Potential use of Japanese Sweetflag for Remediation of Contaminated Surface Water

Noha Abdel-Mottaleb and P. Chris Wilson

Acetaminophen is often found in high concentrations in wastewater treatment effluent and surface waters contaminated with wastewater and reclaimed water. Conventional remediation techniques are often impractical for non-point sources and for compounds without water quality regulations. One possible remediation technique under evaluation is the use of floating islands of ornamental wetland plants.

A mass balance study was conducted to characterize the uptake of 14C-labelled acetaminophen by the ornamental wetland plant, *Acorus gramenius* (Japanese sweetflag). Over a 14 day exposure period, 100 % of the compound present in the growing solution, was taken up by the plants, with the majority occurring in the roots. Preliminary results suggest that *A. gramenius* grown in floating islands may be useful for removing acetaminophen from contaminated surface water. Future research will evaluate the uptake potential for other contaminants with differing hydrophobicity to try to identify optimal properties for uptake.

Cadmium Monitoring in Cacao Farms of Southern Ecuador: Soil Contamination and Potential Remediation

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Excessive cadmium (Cd) content was reported in cacao (*Theobroma cacao* L.) beans from southern Ecuador, which is key ingredient of fine-dark chocolates. Information regarding soil-Cd in cacao-growing areas is limited. This study investigated Cd enrichment in soils and cacao beans in southern Ecuador and evaluated soil amendments as potential remedy. Concentrations of Cd in soil and bean on representative cacao farms were monitored whereas the potential of amendments in reducing plant-available Cd was evaluated in three cacao-growing soils. According to US standards, all soil samples had Cd concentrations above critical levels for agricultural soils (> 0.43 mg kg^{-1}). Cadmium was substantially accumulated in surface layer (< 15 cm) and significantly decreased depth wise, indicating that Cd contamination to the soils might have been mainly resulted from anthropogenic activities. Bean-Cd was significantly correlated to Mehlich 3- and 0.01 M HCl-extractable Cd ($r > 0.78$, $P < 0.01$) in soils. Therefore, these methods are adequate for predicting plant-available Cd. Soil Cd fractionation analysis indicated that acid-soluble fraction was significantly correlated with both bean-Cd and extractable-Cd ($r > 0.80$, $P < 0.01$). In cacao trees, more Cd was accumulated in beans than in leaves or stems. 12 out of 19 sites registered bean-Cd content higher than European Union standards (> 0.06 mg kg^{-1}). The incorporation of vermicompost at 2% significantly reduced water-soluble and exchangeable Cd ($P < 0.01$) in three contaminated soils, likely due to raised soil pH. Vermicompost may have potential in reducing Cd uptake by cacao trees in the contaminated soils.

Development and first tests of a of a simple wetland methane model.

Carla Alonso-Contes and Stefan Gerber

One of the largest sources of methane emissions are wetlands, accounting for about 20 to 40 % of all methane emissions. We developed a simple Methane model following the approaches used in more complex global gas emission models. Initial model tests focused on soil methane oxidation, water table, and the resolution of vertical soil levels. We found that methane consumption yields similar results if formulated based on CLM4Me or LPJWhyMe, while the former had significant drawbacks with respect to the stability of the model. Secondly, the parameters that emulate water table behavior, depth of soil profile, and amount and soil layer thickness where changed one at a time to explore the model response. We found that increasing depth of the soil column increases simulated CH_4 emissions. Methane emissions increase from 1.5 mol m^{-2} yr^{-1} to yields 2.4 mol m^{-2} yr^{-1} if the total soil column depth increases from 0.39m to 10 m. The thickness of the soil layers showed to have minimal effect on methane emissions, suggesting that the model can be run efficiently using a coarse vertical resolution. A constant water table below the soil surface and seasonal inundation showed lower emissions (6 mol m^{-2} yr^{-1} , 3.5 mol m^{-2} yr^{-1}) compared to simulation where the water table perpetually located above the soil surface (13 mol m^{-2} yr^{-1}). These initial results help us to determine model configurations, as well as understanding the factors that most strongly affect modeled methane emissions.

THE EFFECT OF SHORT TERM INUNDATION ON POTENTIAL NITROGEN FLUX IN A COASTAL ECOSYSTEM

Rose Collins, Rao Mylavarapu, Mark Clark, and Todd Osborne

ABSTRACT

Excess nitrogen loads are considered one of the greatest threats to the integrity of coastal ecosystems but a variety of influencing factors make the amount and rate of N input to the coast difficult to determine. Explored in this study is the effect of short term inundation on potential N flux in a coastal ecosystem. Four coastal locations were chosen in St. John's County, Florida and consisted of a submerged, marsh, upland and residential ecosystem. Three soil cores were collected from each of the four coastal ecosystems and were saturated and then inundated with a 10cm head of floodwater. Floodwater samples were then collected after 0, 6, 12, 24, 72, 120 and 168 hours and underwent analysis for TKN, NH_4-N and NOx-N to determine the Total Nitrogen concentration and flux across the study period. After a one day inundation period there was no statistical difference in the total N concentration or flux in the floodwater among the four sites. After a seven day inundation period, the residential and upland TN concentrations were significantly higher than the marsh and submerged, and the TN flux from the residential ecosystem was significantly higher than the marsh ecosystem. These results show that a short term flooding event will have similar effects on N flux regardless of ecosystem, but a longer duration of inundation could lead to a significantly greater N flux from the residential ecosystem. This could possibly pose a threat as future predictions in sea level rise leave inland communities vulnerable to increased flooding events, causing excess N concentrations in the floodwater to be transported to the coast.

Nitrate loading and source identification across dominant land uses in the Silver Springs springshed

Amanda Desormeaux, Dr. Marc G. Kramer, Dr. James W. Jawitz, Dr. Patrick Inglett, and Dr. Michael D. Annable

Abstract: Increased nitrate concentrations have been identified as a threat to primary producer communities in many of Florida's springs and these rising concentrations have been attributed to anthropogenic nitrogen loading to the aquifer. The Silver Springs springshed contains a variety of land uses, each with a range of management intensities. In-situ measurement of nitrate flux below the root zone allows for quantification of nitrate attenuation and groundwater loading across dominant land uses. Ion-exchange resin columns (IERCs) offer many advantages for measuring seasonal nitrate flux and can potentially be used to quantify water flux. Nitrate adsorbed to the resin can also be analyzed for $\delta^{15}N/\delta^{18}O$ to identify manure and fertilizer isotopic signatures early in the leaching process, which could help to elucidate nitrate source identification in the groundwater. By instrumenting sites representing dominant land uses across a range of management intensities, direct measurements of nitrate loading can aid in the identification of priority management areas within the springshed. This work proposes to deploy IERCs in dominant land uses within the Silver Springs springshed to measure nitrate flux and the isotopic signatures of nitrate.

Catching nitrate at the source?: Potential for soil and vadose zone denitrification in the Silver Springs springshed

Katelyn Foster

Over the past 100 years, nitrate levels have been rising steadily in outflows of Silver Springs. Denitrification is an important component in determining nitrate fate in watersheds and thus the remediation of nitrate levels in this particular springshed. The purpose of this study was to look at the denitrification pathway in soil, and test the potential for denitrification to occur at depth in the subsurface and karst aquifer layers. Soil samples were collected from 12 wells drilled throughout the Ocala, FL area (the dominant portion of the Silver Spring springshed), and at select depths a denitrification enzyme (DEA) was determined including with/without additions of glucose to test potential carbon limitation. For all 12 sites denitrification was highest in the top meter of soil, and decreased with depth. In most sites, C is not limiting denitrification in the surface soils. In contrast, Deeper in the soil (0.6-1.2 meters) carbon was generally limiting, except in cases of buried marine horizons with high levels of organic matter. This indicates with a carbon source present beyond what exists in the soil, denitrification rates could occur at higher rates, leading to more nitrate removal. Based on measured DEA, total organic carbon and extractable nitrate a regression equation for denitrification in these soils was developed. Current work will expand this study to assess factors such as nitrogen source (fertilizer for both turf and crop, cattle manure, horse manure, septic, and applied treated wastewater), soil moisture, and temperature to develop a predictive model for soil denitrification based on land use in the Silver Springs springshed.

Anthropogenic Factors that Influence Soil Management: Ethnopedology and Ethnopedozoology

Claire Friedrichsen, Samira Daroub and Ann C. Wilkie
Soil and Water Science Department

Ethnopedology is the study of a local population's knowledge and management of their soil. Ethnopedozoology is the study of human interactions with soil biota. Ethnopedology and Ethnopedozoology were developed to answer questions related to human-centered design including social, cultural, political and economic factors that influence soil management. These disciplines have also shown that local and scientific knowledge can be combined to find solutions for soil-related problems. Transdisciplinary research encounters many problems including the creation of new methods to answer research questions and how to communicate their findings. Currently, local knowledge is collected using qualitative methods and scientific knowledge through quantitative methods. Different methods have been used to integrate these two knowledge bases including GIS and participatory research but both methods have encountered challenges. The scope of ethnopedology research needs to be expanded to include the effect of local soil knowledge and beliefs on soil management. Ethnopedology also needs to include an examination of how green-revolution technologies affect the dynamic of local soil knowledge, beliefs and management. Ethnopedozoology is a new discipline, whose scope so far has only looked at macro fauna. An extension of the scope of ethnopedozoology to also include beneficial microorganisms would allow the scientific community to better understand how to communicate and facilitate adoptions of probiotics and composting. This would also create the opportunity for the scientific community to learn about a possible local management practice, which would promote soil biodiversity.

Cellulosic Ethanol Stillage as a Cultivation Medium for *Spirulina*

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Algae are high-yielding plants and a potential alternative to conventional fossil fuels that can alleviate the greenhouse effect while simultaneously treating wastewater. Cultivating algae requires high nitrogen inputs to sustain growth and produce feedstock biomass, providing a possible bioremediation option for high-ammonia wastewaters such as stillage from cellulosic ethanol production. Cultivating algae on stillage can help to offset the energy consumed in the pretreatment and distillation operations of bioethanol production as it combines nutrient removal and algal production for potential use as a biofuel feedstock. Thus, this creates a sustainable, closed-loop process. The objective of this study was to determine the growth and remediation potential of *Spirulina*, a filamentous, blue-green algae with high biomass productivity, on sugarcane bagasse stillage. Cultures were prepared with 10% inoculum in 125 mL Erlenmeyer flasks (50 mL active volume). The treatment mediums consisted of 100% thin stillage (negative control), Modified *Spirulina* Medium (positive control), and 2%, 5% and 10% concentrations of thin stillage with 1% (v/v) sodium bicarbonate. The cultures were cultivated for 72 hours under 120 µmol photons/m^2/s fluorescent lighting on a 24:0 (light:dark) photoperiod. Cells were subjected to moderate mixing (120 rpm) provided by a mechanical shaker. Algal growth was monitored spectrophotometrically using absorbance at 680 nm. The data revealed that thin stillage in dilutions is promising for cultivating *Spirulina*. Compared to algal growth in Modified *Spirulina* Medium (2.31 g/L), the 2%, 5% and 10% thin stillage mediums exhibited biomass yields of 1.60, 1.96, and 1.93 g/L, respectively.

The responses of key nitrogen cycling genes to seasonal and tidal variations in a tropical estuary

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To study the effect of different seasons and tidal variations on the abundance of key nitrogen (N) cycling genes around the Yucatan Peninsula, Mexico, water samples were taken across the halocline in the groundwater system, Cenote 7 Bocas (C7B), during the dry season (April, 2014) and wet season (September, 2014). Corresponding samples were taken from an area associated with submarine groundwater discharge (Pargos Spring) during low and high tides during the wet season. Results showed that: **1)** Most key N cycling genes were enriched during the wet season in C7B and at high tides in Pargos, and significantly higher numbers of denitrification genes (*nirK* and *nirS*) were observed at high tides in Pargos, indicating that lower groundwater input to coastal regions may favor nitrate removal; **2)** Most N cycling genes were more abundant at higher pH in this area, and that nitrite reductases (*nirK*, *nirS*, *nrfA* genes) were significantly positively related to salinity in Pargos; **3)** The similarity between the lower depths of C7B and a channel leading to the Pargos spring was possibly due to the connection between Pargos and a cenote similar to C7B; and **4)** seasonal and tidal variations clearly change the distribution of N cycling genes in these freshwater and marine systems. The results have implications for the impacts of sea level rise on coastal submarine estuaries.

Struvite Recovery from Small Wastewater Treatment Plants.

John Hallas, Cheryl Mackowiak, and Ann C. Wilkie
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Municipal wastewater treatment plants (WWTPs) may be an attractive source of recoverable phosphorus (P) through precipitation of the mineral struvite ($MgNH_4PO_4 \cdot 6H_2O$). Struvite may be used as a slow-release fertilizer to supply a renewable source of P and nitrogen (N). The deliberate precipitation of struvite for P recovery has focused on large WWTPs, using digestate from the anaerobic digestion of biosolids. However, small WWTPs (< 12 MGD discharge) are typically operated through activated sludge processes and make up the majority of WWTPs, (97% in Florida and 98% nationally). Laboratory experiments with reagent-grade salts resulted in struvite product yields of approximately 71%, under ambient conditions (23 C), with equal molar (10 mmol) Mg^{2+}, NH_4^+, PO_4^{3-} concentrations that were within the range of aerobically digested sludge values. A chemical equilibria model, based upon a typical aerobically digested sludge filtrate composition was developed, using the computer program Visual MINTEQ version 3.1 to identify the ion activity product (IAP). The model demonstrated favorable conditions for struvite formation at 3 of 4 operational WWTP sites in Leon County, FL, while the fourth site required a four-fold addition of $Mg^{2+}$to promote struvite formation. The MINTEQ IAP model was used to track the molar concentration of struvite and other solid phases across a pH range of 4 to 14. Struvite precipitation was maximized at pH >10; however, the more alkaline range also resulted in competing solid phases, such as brushite ($CaHPO_4 \cdot 2H_2O$), brucite ($Mg(OH)_2$), and newberyite ($MgHPO_4$). The MINTEQ IAP model indicated that 75-90% of maximum struvite precipitation should occur at a pH range from 8.5 to 9.0, resulting in less contaminant minerals. The lower pH target also translates to less modification of the WWTP digestates, which often range from approximately 7.5-8.5 pH units. Model validation is currently being performed by testing actual WWTP filtrate samples at pH ranges from 8.0 to 9.0.

SWS Research Forum 2015 Abstract Submission

Title: Florida Wildfires during the Holocene Climatic Optimum (9,000-5,000 BP)

Fire is an important ecological driver the southeastern United States. The combination of plant species composition and fire pose the possibility of positive feedback loops in a landscape. It is uncertain how fire regimes will change with global warming in coming century. To better understand the main factors that control fire, I reconstructed Holocene fire history, using macroscopic charcoal (as a fire proxy) in sediment cores from two lakes in the Orange Creek Basin, north Florida. A 99% decline in charcoal concentration was observed at ~8,000 cal yr BP in a 3.9-m core from Newnans Lake (basal age: 8,870 cal yr BP), and at ~7,000 cal yr BP in a 5.4-m core from Lochloosa Lake (basal age: 9,280 cal yr BP). This decline in charcoal concentration is not an artifact of changes in bulk sedimentation, i.e. dilution, but instead reflects charcoal production. The hypothesis that charcoal concentration declined because of a decline in the relative abundances of *Quercus* pollen was not proven, because the regional shift from *Quercus* to *Pinus* pollen during the HCO (9,000-5,000 cal yr BP) seen in previously studied lakes was not found in the Orange Creek Basin. Instead, *Pinus* pollen abundances remain high (>50%) through the entire Holocene. Pollen counts and the diversity of arboreal pollen, however, is lower in the early Holocene deposits. Topography was found to be an important factor to determine variations in Holocene plant communities and understand why the *Quercus* to *Pinus* shift is absent in the Orange Creek Basin.

Abbreviations: BP= before present; cal yr BP= calibrated years before present; HCO=Holocene Climatic Optimum

Kalindhi Larios, Stefan Gerber, Mark Brenner

Dissolved organic nitrogen in runoff/surface water from Agricultural Fields

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University of Florida

In this study, runoff and surface water samples were collected during the period of March 2013 to December, 2014 from citrus grove furrows and waterways connecting the agricultural fields to the discharge point at the Indian River Lagoon (IRL). These samples were analyzed for dissolved organic nitrogen speciation. The concentrations of dissolved organic N (DON), dissolved free amino acid (DFAA) and dissolved combined amino acid (DCAA) in the surface water samples were in the range of 0.219-2.93, 0.025-0.174 and 0.024-0.136 mg L^{-1}, respectively, with corresponding mean values of 0.964, 0.083 and 0.075 mg L^{-1}. The concentration of DON was highest in summer, while the concentration of DFAA and DCAA was highest in September. DCAA and DFAA accounted for 12.2% and 11.4% of DON, respectively, and showed no significant relationships with DON. The dominant DFAA forms detected in the water samples were phenylalanine, isoleucine, leucine, cystine and lysine. These results suggest that most of the DON species in the surface water may not be readily available to plants.

Key word: Agriculture, organic nitrogen forms, temporal variation, storm water

Simulating Everglades carbon fluxes and GHG emission under varying hydrology parameterization in the Community Land Model

Yan Liao and Stefan Gerber

Wetlands plays an important role on carbon cycle and global climate changes. Carbon flux in wetland distinguishes from that in other types of ecosystems because of special soil and hydrological processes. This research focuses on simulating the CO_2/CH_4 fluxes as well as other aspects of the carbon cycle in the Everglades using a widely used Earth System Model, the Community Land Model (CLM). One of the big challenges is to actually “create” conditions that lead to the establishment of a wetland within CLM. In order to achieve this we modified the hydrologic conductivity in CLM’s soil layers. Further we introduced an impermeable soil layer at the bottom. We performed several simulations with CLM that address the variation of saturated conductivity in the lower soil layers to compare its impact on the carbon fluxes and GHG emission in the study area. Our analysis shows that such modifications require a very long spin-up period, in which carbon continuously accumulates. We further find, that our model changes help to establish wetland conditions that lead to increased soil water, decreased oxygen in the soil column and enhanced methane production.

Reducing labile phosphorus pools by controlling floating aquatic vegetation in drainage canal sediments

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It is hypothesized that FAV has a significant impact on the ability of agricultural canal sediment to retain and release P in the EAA. This study was initiated to investigate effects of controlling FAV, such as water lettuce (*Pistia stratiotes*), on the formation of denser inorganic sediments and recalcitrant P forms. It is hypothesized with FAV removal, more light penetrates the water column, potentially allowing co-precipitation of P with Ca-Mg into less labile minerals and reducing the accumulation of labile P in sediments. Also more oxygen is present, possibly increasing redox potential and P-sorption capacity of Fe-Al minerals into more recalcitrant forms. Phosphorus fractionation was used to measure labile and recalcitrant P pools in canal sediments at the 0-2.5 cm depth for eight EAA farms. Treatment canals implement aggressive FAV control, while control canals operate under normal management practices. The generation of denser inorganic mineral P may reduce P transport out of farm canals and reduce P loads into the downstream Everglades ecosystem. On all farms, residue and Ca-Mg-bound P pools have the highest concentrations, and labile P has the lowest. There have been no significant changes found in P pools by farm over the sampling periods so far. In addition, XRD analysis is being used to assess the spatial and temporal change in mineral composition of canal sediment. In the future, sediments exported with drainage water will be subject to P-fractionation analysis to assess P speciation exported during pumping events.

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Abbreviations
Ca-Mg- Calcium and Magnesium
EAA- Everglades Agricultural Area
FAV- Floating Aquatic Vegetation
Fe-Al- Iron and Aluminum
P- Phosphorus
XRD- X-ray Diffraction

Assessment of microbial community structure within an oligotrophic tropical peatland

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Soil microbial communities are complex networks comprised of numerous interactions that drive many biogeochemical processes. In this study, we apply a combination of bioinformatics techniques with molecular data to begin to understand the structure of these communities and how they may function within an oligotrophic tropical peatland. Our study site is San San Pond Sak of Bocas del Toro, Panama, which is characterized by well-studied phosphorus (P) gradient that has led to documented changes in plant communities and biogeochemical cycling. Our objectives for this study are to: (1) assess the microbial community structure at each site along the gradient and (2) create putative phylogenetic networks for microbial groups along the gradient. We sampled soils at sites along the gradient, from low-P to high-P sites, isolated DNA from these soils, and used 16S rRNA metagenomic techniques to assess prokaryotic community structure. We found that community composition and putative phylogenetic networks shifted along the gradient. The dominant prokaryotic phyla were consistent across the gradient, but sites differed in the composition of less abundant phyla. By studying the dynamics of microbial community structure within oligotrophic peatlands such as San San Pond Sak, we can better understand the interlinked dynamics of microbial dynamics in these unique systems.

Modeling peat growth and soil subsidence in the Everglades Agricultural Area

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Soils in peatlands form under slow decomposition conditions, which can be achieved either by low temperatures or by water saturation. As such, developed peat soils are valuable because they are rich in organic materials and store large amounts of carbon. The Florida Everglades were formed under flooded conditions approximately 5000 YBP. This hydrological regime was conducive to the formation of the type of peat soils that characterize The Everglades. The Everglades' rich organic soils that are located in what is now called the EAA were drained by the beginning of the 20th Century. This change in their water regime led to a soil subsidence problem with subsidence rates that averaged 2 cm per year. A simple model to study peat growth was adapted to the Everglades in order to identify the key parameters controlling peat growth and loss. Historical data, and analytical methods were used to estimate parameters and a code was developed. Simulations were run using R Statistical Software. Preliminary results are able to simulate the process of pre-drainage peat growth, and how the increase in depth of the water table caused by drainage induced peat loss (subsidence). Tests indicate that water table depth is a critical parameter controlling the rate of soil subsidence. Future research involves the estimation of decomposition rates using field experiments as well as the determination of carbon fractions, and mineral content of the EAA soils, factors that could modify soil subsidence rates.

Abbreviations: YBP (years before present) EAA (Everglades Agricultural Area)

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Investigating N source preference for bloom forming pico-cyanobacteria in the northern Indian River Lagoon, Florida

Joshua Papacek, Edward Phlips, Margaret Lasi & Patrick Inglett

The northern Indian River Lagoon (NIRL), a subtropical estuary in eastern Florida, is experiencing HABs at an increasing rate, including the unprecedented Superbloom of pico-cyanobacteria and *Pedinophyceae* in 2011. Such bloom events are often correlated with eutrophication, and bloom-forming species are often competitive for dissolved inorganic (DIN) and organic forms (DON) of nitrogen (N). However, in the case of the phytoplankton dominating the NIRL in 2011, it is currently unknown which N forms are preferred. In this study, isotope tracer techniques were used to identify the nutritional preferences of the pico-cyanobacteria involved in the Superbloom. Cultures of N-limited pico-cyanobacteria were amended with four different isotopically-labeled N compounds (ammonium (^{15}N-NH_4^+), nitrate (^{15}N-NO_3^-), ^{15}N-urea, and a ^{15}N-^{13}C amino acid (AA) mixture) at four different concentrations (0.1, 1, 2 & 10 µM-N). Additionally, the ability for these pico-cyanobacteria to fix atmospheric N_2 was tested using the acetylene reduction assay (ARA) technique. Results from the uptake experiment show largest ^{15}N enrichment for reduced N-compounds, with NH_4^+, AA, and urea being most preferred in that order. Cultures spiked with NO_3^- showed little enrichment, indicating that it is not a preferred source of N. Uptake for NH_4^+, urea, and NO_3^- was linear over the range of concentrations and therefore did not reach saturating conditions necessary for kinetic modeling. Slow, linear uptake of NO_3^- is possibly an effect of simple diffusion into the cell rather than active uptake for NH_4^+ and AA. Additionally, ^{13}C from the AA mixture was also incorporated into pico-cyanobacteria biomass. Lastly, ARA results show that N_2 fixation as a source of N is unlikely. Overall, results from this experiment indicate that the pico-cyanobacteria responsible for the NIRL Superbloom: 1) actively prefer dissolved, reduced N compounds, 2) are readily able to utilize DON, 3) are potentially capable of incorporating C mixotrophically, and 4) are unable to fix atmospheric N_2.

Title: Landscape denudation rates of a low relief carbonate platform

Author: Eron Raines and Todd Osborne and Matthew Cohen

Abstract:

The state of Florida is situated atop a mosaic of carbonate rock landscapes. Dissolution processes of the carbonate landscapes results in karst features such as sinkholes, springs, and the Floridan Aquifer all of which affect the lives of every Floridian every day. Of the global land surface, ~12% is composed of carbonate rock. From that 12%, ~20-25% of the world's population, 1.9 billion people, depend on karst aquifers for their daily drinking water. These aquifers are extremely susceptible to change, contamination, and collapse given strain on water tables from overuse and introduction of anthropogenic or natural contaminants that expedite dissolution processes resulting in changes of subsurface water flow characteristics or even sinkhole formations. With a significant portion of the human population dependent on and living in close proximity to carbonate rock, it is important to fully understand the mechanisms driving and dynamics of carbonate rock dissolution. This poster presents a preliminary study that is part of a larger study on dissolution processes of carbonate rock from micro- to macro-scale. Presented here are landscape-scale denudation rates in terms of calcite exported which were determined for what is designated as Big Cypress National Preserve. Rates were determined using historic surface water-flow, water-chemistry, and hydrometeorologic data collected by the USGS, NPS, and SFWMD. The denudation rates were found to be in the range of 0.26-0.46 mm/year. Using the results from this preliminary study, further investigations are being made into the mechanisms responsible at the micro- and macro-scale for dissolution of a carbonate platform.

Influence of Sediments on the Fate of Granular/Pelleted Formulations of the Aquatic Herbicide fluridone

Matt Nance, William Haller, and P. Chris Wilson

Control of invasive aquatic plants using efficacious herbicides is crucial to the maintenance of chemical, biological and ecological cycling in bodies of fresh water. Two potential factors affecting herbicide efficacy are mode of application (liquid vs. solid/granular) and sediment composition. Organic matter content of lake sediment readily adsorbs many applied herbicides, preventing their uptake by targeted plants. Coupled with direct physical contact of granular formulations with sediment, this represents a large potential sink for herbicides, sequestering them from the water column where they are effective. To test the impact of sediment carbon content on fluridone, microcosms were constructed with reformulated sediments having a range of organic matter content between <1% (playground sand) to approximately 40%. After filling microcosms with water, fluridone was added in either the liquid or granular formulation and the fate was followed over 40 days. Herbicide release to the water column was more efficient with liquid formulations, with a maximum of 90% active ingredient being recovered from the water column in liquid treatments within 30 days. In comparison, <20% of the applied fluridone was recovered from granular treatments during the same period. Organic matter content had an effect on herbicide release, though the presence of sediments of any type resulted in only a maximum 33% herbicide release into the water column for all granular applications compared with sediment-free controls. Granular, sediment-free control treatments achieved a maximum concentration of 70% that of liquid controls. Results indicate that granular formulations of fluridone may not be efficacious for controlling non-rooted weeds due to their reduced release into the water column.

Evaluation of an organic carbon trajectory over a 10 -year period on a restored spoil island in south-central Florida

Tracey Schafer, Caitlin Hicks, Rex Ellis, and Todd Osborne

Long-term monitoring of restoration projects aim to determine long-term sustainability and stability of restored systems. In coastal wetlands, one indicator of restoration of ecosystem function can be seen with organic matter (specifically carbon) accretion. SL-15, a spoil island in Fort Pierce, FL was restored in 2005, and has been monitored for return to natural condition over the last 10 years. To assess sediment carbon accretion, sediment cores were collected in a set of eight plots, located on the SL-15 mangrove island and the surrounding seagrass recruitment area. These were analyzed for organic carbon, % organic matter, and total nitrogen. The biogeochemical data collected in the previous year was compared to data collected in 2005-2007. From this information, a trajectory has been formulated on organic carbon accretion and vegetation shift from the time of original restoration activities. By comparison to control sites nearby, realistic estimates of time required to reach natural levels of carbon and vegetation community structure were calculated for 43-56 years in mangrove sites and only 3.3-4.3 years in seagrass sites. Ongoing vegetative studies suggest levels of accretion in seagrass sites are confounded by algal biomass establishment in place of seagrass vegetation.

Title: Synthesis and Characterization of Lignin-based Dendrimer Gel for application in Fertilizers' Controlled Release

Shanyu Meng, Zhaohui Tong, Fei Wang, Nusheng Chen, Yuncong Li

Abstract: There is significant interest to substitute current petroleum-based coating plastics by its biobased counterparts with biodegradability in the application for fertilizer controlled release. Lignin, the second abundant natural materials, has received less consideration than plant polysaccharides in current biomass conversion platform. It has usually been burned for low value heat sources. However, its phenylpropane units with multiple functional groups and cross-linked structure make lignin to be a good candidate for preparing bio-based strong gels. In this study, we at first modified lignin phenolic OH groups to epoxy groups and then reacted with diamine to form nanogels with a dentrimer structure. The ^{1}H-NMR and ^{13}C-NMR results show that the successful synthesis of lignin-based epoxy and the formation of the dentrimer structure. The dynamic rheology results indicate that the lignin-based dentrimer presents some gel-like behavior. We will further optimize the reaction parameters and characterize the final products including water holding capability, biodegradability, the release kinetics using both dye and fertilizer.

Decomposition in a Shifting Coastal Wetland Habitat

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Across the globe, climate change has driven modifications in the structure and distribution of many ecological communities. In parts of the southeastern United States, decreased incidence of freeze events have resulted in the poleward range expansion of mangroves at the expense of salt marsh habitat. The replacement of coastal wetland foundation species will likely have substantial functional and structural repercussions, ranging from important biota effects, to ecosystem stability, to biogeochemical processes. Understanding the long term viability of these habitats and their carbon pools depends on, in part, how litter decay responds to climatic change. We investigated aboveground decomposition along a 342 km latitudinal gradient on the Atlantic coast of Florida, spanning pure mangrove habitat, the salt marsh - mangrove ecotone, and pure salt marsh habitat. Decomposition bags filled with *Spartina alterniflora*, *Avicennia germinans* and *Borrichia frutescens* were deployed at 10 sites and collected at times 0, 3 mo, 6 mo and 9 mo. Litter mass lost (%) was significantly different between species and along the latitudinal gradient. *Avicennia germinans* lost more mass over 9 mo than did *Spartina alterniflora,* suggesting a major shift in nutrient cycling of the system as mangroves displace salt marsh. However, the rate of species decomposition will be constrained by temporal differences along the latitudinal gradient. Modification of ecosystem services depends largely on the balance between organic matter production and decay, and an alteration in foundation species distribution will likely alter decomposition and ultimately the carbon dynamics of these systems.

Title: WATER AND NITROGEN FLUXES WITHIN THE UPPER FLORIDAN AQUIFER IN THE SILVER RIVER SPRINGSHED

Authors: Antonio Yaquian, James Jawitz, Michael Annable, Jaehyun Cho, Harald Klammler

Abstract: The goal of this project is to quantify the spatial distribution of groundwater and nitrogen fluxes in the upper Floridan Aquifer System. Field measurements have been conducted for the last year throughout the Silver Springs springshed using Passive Flux Meters (PFMs). These devices enable measurement of local fluxes of 1) nitrate, through accumulation on a sportive media (ion-exchange resin) and 2) groundwater, through release of resident tracers in a borehole or monitoring well. After deployment of these devices in a groundwater flow field for exposure periods of approximately 30 to 60 days, they are recovered for extraction and analysis to quantify the mass of contaminant sorbed, and thereby determine groundwater and contaminant fluxes. The results indicate relatively homogeneous groundwater fluxes with highly heterogeneous solute fluxes. The data collected to date suggest that less than 10% of the flow is through the rock matrix, which comprises most of the aquifer volume, and that the vast majority of the flow occurs in fissures and conduits, which occupy a small fraction of the aquifer volume. The next steps are to specifically examine vertical heterogeneity of flow and transport by seeking out high-flow fissures and conduits in the aquifer. Improved understanding of the dynamics of the complex aquifer system will support predictions of aquifer response under scenarios of different aquifer management strategies.

Impact of Flooded Rice Cultivation on Water Quality in the Everglades Agricultural Area

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Phosphorus concentration is an important factor of farm drainage water in the Everglades Agricultural Areain south Florida and rice cultivation may reduce P concentration through plant uptake and particulate settling. This two-year study isconducted to assess the impacts of four water management schemes on outflow water quality, rice yield, and rice water weevil infestation.Four water level treatments: 15 cm continuous flood,15 cm continuous flood with midseason drawdown, 5 cm continuous flood, and 5 cm continuous flood with midseason drawdown, and two rice cultivars: Cheniere and Taggart, are tested in a 2.4 ha split-plot experimental design with four replications.Phosphorus (P) concentration is measured inwater samples of inflows and outflows of each experimental plot. First year results have shown the highest Pconcentration reduction (58%) in 15 cm continuous flood and lowest reduction (39%) is in 5 cm midseason drawdown, with an overall average reduction of 46%. Rice grain yield was not significantly different between treatments; average yield was 4.6 Mg ha^{-1}.Rice water weevil larval density in the 15 cm flood was significantly higher (39%) than 5 cm flood. First year results show that growing flooded rice under shallow water level appears to improve water quality and reduce rice water weevil infestation. A single midseason drawdown can potentially be used to conserve 3600 m^3 ha^{-1} of water per day without significantly decreasing rice yields and water quality.

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2015 SWSD RESEARCH FORUM – POSTER ABSTRACT

Title: Soil Salinity differences between Irridrain and Conventional Seepage Irrigation

Authors: Eunice Yarney and Mark Clark

Soil salinity tolerance threshold varies for different crops. Crops growing in conditions exceeding these thresholds exhibit nutrient deficiency symptoms, stunted growth, reduced yield and crop mortality. In soils with high salt concentrations, reducing new inputs and leaching salts from the soil is the most efficient means to keep the salinity below the crop tolerance threshold. Salinity impacts on potato and vegetable crop production in 2011 and 2012 in the Tri-County Agricultural Area of Florida resulted in a need to determine what alternative irrigation and drainage practices might be viable in this area to reduce soil salinity.

Soil salinity differences between irridrain and conventional seepage irrigation were compared over a period of two years to determine which irrigation practice promoted low soil salinity concentrations. Differences in soil salinity within the soil profile at one foot depth increment was also compared among the two irrigation practices. Soil samples were collected from six farms having both irrigation practices during the growing and non-growing seasons of the years 2013, 2014, and 2015.

Results indicate that irridrain irrigation significantly reduced the soil salinity at varying percentages at all soil depths. For the six farms, the overall average percentage soil salinity reduction for the depth 0-1ft was 46%. Soil salinity reduction at lower depths was 44%, 35% and 22% for the depth 1-2 ft, 2-3 ft and 3-4 ft, respectively. This study shows that irridrain irrigation has a significant potential to reduce soil salinity. In addition, water consumption rates were lower with irridrain irrigation thereby reducing the total input of salts to the soil.

Effect of pH and solid-liquid ratio on metal leachability in coal combustion residual

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Knowledge regarding the potential leachability of metals in coal combustion residual (CCR) is important to determine its reusability. Representative CCR samples from five Florida coal-fired power plants were collected. The objectives were to: (1) measure the metal leachability under different pH conditions using LEAF Method 1313 (pHs 2, 4, 5.5, 7, 8, 9, 10.5, 12, and 13); (2) evaluate how the liquid-solid ratio affected metal leaching using LEAF Method 1316 (0.5, 1, 2, 5 and 10); and 3) compare the results to those obtained by synthetic precipitation leaching procedure (SPLP).

Sample preparation and analysis followed the protocols of SPLP and LEAF Methods 1313 and 1316. The data showed that CCR samples were either in low or high pH categories. As and Cr showed amphoteric behavior presenting higher concentrations at very low and high pH using LEAF Method 1313. However, Cd leaching decreased in pH > 7 and its highest leaching was observed in pH 2 and 4. For LEAF Method 1316, with increasing LS ratio, metal concentration decreased in most samples. The SPLP results were variable when compared to LEAF data. Metal leaching was low in soil pH range of 4 to 8, which is typical for soils in Florida. Due to the potential leachability of trace metals into soil and groundwater, caution should be exercised during its beneficial use.