



Research Programs - I

A Message from the Chair - K. Ramesh Reddy

The Soil and Water Sciences Department's (SWSD) current research addresses critical soil, water, and environmental issues related to sustainable production (food, fiber, and fuel), water quality, water conservation, soil quality, carbon sequestration, greenhouse gas emissions, and public health. Successful research programs require faculty creativity, innovation, and flexibility to capture unexpected opportunities and to address current needs and future challenges. Our programs are adaptive in nature, and will continuously change to ensure that the department's vision, core values, and goals remain relevant to meet the changing needs of our clientele.

The SWSD faculty are actively involved in addressing various emerging issues including: (1) developing best management practices to protect water quality and maintain sustainable crop productivity; (2) remediating contaminated soils, aquifers and waters; (3) addressing urban issues including water-borne pathogens and emerging contaminants; (4) evaluating the capacity of stormwater treatment systems to retain contaminants; (5) determining carbon sequestration under various land-use activities, and (6) protecting and restoring natural systems such as springs, wetlands, lakes, and other aquatic systems.

The statewide network of SWSD faculty are currently involved in several aspects of soil, water, and environmental issues and are working closely with other disciplines and state agencies, through teaching, research, and extension programs. To address these complex inter-related issues, the SWSD research programs are developed in an interdisciplinary format by maintaining disciplinary strength. The SWSD faculty actively collaborate with researchers in other UF departments and other universities and state and federal agencies, by offering complementary programs. In this and the next newsletter we present a few examples of current research activities of the SWSD faculty.

Department Name Change

For the past several years our department has been very active in conducting teaching, research, and extension programs in soil and water sciences. To reflect our current activities and our long-term goals, our name is officially changed to:

Soil and Water Sciences Department

Land Application of Biochar and Phosphorus Retention: “An Inconvenient Truth”

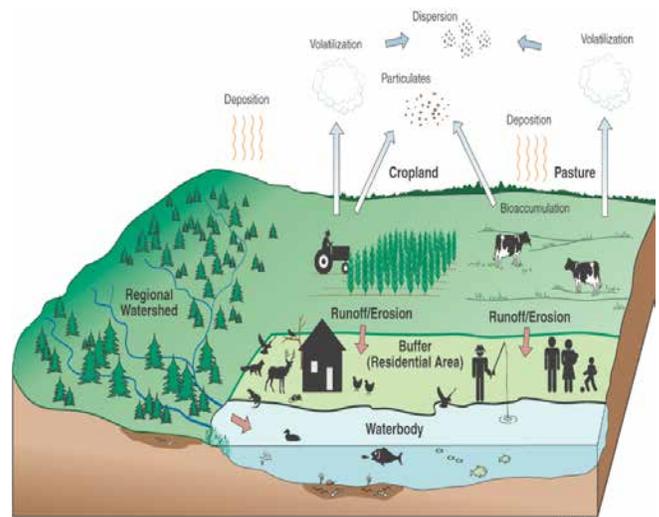
The paradox of biochar with high cation exchange capacity and at its ability to adsorb phosphorus (P) at the same time has puzzled scientists. Our research has shown that: i) biochars can constitute a P source when applied to minimally P-impacted sandy soils, and ii) biochar-enhanced P retention at elevated solution concentrations may be reversible as P concentrations revert to background levels. X-ray diffraction analysis did not identify any newly formed crystalline phase in heavily P-impacted hardwood or poultry litter biochar of our studies, though the latter contained a P mineral in its initial state. Both biochar samples prior to P additions had higher equilibrium P concentrations than the soils. Soil rather than biochar properties dictate environmentally sound P loading rates; the soil P storage capacity (SPSC) could be used as a tool to evaluate “safe” biochar applications at a given site. For additional information, contact Vimala Nair at: vdn@ufl.edu



Graduate student, Andressa Freitas, working on biochar from different feedstocks

Assessment of the Risk of Trace Organics in Land Applied Biosolids

Assessment of the risk of trace organics in land applied biosolids to human and environmental health is hampered by incomplete compound fate and transport data. Previous work generated data for the two most common trace organics (triclosan and triclocarban), but many others remain under-studied. The United States Environmental Protection Agency (USEPA) has identified three additional compounds as high priority targets for study, ciprofloxacin, azithromycin, and polybrominated diphenylethers. Our research program is focused on determining the parameters needed to describe pathways of compound fate and transport and to promote scientifically-based risk assessment. Data is currently being generated in laboratory, greenhouse, and field studies. For additional information, contact George O'Connor at: gao@ufl.edu.



T. L. Jones-Lepp/EPA

Welcome New Students Summer 2016

PhD

Yanyan Lu (Silveira)
Hanh Thi Nguyen (Teplitski)

MS

Kevin Berling (Li)
Daniel Fahr (Reddy)
Cassie Henegar (Wright)

BS - SWS (Advisor - Bonczek)

Sean Coughlin

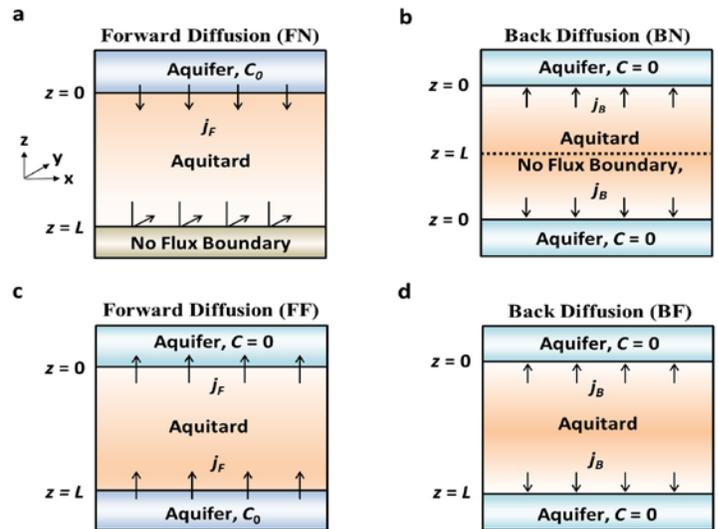
BS - IS-EMANR (Advisor - Curry)

Gilmer Bautista
Christopher Currie
Chelsey Hughes
Rosalie Morrissey
Sarah Redmond
Tyler Tornese

Contaminant Fate and Transport in Aquifers

The exchange of solutes between aquifers and lower-permeability layers is of considerable interest for solute and contaminant fate and transport. We developed novel analytical solutions for solute diffusion between aquifers and aquitards, validated in well-controlled experiments, and applied to data from laboratory and field-scale problems with diffusion time and length scales ranging from 10^{-2} - 10^8 years and 10^{-2} - 10^2 m.

Thin aquitards a few centimeters thick affect local processes such as point releases of solutes; intermediate-scale aquitards a few meters thick can strongly influence transport of solutes applied across catchment-scale areas; aquitard formations hundreds of meters thick can control solute fluxes and mass discharge in major, regional-scale aquifers. Our relatively simple models enable transferability to all these systems with physical dimensions that span 10 orders of magnitude. For additional information, contact Jim Jawitz at: jawitz@ufl.edu.



Myakka (pronounced ‘my-yak-ah’ – Seminole word for “big waters”) gives a special identity to our department, as it is also the name of Florida’s State Soil, Myakka fine sand. The State of Florida has the largest total acreage of Myakka fine sand (sandy, siliceous, hyperthermic Aeric Alaquod) on flatwood landscapes.

Biogeochemical Modeling of Nitrogen in Watersheds

Waterways in forests worldwide carry varying levels of nitrogen. High nitrogen concentration can oftentimes be ascribed to pollution. Yet in healthy forests often very little nitrogen is carried away from soils into streams. Using modeling tools, we found that high root densities in soils are responsible for reducing soil nitrogen concentration dramatically.

When evaluating our new model, we found a remarkable correspondence between our prediction and observed nitrogen export in streams. The outcome of this modeling effort is a surprisingly simple mathematical expression of plant nutrient acquisition that can ultimately help determine what constitutes healthy nutrient levels in waters. For additional information, contact Stefan Gerber at: sgerber@ufl.edu.



Waterways (here a stream in a tropical forest in Costa Rica) carry nutrients from upland ecosystems. The work in the Gerber Biogeochemistry Modeling Laboratory aims to understand how levels of nutrient concentration in stream water links to nutrient cycling in soils. Photo Credit: Jack Brookshire.

Current and former students, faculty, staff and departmental affiliates: Join the department’s new LinkedIn group, “University of Florida Soil and Water Sciences Department,” to network with and learn from fellow alumni and students: <https://www.linkedin.com/grp/home?gid=8390114>.



Microbes at Work in Wetland Ecosystems

Methylmercury is of great concern in Florida because of its potential accumulation in wildlife and high levels of toxicity. Dr. Hee-Sung Bae and colleagues from DB Environmental, Inc., found that a group of sulfate reducing bacteria (syntrophs) that cooperate with methanogens are the dominant mercury methylators in Everglades' soils, and that methanogens may be responsible for much of the demethylation of methylmercury in those soils.

Elise Morrison and Laibin Huang are studying the factors that control community assemblies along two different environmental gradients that are sensitive to projected climate change. Elise found that a core of microbial groups is constant across a phosphorus gradient in a Panamanian swamp, and that this core is dominated by a group that was selected by the acidic conditions and low available nutrient concentrations. Laibin's study sites vary greatly with respect to salinity as he moves from cenotes

to a lagoon in Mexico, with no apparent core group. Sulfur metabolism and O₂ availability structures the communities. For additional information, contact Andy Ogram at: aogram@ufl.edu.



Graduate students Laibin Huang (left) in the Yucatan Peninsula and Elise Morrison (right) in the Panamanian Swamp

Therapeutic Technologies to Improve Citrus Tree Health



A major part of my research and extension program is directed at improving citrus production in Florida, particularly the Indian River region. My goals are to improve orange and grapefruit production through better nutrient management and identification and application of therapeutic technologies that improve tree health and allow trees to more effectively resist damaging diseases.

The proper use of nutrients, with respect to soil and foliar application methods, allows for optimization of citrus grove production and health.

Micronutrient management is increasingly critical for citrus to meet grove demands, and is an important aspect of current research efforts. Various therapeutic treatments are being evaluated to determine efficacy in combating HLB-related grove decline symptoms, and these include various soil amendments such as composts, humic acids, and soluble organic materials, anti-microbial products, fertilizers, and micronutrients. The combination of differing mode-of-action treatments may hold promise to help citrus trees combat HLB.

Grower education is achieved through demonstration projects, direct interaction, and numerous seminars and field days, and adoption of new nutrient management strategies and use of therapeutic treatments through time should enhance citrus production. For additional information, contact Alan Wright at: alwr@ufl.edu.

Save the Date: September 15, 2016
17th Annual Soil and Water Sciences Research Forum

For additional information, contact James Jawitz at: jawitz@ufl.edu.



Soil Management for Rice and Vegetable Production in the Everglades Agricultural Area

Sustainable agriculture depends on soil sustainability, water quality and optimization, and nutrient management. Organic soil loss due to oxidation is a concern in the Everglades Agricultural Area (EAA) of Florida; hence, cultivation on sandy soils is increasing to gradually alleviate production from organic soils. Growing flooded rice has proven effective in reducing oxidation and minimizing nutrient loss during wet summer months.

The application of biochar and organic amendments on sandy soils has shown to improve soil health and boost yields by increasing organic carbon, cation exchange capacity, water holding capacity, and nutrient cycling. Bhadha's research program focuses on integrating these practices in the EAA to provide growers with recommendations that will allow them to continue farming for future generations. For additional information, contact Jehangir Bhadha at: jango@ufl.edu.



Grassland Management Strategies in Southwest Florida

Grassland management strategies that can enhance soil carbon (C) sequestration and preserve soil resources in the long-term are essential for ecological balance, anthropogenic C mitigation, and ecosystem sustainability while optimizing land productivity. Maria Silveira's group evaluated the long-term impacts of grassland management intensification on soil C responses. Data indicated that introduction of more productive plant species such as conversion of native vegetation into C4 perennial grasses and adoption of proper grazing and

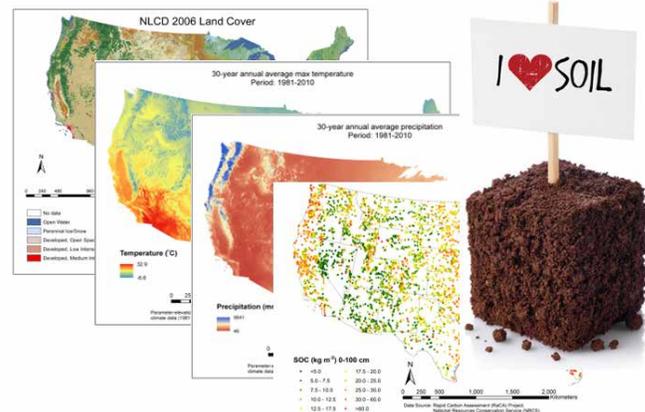
fertilization management strategies can be beneficial for enhancing C sequestration in terrestrial ecosystems. Major differences in the stability and allocation of soil C among the grassland management systems were also observed. These findings are important to inform and support management decisions and policies that can promote long-term sustainability of subtropical grassland biomes. For additional information contact Maria Silveira at: mlas@ufl.edu.



Native rangelands (left) – silvopasture (center) – cultivated pasture (right).

Soil Carbon Assessment Across the United States

Soils may act as a source or sink for atmospheric CO₂, but the uncertainty related to accurate assessment of the spatial variation of soil carbon in the U.S. is still very high. To fill this research gap we assessed soil organic carbon stocks across the U.S. A gridded soil carbon model was produced using soil organic carbon observations, remote sensing and GIS datasets. We found that soil organic carbon is controlled by a mix of soil, geologic, climatic and hydrologic/moisture environmental covariates and to a lesser extent by biotic and topographic variables. We identified seven distinct decadal periods of significant soil organic carbon change, although no significant long-term trends (1920 to 2011) in soil organic carbon gains/losses were found in the U.S. Our investigation revealed links between socio-economic factors (such as periods of economic downturns/recessions, agricultural intensification, increased conservation management, environmental legislation) and changes in soil organic carbon. The increased recognition of the importance of



soil health and soil security have the potential to shift us from a neutral soil carbon budget towards soil-carbon rich ecosystems that help to reduce the impacts of global climate change. For additional information, contact Sabine Grunwald at: sabgru@ufl.edu.

Congratulations Spring 2016 Graduates!

PhD

Mica Franklin (Daroub)

MS

Megan Lougee (Wright)
Rebekah Meyerholt (Ma)
Beth Robertson (Osborne)
Tracey Schafer (Osborne)
William Schmahl (Jawitz)
Nick Sexson (Ma)

MS

Lisa Shaw (Mackowiak)
Mohsen Tootoonchi (Daroub & Bhadha)

BS - IS-EMANR (Advisor - Curry)

Mohamed Gheit
Thomas Kenny
Shane Philhower
Megan Skeen

BS - SWS (Advisor - Bonczek)

Agustin Francisco - Water Science
Taylor Smith - Water Science

SWS Minor (Advisor - Bonczek)

Zachary Higginbotham
Taylor Murphy
Kenyon Watkins
Hannah Westergaard
Alexandria Woodson

Nanodelivery Systems to Enhance Use Efficiency of Nutrients



Graduate student Xiaoping Xin working in the IRREC greenhouse

Research focuses on development of novel technologies and best management practices for sustainable agriculture in the tropical and subtropical regions. Recent projects include remediation of contaminated soil and water resources, development of smart nanodelivery systems to enhance use efficiency of nutrients and pesticides, and novel technologies to convert low grade phosphate rock into slow release fertilizers. We identified calcium water treatment residue as soil amendment for remediation of copper-contaminated soils. We have made progress in the creation of nanoparticles for targeted delivery of effective components for agricultural application. For additional information, contact Zhenli He at: zhe@ufl.edu.

Anna Normand - 2016 Sea Grant Knauss Legislative Fellow

“How do wetlands store so much carbon?” “Is muck the proper term to use?” These are the thoughtful questions I was asked on Capitol Hill by none other than Florida Senator Bill Nelson. Fielding these scientific questions, I felt like I was in a qualifying exam answering questions from an external member. After, the other Senate fellows commented, “Senator Nelson sure likes soils!”

Senator Nelson is the ranking member of the Senate Committee on Commerce, Science, and Transportation, which I work under as a 2016 Sea Grant Knauss Legislative Fellow in the Oceans, Atmosphere, Fisheries, and Coast Guard Subcommittee. Our issues are everything NOAA (National Oceanic and Atmospheric Administration), including the ocean and coast, weather and satellites, and natural resources.

As a Knauss Fellow, my responsibilities are to delve into committee issues and processes; provide scientific expertise and perspective to our team; prepare memos and background documents for hearings, executive sessions, and member decisions; write appropriations letters petitioning for NOAA program funding; and meet with agency representatives, nonprofit organizations, and stakeholder groups. Through Congressional Research Service workshops, I am learning as much as possible about how Congress works so that I can be an asset to agencies and nonprofits in my future career. I have taken advantage of informative briefings for hill staffers and after hour receptions that launch networking opportunities. At one such reception, I listened to Todd Stern, the outgoing U.S. Special Envoy for Climate Change at the State Department, recount negotiating the Paris Climate Treaty, COP 21. Afterwards, I introduced myself to Jonathan Pershing, the new climate envoy, who I will follow to COP 22 in Morocco this fall as part of the Senate delegation. There I will witness international treaty strategy and implementation of the most sweeping climate agreement to date.



In the big picture, I am now aware of something that is hard to envision when immersed in academia - there are so many diverse careers for environmental Masters and Ph.D. graduates! Many times I have tried to answer the question, “What do you want to do after your Ph.D. program?” When the answer is not academia, your career goal may be hard to define. However, after exploring the insides of major (and minor) government agencies, non-profit groups, and the mysterious legislative branch as a Knauss Fellow, I am confident that my career in the science policy sphere is possible with multiple opportunities.

My hope is that more of my peers pursue experiences like the Knauss Fellowship to expand their horizons, network beyond academia, and advance their career opportunities. Successful fellowships and awards applications are about 1) building your academic and community engagement portfolio and 2) writing thoughtful, clear, and compelling personal statements. At SWSD’s 2016 Research Forum, I will present a poster outlining relevant fellowship opportunities for environmental graduate students along with tips for selection success. Amazing opportunities for environmental graduate students are out there, you just have to pursue them! For additional information, contact Anna Normand at: evangeline@ufl.edu.

Allan Bacon Joins the SWSD Faculty



Allan Bacon joined the Soil and Water Sciences Department as an Assistant Professor of Environmental Pedology. His research program is broadly aimed at answering two questions: (1) How do processes of soil formation and change control the structure and function of soil and subsoil? and (2) How do these processes interact with contemporary human activities to influence the management, ecology, and properties of Earth’s surface? He received a B.S. in Forestry (emphasis on forest soils) from Northern Arizona University in Flagstaff, Arizona, and a Ph.D. from Duke University in Durham, North Carolina for his dissertation titled “Pedogenesis and Anthropogenesis on the Southern Piedmont”. Allan joined us from the School of Forest Resources and Conservation at the University of Florida where he was a Postdoctoral Research Associate for the Pine Integrated Network: Education, Mitigation, and Adaptation Project. Allan, his wife Jessica, and their children Silas and Piper are excited to deepen their roots in Gainesville. For additional information, contact Allan Bacon at: allan.bacon@ufl.edu.

Sarah Strauss Joins the SWSD Faculty

Sarah Strauss joined the Soil and Water Sciences Department as an Assistant Professor of Soil Microbiology at the Southwest Florida Research and Education Center. She received a B.A. from Washington University in St. Louis and a Ph.D. from Arizona State University. For her dissertation research on biogeochemical cycling in extreme environments, she spent time collecting samples in Antarctica and the deserts of the Southwest US. Strauss served two postdoctoral assignments, one with the USDA-ARS Tree Fruit Research Laboratory in Wenatchee, WA, and the other with the USDA-ARS Crops Pathology & Genetics Research Unit in Davis, CA. While in Wenatchee, she examined the interactions of the soil microbial community on fertilizer efficiency and plant health in apple rootstocks. In Davis, CA, she focused on developing fumigant-alternative strategies based on alterations of the soil microbial community to manage crown gall disease in walnut rootstocks. Her research priorities at SWFREC are the interactions between plants and the soil microbial community, and developing methods to utilize these interactions to improve crop health and productivity. For additional information, contact Sarah Strauss at: strauss@ufl.edu.



Congratulations to faculty and students for their outstanding achievements:

K. Ramesh Reddy is the recipient of the 2016 National Wetlands Science Research Award by the Environmental Law Institute. Additional information is available at: <http://elinwa.org/2016-national-wetlands-awards-winners>.

K. Ramesh Reddy is the recipient of the 2016 Lifetime Achievement Award by the Society of Wetland Scientists (SWS). He was officially recognized at the SWS Annual Meetings during May 31-June 3, 2016, Corpus Christi, Texas. Additional information is available at: <http://www.sws.org/Awards-and-Grants/society-awards.html>.

The University of Florida Research Foundation has named **Chris Wilson** as a UFRF Professor for 2016-2019.

Todd Osborne was a recipient of the 2016 Early Career Seed Funding Proposal Award. He was also a recipient of the 2016 Climate Change Seed Funding Proposal Award.

The UF Mindfulness Team, led by **Sabine Grunwald**, was awarded a 2016 UF Champions for Change Award (UF Office of Sustainability and the Healthy Gators Coalition). Information about the UF Mindfulness Program is available at: <http://mindfulness.ufl.edu>.

Ann Wilkie was awarded a 2016 Champions for Change award by the UF Office of Sustainability for her work with students in Bioenergy and Sustainable Technology.

George Snyder, Emeritus Professor at the Everglades REC, is the recipient of this year's Florida State Horticultural Society (FSHS) President's Industry Award. The award will be presented at the FSHS annual meeting on June 12-14, 2016, Hutchinson Island Marriott Beach, Stuart, Florida.

Susan Curry, Barbra Larson and Dave DePatie received an Online Education Excellence Award for the development of SW54720C GIS in Soil and Water Sciences.

Fall 2015 Undergraduate Academic Achievements

President's List - **Katie Galluscio** (Bonczek)

Dean's List - **Sara Baker, Katie Galluscio, Jennifer Sarchapone and Taylor Smith** (Bonczek)

