasivam and Center director and environmental engineering professor Dennis George looked at suitable substrates that could be used in phosphorus removal from water systems.

The objectives of the project were to characterize the suitable filter media, conduct laboratory batch tests under varying oxygen reduction potential (ORP), evaluate the influence of pH and influent phosphorus masses on the removal efficiency, determine the hydraulic conductivity of the substrate, and perform column studies.

"This work will help lower maintenance operational costs in decentralized wastewater operations," George said.

To date, physico-chemical and biological processes, and a combination of both have been used as common mechanisms in phosphorus removal. The factors that have affected phosphorus



removal include the characteristics of the substrates used, including the chemical composition, effective particle size, porosity and hydraulic conductivity, cation exchange capacity (CEC), and organic matter, and the characteristics of the influent wastewater.



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