

**Annual Report
2007-2008
Center for Science and Policy Applications for Coastal Environments (C-SPACE)**

Part I - Web Summary (Executive Report)

Period Covered by the Report: 9/1/2007 - 8/31/08

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Title: Center for Science and Policy Applications for Coastal Environments

Investigators: Christopher F. D'Elia, Ph.D. and James A. Gore, Ph.D.

Institution: University of South Florida St. Petersburg

Research Category: 2004-STAR; **RFA:** Targeted Research Center (2004)

Project Period: 9/1/2005 – 8/31/2009

Description:

Objective(s) of the Research Project: This funding supports an interdisciplinary center for the study, protection and amelioration of the coastal environment. The center aims to enhance understanding of ways that human activity in rapidly developing coastal areas affects ecological systems and of human institutions and practices for managing such effects. The center focuses primarily on subjects and issues relating to the use and protection of natural waters in the coastal zone of Florida. The main thrusts of the project concern: (1) the use, supply and quality of freshwater; (2) the fate, effects, assessment and remediation of water-borne pollutants; (3) water quality and quantity driven changes in inland and coastal ecosystems; and (4) management and policy of coastal freshwater and marine ecosystems.

Summary of Progress: C-SPACE began with ten individual projects within four component core areas were supported by the initial EPA award (referred to herein as “Phase I” projects) for the initial year of the Center’s operation. These projects were originally planned for completion in a 2-year period (Sept. 2005 through Aug. 2007), but with the awarding of “Phase II” funding in 2006, projects were either merged into continuing funding or allowed to continue separately through the end of the grant period in Sept. 2009. Much of the initial laboratory-based work was dependent on the acquisition of new equipment (cf. project 7) and the completion of a new facility we are sharing with USGS, which was occupied in 2006. Ten individual new projects in five component core theme areas plus a management and administration project were supported by the second C-SPACE award in 2006. The research in these projects is also nearly completed. Both C-SPACE 2004- and 2006-funded projects are summarized below. Findings to date are summarized below by funding phase on a project-by-project basis.

C-SPACE “Phase I” Funding (2004 Award)

- ◆ **Project 1: Past and Present Water Quality in Florida Coastal Waters.** *Joseph M. Smoak, Melanie Riedinger-Whitmore and Matthew N. Waters (UNC-Chapel Hill).* We have been working to identify the pigment Gyroxanthin-diester in sediment core samples from the Florida west coast. Gyroxanthin-diester is unique to Florida Red Tide (*Karenia Brevis*) and has been used to identify Red Tide in the water column. It is our goal to determine the

feasibility of using Gyroxanthin-diester in the sediments to reconstruct past occurrence of Florida Red Tide at selected bay sites. Previously we identified Gyroxanthin-diester in several cores from Sarasota Bay and Tampa Bay. The identification was based on comparison with a monoculture sample of *K. Brevis*, a *K. Brevis* standard, and comparison with published spectra of Gyroxanthin-diester in water samples. Unfortunately these cores were not suitable for dating due most likely to anthropogenic disturbances. In the past year we collected additional cores from more protect areas in Sarasota Bay. Gyroxanthin-diester was not present in these cores. We also collected samples from the Ten Thousand Islands area in which Gyroxanthin-diester was present. We are in the process of measuring Pb-210 in order to date the cores.

- ◆ Project 2: Cyanobacteria Proliferation and Eutrophication in Florida Lakes. *Melanie Riedinger-Whitmore and Thomas J. Whitmore.* Cyanobacterial algal blooms are common in many eutrophic lakes in Florida. Although cyanobacteria have had considerable impact on freshwater quality within the state since the mid 1900s, the timing and causes of their appearance have remained unknown because water-quality monitoring began in Florida only after 1980. This project's researchers proposed to recover sediment cores from six eutrophic central Florida lakes and to analyze sedimented algal pigments to document the onset of cyanobacterial presence. Their goals were to track the appearance and persistence of cyanobacteria, and using existing paleolimnological data on historical water quality from these sites, to examine the relationship between cyanobacterial proliferation and eutrophication. Their objective also was to determine the water-quality conditions that promote cyanobacterial persistence and lead to a shift to cyanobacterial dominance. Sediment cores representing ~ 100 yrs of deposition were recovered from Lakes Harris, Newnans, Yale, Little Jackson, Weir, and Lulu for this project during the first phase of this project. Sediment cores from an additional lake, Little Bonnet, were recovered during the project's second phase. Field assistance was provided by personnel from the Land Use and Environmental Change Institute at the University of Florida. Sedimented pigment profiles indicated that cyanobacteria were present throughout the records of all seven lakes. The cyanobacterial pigments oscillaxanthin and myxoxanthophyll were historically low in sediments from three study sites, Lakes Weir, Little Jackson, and Newnans, but cyanobacterial pigment concentrations increased in recent sediment deposits. Cyanobacterial pigment profiles from three lakes, Lakes Harris, Yale, and Little Bonnet, showed several historic peaks in cyanobacteria, suggesting that cyanobacterial populations frequently fluctuate in these systems. Only one lake, Lake Lulu, demonstrated decreases in cyanobacterial proliferation in recent sediments. Highest cyanobacterial concentrations were found near the base of the sediment record in this lake. Peaks in cyanobacterial pigment concentrations were compared with existing paleolimnological data for inferred total phosphorus and trophic state index (TSI) values for six of the study lakes, to examine the relationship between water quality and cyanobacterial proliferation. Cyanobacterial population increases in most study lakes occurred when inferred TSI ranged from 51-67, and TP values ranged from 44-70 $\mu\text{g/L}$. These ranges are consistent with paleolimnological data for cyanobacterial proliferation in 14 other central Florida lakes and suggest that predictable threshold levels for shifts to cyanobacterial dominance exist. These values might serve as reference points for predicting and/or managing cyanobacterial dominance. The lake histories examined in this project represent 4 central Florida lake regions (75-08, 75-14, 75-

31, and 75-33). There is some evidence of regional differences in threshold values. For example, Lake Weir and Little Lake Jackson both experienced cyanobacterial increases at TSI or TP values that were considerably lower than the other lakes examined in this study. These lakes are in regions with deeply weathered and nutrient-poor watershed soils, and might be more vulnerable to cyanobacterial establishment at lower threshold levels. In the next phase of this project, the researchers will infer TSI and total phosphorus values from sedimented diatoms from Little Bonnet and compare them with the cyanobacterial record. They will continue to define regional patterns in threshold response to cyanobacterial dominance, and will be exploring the influence of invasive aquatic plants, and aquatic plant community shifts, on changes in algal community structure and cyanobacterial dominance in a new suite of study lakes.

- ◆ Project 3: Reactive Metal Particle Emulsions for Removal of PCBs. *Kathleen Carvalho-Knighton, PI, Cherie Geiger, Christian Clausen.* PCB's, along with PAH's and organochlorine pesticides are contaminants in the Tampa Bay area that have been monitored since 1993. Four locations in the Tampa Bay have been significantly studied including the lower Hillsborough River, the Palm River, the Alafia River, and the Little Manatee River. PCB's have been detected in extremely high concentrations in the Palm River, moderate to high concentrations in the Hillsborough River and low to moderate concentrations in portions of upper Hillsborough Bay. Based on the areas already affected by PCB's additional work must be done in areas of the Ybor channel and the Seddon Channel. Storm water runoff and landfill leaching are considered to be likely sources of PCB's in the Tampa Bay area. PCB sediment contamination in Tampa Bay has led to morphological and histochemical changes in fish and increased defense mechanisms in oysters. Since the high levels of PCB's in the Tampa Bay area are of concern, there is a need for a low cost, effective remediation technique. This project seeks to develop the necessary technique for in situ remediation of PCB's in the Palm River. The project is proceeding as planned and has the participation of many enthusiastic and strongly motivated students from USF and UCF. Task 1 was to obtain reagents and supplies and begin feasibility studies. Aroclor 1254 standards and individual PCB congeners have been purchased. An emulsion consisting of Pd/Mg bimetal, oil, water, and SPAN 85 was tested with Aroclor 1254. Degradation was slow (>10% in a week) -- possible explanation may be PCBs remaining in oil layer and not diffusing into water layer to react with metal, so the researchers began formulating other possible emulsions. Task 2 was to continue feasibility studies and perform kinetic studies. Several different emulsion formulas have been tested. Emulsions consisting of varying amounts of Pd/Mg bimetal, ethanol, water and SPAN 85 – not stable. Emulsions consisting of varying amounts of Pd/Mg bimetal, methanol, water and SPAN 85 – not stable. Current emulsions being tested consisting of Pd/Mg bimetal, methanol, water and Triton X-100, a surfactant proven successful in PCB soil remediation. Kinetic studies have been focused on several individual congeners with neat Pd/Mg. PCB 77 was chosen because of the high TEF (toxicity equivalent factor) value. PCB 52, 61, 62, 65, 70, and 80 were examined for structural reasons and to compare to PCB 77. PCB 93, 95 (pentachlorobiphenyls) and PCB 151, 153 (hexachlorobiphenyls) were examined and by-products were identified. Kinetics indicate a pseudo first order reaction and rate constants have been determined for all of the above congeners. The mechanism appears to be step-wise with biphenyl as the final product. In all congener studies, reaction with Pd/Mg is slow for first 30 minutes, rapid dechlorination

between 30 – 50 minutes and then levels off. The research performed indicative that the mechanism for degradation of polychlorinated biphenyls varies depending on the solvent system that is used. Not only are the relative rates of dechlorination different when comparing ortho, meta, and para, but the final byproducts also are different. The individual congener studies have been completed and a stable bimetallic emulsion is currently being prepared.

- ◆ Project 4: The Social and Environmental Dimensions of Xeriscaping: A Pathway for Ameliorating Coastal Environments. *Rebecca Johns, PI, James Krest, Joseph Dorsey.* More than 80% of the domestic water in Florida is used for lawn and garden maintenance despite the relative high expense and scarcity of this important resource. Established xeriscaping techniques could be implemented by citizens to conserve water, but growth in the adoption of sustainable lawn management practices has been slow. This project is a pilot study conducted in the racially- and economically diverse neighborhoods of Pinellas County to investigate the socio-economic underpinnings of Florida residents' lawn management decisions, the persistence of cultural preferences for certain lawn types, and the specific impact of xeriscaping in ameliorating pollution from yard runoff. The study investigates the relationship between characteristics of ethnicity, gender and socio-economic class in St. Petersburg and degrees of receptivity to environmentally appropriate landscaping. The second year of the project was spent in finalizing data collection, data analysis and publication of data. Three journal articles were completed, submitted and published (two articles in *Interdisciplinary Environmental Review*, and one in the *Papers and Proceedings of the Applied Geography Conferences*), and a fourth was completed, submitted and is currently under review at *Environment and Planning D*. Summaries of the data were sent to individuals who assisted in the data gathering for the project; one presentation of the results was made at an academic conference, and one presentation was made at a community gathering.
- ◆ Project 5: An Historical Perspective on the Economic and Environmental Impacts of the Phosphate Industry on the Tampa Bay Region. *Antoinette Criss and James Krest.* The phosphate mining industry confers positive economic impacts on the state of Florida and the Tampa Bay region. However, because the industry is dependent upon a mined resource whose stocks are being diminished, the future of the industry is limited by the economic viability of continued extraction of this resource. Fortunately, extraction levels have been maintained according to the most recent published data for 2007. Significant consolidation and vertical integration (with fertilizer producers) of the industry has taken place, enabling the industry to maintain itself for the near term. Dissolution of the Florida Phosphate Council, the lobbying group for the industry, is, however, consistent with the decline of the industry. The environmental concerns that have been raised with respect to the industry are currently being addressed through local advertising efforts. Fieldwork addressing the environmental impact of waste discharge on Tampa Bay is being completed in Spring 2009. This fieldwork has been concentrated in Bishops Harbor (where phosphogypsum stack wastewater was actively discharged between 2002 and 2007), and in Cockroach Bay, which is being used as a control in this study due to its similar size and drainage. Water and sediment samples were collected over the summer 2006 and Spring 2007. Further sampling is planned for Spring 2009 for follow-up data. For samples collected to date, water samples

show no difference in phosphate loading in the water column, most-likely due to the short residence time of water in the bays. Average orthophosphate concentrations in Bishop Harbor, collected in 2006, were 0.2 +/- 0.15 mg/l. Concentrations from Cockroach Bay were 0.4 +/- 0.3 mg/l. Similarly pore-water inventories from Cockroach Bay and Bishop Harbor are not significantly different. This suggests that discharge of contaminated water into Bishop Harbor had little or no discernible long-term impact on the ecosystem even though there were reports of enhanced macro-algal growth in Bishop Harbor during the peak discharge periods. Additionally, sediment samples were also collected to look at solid-phase storage in the sediment column. These samples are being processed for total phosphorus concentrations which should provide more insight into storage of phosphorus in the bays. This study has funded research and senior thesis projects for several USF St. Petersburg Environmental Science students, culminating in short papers and academic presentations. Preliminary results of one of these projects were presented by a student at a small conference sponsored by the American Chemical Society in March 2007.

- ◆ Project 6: Interfacing SWAT and PHABSIM: A Potential GIS-based Water Resource Management Tool. *Barnali Dixon, PI, James Gore, Andy Casper.* Based on investigations and research in the past five years, climatologists believe that multi-decadal periods of warming and cooling of the North Atlantic Ocean's surface waters ultimately affect precipitation patterns across much of the United. Since river flows are largely rainfall dependent, variation in rainfall should result in variations in river flow to coastal areas, as well. Flow increases in the northern part of Florida and flow decreases in peninsular Florida are consistent with the AMO and the reported relationship with rainfall. These relationships extend not only to rivers in Florida but to the entire southeastern United States, both Atlantic and Gulf coastal rivers. Although spatially explicit data layers commonly used in hydrologic models are readily available, accessibility of meteorological data with adequate spatial and temporal coverage remains a challenge. The ability to accurately predict stream flow with a model, for example, can be strongly impacted by the input data. The goals of this study are to (1) determine sensitivity of the SWAT (Soil and Water Assessment Tool) model to the use of measured, local versus simulated meteorological data for a given resolution of soils, land-use and Digital Elevation Models (DEMs) required by the model and (2) explore integration of SWAT with PHABSIM as a potential tool for GIS-Based water resources Management. The key findings are as follow: (1) the model does not appear to respond to the difference in meteorology in a significant manner; (2) for this basin at least, the model does not appear to respond to the detail of the original soils layers as much as to the resolution to which it is resampled; (3) the SWAT model and the validation data from USGS both suggest that there is more going on in the system at the upper reaches of the watershed than can be easily explained by simply modeling and calibrating the outlet; (4) resolution of input data, particularly DEMs cannot be ignored or simply resampled to meet the desires of the model without consequences; (5) processes occurring within the watershed itself (perhaps pumping/groundwater irrigation, groundwater revaporation/discharge) may be contributing to the discrepancy between measured streamflow in the sub-basins when compared to the basins in the times of high rain; (6) finer the DEM resolution used in SWAT or other GIS-based basin models (currently 30 m is the best widely available) the more realistic the long-term hydrograph records are likely to be; and (7) we demonstrate that linking these two different types of models (i.e. using a SWAT model to develop long-term discharge patterns from

watershed characteristics and precipitation records) is a viable option, though not without technical limitations.

- ◆ Project 7: Acquisition of Counters for Gamma-emitting Radioisotopes. *Jim Krest, Donny Smoak, Kathy Carvalho-Knighton.* Instrumentation was acquired to support ongoing C-SPACE research projects: (1) in support of Projects 1 and 5, a germanium-crystal gamma-detector configured with a 1.5-cm well for analysis of naturally occurring radioisotopes concentrated from water samples; (2) a germanium-crystal gamma-detector with a planar configuration for analysis of naturally occurring radioisotopes in soil and sediment samples; (3) a Gas Chromatograph with an Electron Capture Detector (GC-ECD) to be used for the detection of halogenated compounds in Project 3. This instrumentation has been set up and is now operating well. Initial problems with high background counts for the germanium-crystal gamma-detector have been resolved by better ventilation and “curing” of walls and floors in newly constructed spaces. A Shimadzu Gas Chromatograph was ordered in November, 2005, and was set-up during Spring 2006. It is currently being used in support of Project 3. Two Gamma Detectors were ordered from Princeton Gamma-Tech in December 2005, and lead shields were ordered from Gamma Products, Inc, at the same time. Part of the shipment (lead shields) was delayed until June 2006, and were moved into new facilities at USGS building when they became available in August 2006. Initial site visit for set-up of detectors discovered problems with electronics, and detectors were shipped back to PGT. The detectors came back to USF in the beginning of November, 2006, and were set-up by a technician on November 15, 2006. Both detectors are currently up and working, and are being used in support of Projects 1 and 5.
- ◆ Project 8: Guided Surface Vehicles. *Eric Steimle.* Guided Surface Vehicles (GSV's) are finding a niche as mobile instrument platforms with many uses ranging from environmental monitoring to security-oriented monitoring. They are versatile, inexpensive and easily configurable. USF St. Petersburg's GSV (dubbed “Rocky”) is outfitted with a wireless computer interface that allows instrumentation to be deployed and controlled by a remote user or autonomously by the vehicle. “Rocky” is currently 72” long and 38” wide, has a 250-pound payload capacity and can travel at speeds up to 4 knots. “Rocky” is battery powered, utilizing a twin-screw design for steering, making it highly maneuverable. Although this C-SPACE project per se has reached its conclusion, the development of the GSV still continues with funding from other projects and building on what we have accomplished with C-SPACE funding. In the final phase, we changed the GPS overlay system for a custom geo-referenced database with a Google Earth interface. This allows the user to easily find images using the familiar Google Earth software. The data can also be exported to an ARCGIS compatible file to employ the standard spatial analysis tools. An example of this can be seen in Project 2 in CSPACE Phase II funding. We also performed a survey of a 10-acre retention pond for the city of Kissimmee using SONDE multi parameter water quality sensor and bottom classification sonar. We completely surveyed the pond in 4 hours and collected approximately 11,000 geo-referenced data points. Each point contained depth to bottom, bottom type, dissolved oxygen, turbidity, chlorophyll, temperature, and conductivity and Cyanobacteria count for a total of 88,000 individual data points.

- ◆ Project 9: Science Journalism. *Mark Walters, PI, Tony Silvia*. Project 9 is the first of two parts that have extended from CSPACE Phase I funding into CSPACE Phase II funding, Project 9 “Communicating Science to the Public.” In the first “research” component we sought background information for the second and larger component — a conference on the subject. Our goal has been to identify the obstacles to better scientific communication to the public and attempt to remedy these in the approach we take to the conference through a search of the quantitative literature. In the second conference component, described below, we offered a communication workshop and conference to C-SPACE participants and the larger Tampa Bay scientific community aimed to help them communicate their ideas, research and knowledge clearly and forcefully to the public. Based upon reviewer comments for our proposal for the second year of funding for C-SPACE, we conserved Phase I funds to combine the Science Communication Workshop and the Conference and do one larger, high-impact event rather than to conduct two smaller, separate events. This highly successful conference is reported on more fully in Phase II, Project 9.
- ◆ Project 10: Administration and Outreach, *Christopher F. D’Elia and James A. Gore*. This project is continued as Project 11, Phase II. See below for more details.

C-SPACE “Phase II” Funding (2006 Award)

- ◆ Project 1: Water Quality Sampling Strategies for Monitoring Coastal Rivers & Estuaries – Applying Technological Innovations to Tampa Bay & Tributaries. *Barnali Dixon, PI, Eric Steimle, James Gore, Paula Coble, and Robyn Conmy and Andrew Casper*. Rivers, estuaries, reservoirs, and lakes are multi-use systems that supply water for agricultural, industrial, and human consumption while simultaneously assimilating both point- and non-point source discharges. Existing methods of data collection are generally limited to snapshots in space and time while a comprehensive view of spatial variability remains elusive. Accelerating the integration of existing in-situ sensors, geospatial analysis techniques, and reliable autonomous sampling platform technologies provide immediate improvements for sampling and assessment programs. We provide a demonstration of this integration for high spatial resolution sampling and analysis in a non-wadeable river with an inexpensive unmanned sampling platform (USV), standards sensor arrays, and widely used geospatial techniques. These are used to creating 2-D maps of temperature, conductivity, salinity, turbidity, chlorophyll florescence and chromophoric dissolved organic matter (CDOM). 2-D surface water quality maps show significant influences on local water quality from tributary confluences, submarine groundwater plumes, floodplain/riparian interfaces and other patchily distributed limnological features. Moreover, this project demonstrates how sensors, autonomous vehicles, and geospatial technologies work in concert to create a more comprehensive spatial picture compared to the standard systematic sampling grid with data displayed as means and standard deviations. During academic year 2007-2008, project PI Dr. Andrew Casper took another position at the Waterways Experiment Station, US Army Corps of Engineers, Vicksburg, MS. Dr. Barnali Dixon became the nominal PI for this project, although Dr. Casper remains active in completing the project. All field sampling and initial geospatial analysis are complete. Currently the focus of this project is producing a revised manuscript for the Journal *Water Resources Research* and disseminating results through conferences and seminars. 2D maps of 7 water quality parameters have been

produced (shapefiles) for all 3 sampling dates (11/06, 02/07, and 09/07). A manuscript was prepared and not accepted by *Environmental Science and Technology* and is in revision.

- ◆ Project 2: Investigation of terrestrial and groundwater nutrient fluxes to the coastal waters off Pinellas County, Florida, and their importance for harmful algal blooms. *James Krest, PI, Peter Swarzenski and Eric Steimle.* A survey transect was set up to get baseline data on the distribution and inventories of radium isotopes and inorganic nutrients in lower Tampa Bay and offshore, coastal waters. Samples were also taken from the larger streams and rivers flowing into Tampa Bay to determine freshwater fluxes of these species. The transect has currently been sampled 3 times, with additional sampling scheduled for Spring and Summer 2009. Results from the short-lived radium isotopes (Ra-224 and Ra-223) indicate that only about 10% of their dissolved inventory is supplied from freshwater surface water sources. Rough calculations indicate that another 10% can be supplied by molecular diffusion from the bottom sediments. The remaining inventory (80%) must be supplied from groundwater, most-likely as some combination of submarine groundwater discharge (undersea outflow) and tidal pumping of recycled sea water through sediments. Longer-lived isotopes (Ra-228 and Ra-226) will help us to constrain these terms as their slow regeneration rates will provide limits on the bottom sediment flushing depths. These isotopes are still being analyzed on the gamma-counters due to long counting times and a large queue of samples. Nutrient analyses are crucial to this study, and sampling was temporarily curtailed until we could work out issues with instrumentation for this purpose. Technician funds were used to hire an experience analyst on a part-time basis to work out the kinks with our Technicon analyzer. We are currently seeing excellent results, and are ready to recommence sampling. Sampling is also being coordinated with Florida Wildlife and Research Institute to get complementary HAB organism identification. As we might have anticipated, there have been no HAB's in the area since the start of the project, so correlation of nutrient budgets with HAB organisms is not possible at this time.
- ◆ Project 3: Tree Islands of the Everglades: Ecological Shifts in Response to Nutrient Loading. *Joseph Smoak, PI and Charles Holmes.* This project funded a postdoctoral fellow to work within the Florida Everglades on two projects described below. (1) *Tree Island Paleoreconstruction* - Tree islands are accepted as one of the most ecologically important settings within the Everglades. However, little is known about how these islands have changed ecologically over the last 100 years. Most investigators attribute the decline in the tree islands directly with the hydrological changes that occurred since the 1950s impoundment. This investigation uses the sediment record to document the ecological shifts on a tree island in response to the hydrologic modifications over the last 100 years. The results reveal that mass accumulation rates began to increase circa 1950s on this tree island. Coincident with increasing mass accumulation rates both $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values of sediment organic matter decreased. The decrease in $\delta^{15}\text{N}$ could indicate a change in the vegetation on the island as a result of change in hydroperiod and/or a decrease in bird population on this island. The former hypothesis is supported by the C/N ratios which increased since the 1950s and by sedimentary photosynthetic pigment data that indicate increases in macrophytes and algae on the island since the 1950s. This does not exclude the possibility that bird populations on this island decreased along with a shift in vegetation. Decrease in bird population reduced the contribution of bird guano which was enriched in ^{15}N . In

conclusion impoundment produced longer periods of high water beginning in the 1950s and promoted encroachment of different vegetation on the island or a change in the dominant vegetation. The 1950s was a period of major change in the Everglades with the transition from drainage to impoundment. (2) *Calculating Historic Nutrient Loading in WCA-2A Wetlands*. The northern Everglades Water Conservation Areas have experienced recent ecological shifts in primary producer community structure involving marl periphyton mats and dense typha stands. Multiple investigations have identified phosphorus as a driver of primary producer community structure, but the effects of water impoundment beginning in the 1950s have also been identified as a concern. Unfortunately, long term monitoring data does not exist for the Everglades so primary producer community structure prior to 1950 is inconclusive. In an effort to understand pre-1950 primary producer community structure and identify community shifts since 1950, we measured paleolimnological proxies on four sediment cores collected in Water Conservation Area-2A (WCA-2A) along a phosphorus enrichment gradient. We conclude that a concentration of 650 to 700 $\mu\text{g}/\text{kg}$ of phosphorus in the sediments is needed to promote typha dominance. It has been shown that the marl periphyton communities serve as a mechanism for removing water-column phosphorus and depositing it into the sediments. In addition, inorganic phosphorus is co-precipitated with the calcium carbonate associated with the marl. These increasing concentrations of sedimentary phosphorus and inorganic phosphorus provide optimal conditions for typha growth. These temporal and spatial differences indicate that the water-column phosphorus gradient is the primary driver of primary producer community structure in WCA-2A. The establishment of the marl periphyton in the middle and southern areas of WCA-2A correspond to the impoundment period beginning in 1950. We infer from paleolimnological data that hydroperiod works as a secondary driver in determining primary producer community structure. Possible mechanisms could be increased delivery of water-column phosphorus farther into WCA-2A, decreased dry periods that could desiccate and destroy primary producers and alternations to biogeochemical processes regulating sedimentary phosphorus concentrations. Nevertheless, these data confirm the historic significance of phosphorus and hydroperiod in regulating primary producer community structure in WCA-2A and should be considered when making future management decisions.

- ◆ Project 4: Arsenic contamination of Florida lakes from MSMA herbicide mobility: implications for human and aquatic vertebrate health. *Thomas Whitmore, PI, and Melanie Riedinger-Whitmore.* Our studies, beginning in 2005, found large-scale arsenic (As) contamination in sediments of Little Lake Jackson, Highlands County, Florida because of monosodium methylarsonate (MSMA) application to adjacent golf courses. Total As concentrations reached 435 $\mu\text{g}/\text{l}$ in pore waters and 148 mg/kg in dry sediment, Total As inventory was ~ 555 kg of As in $>19,000$ metric tons of sediment and $10.8 \times 10^4 \text{ m}^3$ of porewaters. Total As content in surface sediments (mean = 47.3 mg/kg) exceeded consensus-based sedimentary concentration for probable toxicity effects in freshwater benthic fauna. Initial results were presented at the 10th International Paleolimnology Symposium in 2006. In 2007, we documented total As concentrations 4-11 times higher than the U.S. EPA Maximum Contamination Level for drinking waters in the surface and subsurface waters that enter the lake. Findings were published in 2008 (Whitmore *et al.* 2008). Our present study documents total As, As(III), As(V), DMA, AsB, and MMA content in fish, crustacean, and reptile tissues at various levels in food chains of two MSMA-contaminated. The objective is

to evaluate the biotoxicity potential for the aquatic vertebrate fauna, as well as for humans who consume aquatic fauna. We compiled information about location and age of 330 golf courses in an 8-county area of Florida. Dr. Natalia Hoyos (Department of Geography, University of Florida) prepared GIS maps that enabled us to target 13 lakes based on proximity to golf courses and duration of MSMA exposure. We collected sediments from all 13 lakes, and analyzed total As content. Lakes Little Jackson and Little Bonnet (Highlands Co.) were selected for bioaccumulation studies. Collection permits were obtained from Florida Fish and Wildlife Conservation Commission. Herpetologist George Heinrich collected specimens of crayfish, 8 species of fish, non-lethal samples from two species of turtles, and watersnake tail clips using hoop nets and live traps. Sirens, amphiumas, and salamanders were absent entirely, suggesting amphibian vulnerability to toxicity. Tissue samples were freeze dried and sent for arsenic speciation to the Trace Elements Core Facility in the Center for Environmental Health Sciences at Dartmouth College. Total As concentrations were remarkably high in some sportfish specimens in Little Lake Jackson: blue tilapia showed total As concentrations as high as 11.63 ppm in organs and 1.52 ppm in muscle tissue. These values are comparable to total As values measured in tilapia from the Human Blackfoot Disease area of Taiwan, where As in wellwaters leads to necrosis and need for amputation in humans. Bluegills showed total As content as high as 10.75 ppm in organs and 1.3 ppm in tissue. Maximum total As content in Little Bonnet sportfish was significant but lower (e.g. 2.05 ppm in organs). Most tissue As generally was in the form of arsenobetaine, followed by As(V), DMA, MMA, and As(III), although digestion might have favored oxidized forms. Lead (Pb) content also was exceedingly high in both lakes, and we are determining whether the Pb source is atmospheric or from pesticides. As our project closes, we are completing analyses and anticipating 4 manuscripts with colleagues at University of Florida (Geological Sciences) and Dartmouth College concerned with: 1. As bioaccumulation in food chains of Lakes Little Jackson and Little Bonnet (manuscript in prep.). 2. Pb fractionation of sediment samples from Lakes Little Jackson and Little Bonnet to determine whether Pb sources are agricultural or atmospheric (manuscript in prep. by late November 2008). 3. As accumulation in sediments of Little Bonnet, which we believe might arise from agricultural pesticides used for citrus. 3 sediment cores have been ^{210}Pb dated and analyses are near completion for total As content and citrus amendment markers (manuscript in prep. by December 2008). 4. Lead content of tissue samples from Lakes Little Jackson and Little Bonnet for bioaccumulation assessment (analyses pending with Dartmouth College).

- ◆ Project 5: An Integrated GIS and Remote Sensing-Based Strategy for Assessing the Ecological Outcomes of Social Marketing. Barnali Dixon, PI, Richard Flamm and Karin Braunsberger. The overall objectives are: (1) conduct a market analysis in preparation for a social marketing campaign on lawn watering and smart fertilizer use; (2) explore methods for monitoring behavioral change using integrated GIS and remote sensing methods, (3) refine methods for water use and quality monitoring for isolating urban impacts so that we can estimate the effects of residential land-use practices on water resources; and (4) develop a systems-science approach for tying the 3 components together in a framework that can serve as a template to other local initiatives that seek to encourage environmental stewardship. However, as part of the mini pilot project we will only conducted preliminary remote sensing data analysis and GIS integration to demonstrate that effectiveness of the proposed methodology viz. ability to identify health of grass (as a results of amendments) or

impervious surfaces using remotely sensed data. Analysis has been performed on remotely sensed data to determine the impervious surface extent for a selected part of the Central Florida study area. This entailed using Leica Geosystems ERDAS Imagine software to derive impervious surfaces from high resolution color infra-red (CIR) aerial photography obtained from the Southwest Florida Water Management District (SWFWMD), along with accompanying LiDAR to separate classes of impervious surfaces into four categories: driveways, parking lots, roofs and roads. Image analysis is complete for the selected pilot study area. Additional supplementary work was done with the Soil & Water Assessment Tool (SWAT) model to determine the impacts of urbanization on a primarily un-urbanized watershed in terms of predicted stream flow. The second approach was to use FEMA GIS coverages and the categories of A (100yr no base flood elevation (BFE)), AE (100yr with BFE) and A + AE to determine the impacts of urbanization in the more low-lying floodplain. The third approach was to vary the land use only and run the SWAT model. Analysis was done reading in various LU for 1988, 1995 and 2004 from the SWFWMD. We currently are in the process of isolating grass from imageries for two time period.

- ◆ Project 6: Using RUSLE and SWAT to Estimate Fluxes and Fates of Eroded Soil Organic Carbon in the Hillsborough River Basin. *Barnali Dixon, PI, J. A. Gore.* Climatologists believe that multi-decadal periods of warming and cooling of the North Atlantic Ocean's surface waters ultimately affect precipitation patterns across much of the United States. Since river flows are largely rainfall dependent, variation in rainfall should result in variations in river flow to coastal areas, as well. Flow increases in the northern part of Florida and flow decreases in peninsular Florida are consistent with the AMO and the reported relationship with rainfall. These relationships extend not only to rivers in Florida but to the entire southeastern United States, both Atlantic and Gulf coastal rivers. Although spatially explicit data layers commonly used in hydrologic models are readily available, accessibility of meteorological data with adequate spatial and temporal coverage remains a challenge. The ability to accurately predict streamflow with a model, for example, can be strongly impacted by the input data. The goals of this study are to (1) determine sensitivity of the SWAT (Soil and Water Assessment Tool) model to the use of measured, local versus simulated meteorological data for a given resolution of soils, land-use and Digital Elevation Models (DEMs) required by the model and (2) explore integration of SWAT with PHABSIM as a potential tool for GIS-Based water resources Management. With respect to the first goal, the model does not appear to respond to the difference in meteorology in a significant manner; at least for this basin, the model does not appear to respond to the detail of the original soils layers as much as to the resolution to which it is resampled; the SWAT model and the validation data from USGS both suggest that there is more going on in the system at the upper reaches of the watershed than can be easily explained by simply modeling and calibrating the outlet; resolution of input data, particularly DEMs cannot be ignored or simply resampled to meet the desires of the model without consequences; processes occurring within the watershed itself (perhaps pumping/groundwater irrigation, groundwater reevaporation/discharge) may be contributing to the discrepancy between measured streamflow in the sub-basins when compared to the basins in the times of high rain. With respect to the second goal, we now are able to bridge the conceptual and digital divide between watershed and in-stream hydraulic modeling. While we demonstrate that linking these two different types of models (i.e. using a SWAT model to develop long-term

discharge patterns from watershed characteristics and precipitation records) is a viable option, though not without technical limitations. Results confirm that accuracy of the SWAT-predicted hydrograph declines significantly when either the DEM resolution becomes coarser or if DEM data is resampled. The effect is due to both changes in the size and shape of the river basin with DEMs and subsequent shifts in the proportions of physical input characteristics like land use, soils, and elevation. Despite this limitation, the results still show that the use of 30 m or finer DEMs produced hydrographic patterns that are amenable for using of in-stream habitat protocols like the PHABSIM model in ungauged systems, especially where no other hydrographic information exists. We also recommend that, since the effects of resolution and resampling are obvious significant and potentially non-intuitive, the resolution of base topographic data must be chosen and documented as metadata carefully whenever using SWAT or any GIS-based watershed model to generate hydrologic data for water resource management or regulatory decisions such as determination of minimum flows and levels.

- ◆ Project 7: Acquisition of Support Equipment and Instrumentation. *Melanie Riedinger-Whitmore, PI, James Krest and Joseph Smoak.* This project was essentially completed during Phase I. See Phase I Project 7 above for more detail. This project provided for the purchase of an additional gamma detector to facilitate and enhance sample counting. A purchase order was placed for a germanium crystal gamma detector with a 1.5 cm intrinsic well in February of 2007 from Princeton Gamma Tech Instruments. Concurrently, lead shielding for the detector was ordered from Gamma Products, Incorporated. Both items were initially received and set-up during the summer of 2007 with high expectations. Unfortunately, we have been unable to get the gamma detector to function properly. The detector is currently at Princeton Gamma Tech where they are troubleshooting the instrument. This detector was ordered to help us cover the demand of the CSPACE projects, and the continued delays have prevented us from analyzing many of the samples collected for project 2.
- ◆ Project 8: UPTAQ – Understanding the Profile of Tampa Bay’s Aquatic Quality. *Kathy Carvalho-Knighton, PI, Ashanti Pyrtle and Malcolm B. Butler.* The Tampa Bay area ecosystem totals approximately 7,000 km² including estuarine waters, wetlands and drainage basins. Waters of the bay are typically shallow with an average depth of 3.5 m and coastal vegetation is dominated by mangrove forest with some areas of salt marsh. People have lived in Florida more than 12,000 years. The drainage basin currently supports a population of over 2 million, as compared to an estimated population of 300,000 indigenous people statewide prior to the Spanish explorers’ arrival in the early 1500’s (FDS, 2005; Hann, 1996). This dramatic population growth has been accompanied by industrial, agricultural, and other anthropogenic-related activities that have resulted in natural resource depletion, nutrient loading, coastal erosion, increased pollution and other various environmental stresses in Tampa Bay and surrounding regions (Wilmore and Pyrtle, 2004). Historical records and scientific investigations have provided valuable insight (via quantitative and qualitative information) regarding the anthropogenic impact to the Tampa Bay’s water resources. In the past, such insight has often been utilized to develop water resource management practices, conservation measures, usage restriction policies, monitoring programs, and restoration activities throughout the state of Florida. This information is summarized and presented to

participating teachers in order to contextualize the proposed teaching and learning activities that will be conducted in certain geographical locations throughout Pinellas, Hillsborough and Manatee Counties. This project is a 16 month-long interdisciplinary endeavor, involving elementary teachers, university faculty, and elementary, undergraduate and graduate students. The activities that have been completed to date include:

- Designing and developing a new science education course for in-service teachers,
- Hands-on teaching and learning opportunities for USF St. Petersburg graduate students and elementary students from three Tampa Bay area counties; and
- Collaborating with USF St. Petersburg Colleges of Arts and Sciences and Education and USF College of Marine Science faculty to implement teaching and training activities throughout the USF St. Petersburg campus. A formal teacher learning and training occurred during July 2008 for 5 weeks. During the program, teachers worked along side graduate students in hands on environmental projects in which water and soil samples are collected, analyzed and evaluated for purposes of reporting a status of the environment.

- ◆ Project 9: Communicating Science to the Public - A Workshop for Scientists and Journalists. *Mark Walters, PI and Ann Tihansky.* Funded principally by the Environmental Protection Agency through the CSPACE grant, this conference, held in Feb. 2008, was a partnership of the University of South Florida St. Petersburg, the U.S. Geological Survey and the Florida Department of Environmental Protection's Rookery Bay National Estuarine Research Reserve Coastal Training Program. The goals of the Conference were to 1) assist scientist and journalists to communicate more effectively with one another and the public; 2) provide tips and tools that will encourage collaborative efforts to bridge the communication gaps between scientists and journalists; 3) facilitate the "presentation" of critical scientific information to the public and policy makers; and 4) educate participants about predicted effects of global climate on Florida's coastal environment by way of economic, fresh water, public health, and ecological impacts. This conference either met or exceeded the goals set forth in the grant proposal. The total attendance exceeded our ideal goal of 75. An evaluation questionnaire was distributed to participants, and the response to the program was highly positive. In conjunction with the conference, the PI has completed a proposal for a book on communicating science to the public, which includes lessons learned from the 2008 conference. *Regaining the Public's Trust: A Professional's Handbook for Communicating with the Lay Public* has been submitted to publishers for consideration. After nearly a year delay receiving conference video from the videographer (due to payment-for-services delays), we are now in the process of editing it to put it on the conference Web site. This Web site will be expanded to include feature video from the conference, PowerPoints from presenters, as well as the conference summary and evaluation. One of the spin-offs from the conference was a major article in the St. Petersburg Times ("Rising sea level already eating away at Florida's coastline," St. Petersburg Times, March 28, 2008) co-written by reporter Craig Pittman, one of the journalist-panelists for the conference.
- ◆ Project 10: Modeling and Monitoring Needs for Tampa Bay and its Watershed – What Are the Next Steps? *Christopher D'Elia, PI, Erika Asano, Richard Eckenrod, James Gore, Mark Luther, Frank Muller-Karger, Robert Weisberg and Kim Yates.* There has long been an understanding among state and local agencies, consulting firms, and the academic community that the sophistication of models need for the Tampa Bay region must be

increased. Accordingly, C-SPACE project 10 was conceived to bring together key individuals to discuss future modeling needs. The first modeling workshop was conducted on 27 April 2007 at the USGS in St. Petersburg and was attended by over 50 individuals, and a follow-up workshop is under consideration, but may not be essential given the success of the first workshop. The workshop was organized first with a series of keynote presentations by respected and knowledgeable individuals looking at modeling needs from different perspectives. Keynote presentations were presented by Betti Johnson, TBRPC, Holly Greening, TBEP, Sid Flannery, SWFWMD, and Tim MacDonald, FWRI. There was broad consensus that modeling efforts for the Tampa Bay Estuary and its watershed need to be improved. Recommendations were made with regard to the desired model: 1. infrastructure, 2. scale, 3. data resolution, 4. open source availability, 5. database characteristics, 6. kind, 7. and data needs. Additional recommendations concerned the inclusion of human and societal elements and education needs. A complete summary of the meeting and its participants can be found at <http://www.stpt.usf.edu/cspace/workshopi.asp>. It was also recommended that future workshops be held to continue the discussions. The C-SPACE project recognizes that these workshops will require the initiative of state and local agencies, as well as the Tampa Bay Estuary Program.

- ◆ Project 11: Administration and Outreach. *Christopher F. D'Elia and James A. Gore.* This project is for administrative support including program leadership, advisory board activities, meetings, administrative travel, etc. Administrative efforts continue apace. This project has essentially continued into the C-SPACE Phase II (2006 Award) as Project 11. Administrative efforts have gone quite well. This is a multi-year program and this project is simply a continuation of Phase I Project 10. Because of the multi-project structure of the C-SPACE program, most administrative needs concern budgeting needs and interfacing with EPA program managers. We are now in the final year of the project and are beginning to enter the "wrap up" phase. Project PI's are, as anticipated, focusing their efforts on pursuing funding from other sources and building, when possible, on their projects, and several have been successful in doing so. Several of the original project PI's have taken positions at other universities, and we have reorganized accordingly. The large scope and number of researchers have made it difficult to coordinate a program centered around a common, focused topic. As expected, the diversity of activities, even though organized internally around theme areas, have as anticipated, resulted in a number of fairly independent lines of research dealing with coastal environmental concerns. The outreach function of the program continues to function very effectively. With other local agencies (especially USGS), C-SPACE is a proud co-sponsor of the *Community, Science, and Environmental Policy Brown Bag Discussion*, referred to for short as the "Brown Bag." (See <http://www.stpt.usf.edu/brownbag/>.) This 75-minute public forum is held the second Friday of the month, now in a permanent home, the Normille Conference Room at USGS on the USF St. Petersburg campus. A wide range of speakers touch on a variety of environmental science and policy issues, with ample opportunity for open and public discussion being provided. This session is attended by from 40-100 people from the USF system, its partner institutions, and the public. However, in the past year, two additional and successful activities complementary to C-SPACE have involved PI D'Elia's time to such an extent that the Brown Bag has been temporarily suspended until the Spring 2009 semester. (During Academic Year 2007-2008, D'Elia also served as Interim Vice Chancellor for Academic

Affairs.) These are the Progress Energy Florida's Energy and Environment Speaker series (<http://www.stpt.usf.edu/energy/Lecture.htm>), which included as speakers the former EPA Administrator, Carol Browner, NBC News journalist Robert Bazell, former NRC Chair Nils Diaz, and Stanford ecologist Paul Ehrlich; and the Coastal Cities Summit conference (www.coastalcities.org). In addition to these activities, the C-SPACE Program has hosted a website since its inception. This site can be found at <http://www.stpt.usf.edu/cspace>, and is maintained by Dr. Bob Wang.

Publications/Presentations Summary, All Projects:

1. Ayala, Oscar. Florida's Phosphate Industry. ESP&G Senior Project Presentation and Report, August 2006. (Oral Presentation and Literature Review)
2. Bradley, F. and B. Dixon. 2008. Using RUSLE to Investigate the Watershed Source-Sink Relationship of CDOM. AAG Boston, MA, Apr 15-19.
3. Bradley, F. and B. Dixon. 2008. Investigating the Impacts of Soil Erosion and Sediment Yield on Water Quality. USF 2008 Poster Symposium & Competition: "Global Challenges for the 21st Century", Nov 6.
4. Bradley, F. and B. Dixon. 2009. Using GIS to Investigate Soil Physical Properties in Four South Florida Watersheds. 45th Annual FSG Meeting, St. Augustine, FL, Jan 23-25.
5. Bradley, F., B. Dixon and J. Earls. 2008. Characterization of the Spatial Variability of Terrestrial Watershed Properties In Relation to In-Stream CDOM Distributions. Spring Specialty Conference - GIS and Water Resources V, San Mateo, CA. Mar 17-19.
6. Carvalho-Knighton, K.M. "Environmental Chemistry Research" April 2006. University of South Florida College of Marine Science (Invited Talk)
7. Carvalho-Knighton, K.M. "Liquid Membranes Incorporated with Metal Particles for Remediation of PCBs" October 2006. University of South Florida Tampa Environmental Research Interdisciplinary Colloquium (ERIC) (Invited Talk)
8. Carvalho-Knighton, K.M. "Liquid Membranes Incorporated with Metal Particles for Remediation of PCBs" September 2006. University of South Florida College of Marine Science (Invited Talk)
9. Carvalho-Knighton, K.M. "Remediation of Environmental Contaminants using Zero-valent Bimetallic Systems" October 2006. University of South Florida St. Petersburg Environmental Science, Policy, and Geography (Invited Talk)
10. Carvalho-Knighton, Kathleen M.; Geiger, Cherie L. and Clausen, Christian A. "Remediation of PCB Compounds with Bimetal Particles" The 4th European Conference on Oxidation and Reduction Technologies for In-Situ Treatment of Soil and Groundwater (ECOR-4) Amsterdam, Netherlands October 2007.
11. Casper, A.F. and L.E. Johnson, Québec-Océan, Pavillon Vachon, Université Laval, Québec, Québec J1K 7P4, Canada. How Does Environmental Heterogeneity Influence Widespread Populations? (http://www.stpt.usf.edu/cspace/casper_poster.pdf). (Poster)
12. Casper, A.F., B. Dixon, J. Earls, J. A. Gore. 2008. Ecohydrology in ungauged river basins: Constraints in integration watershed hydrology models with instream habitat models when setting minimum flows and levels. [*In review*: Journal of Environmental Management].
13. Casper A.F., Dixon B., Conmy R.N., Hall M.L., and E.T. Steimle. Monitoring Water Quality with Guided Surface Vehicles, High Resolution Data, and Geospatial Mapping

Reveals New Patterns of Spatial Heterogeneity. (In Prep for Water Resources Research Jan 2009)

14. Casper, A.F., M.L. Hall, B. Dixon and Eric T. Steimle. Oct 2007. Combining Data Collection from Unmanned Surface Vehicles with Geospatial Analysis: Tools for Improving Surface Water Sampling, Monitoring, and Assessment. Proceedings of the Marine Technology Society / IEEE-Ocean Engineering Society Conference, Vancouver BC.
15. Conservation Area 2A Wetlands, Final Report for South Florida Water Management District, West Palm Beach, FL, 30pp, 2008.
16. Curtis, and J.M. Smoak. 2006. Inadvertent alkalization of a Florida lake caused by increased nutrient and solute loading to its watershed. *Journal of Paleolimnology* 36(4): 353-370. (This publication includes pigment profiles For Little Lake Jackson).
17. Deszo, Joseph. The distribution and inventories of Ra-223 and Ra-224 in the coastal waters near Tampa Bay. ESP&G Senior Project Presentation and Report, July 2007. (Oral Presentation and Report)
18. DeVor, R., B. Aitken, C.A. Clausen, C.L. Geiger, L. Talalaj, and K. Carvalho-Knighton. "Kinetics and Mechanistic Study of the Stepwise Dechlorination of a PCB using Mechanically Alloyed Palladized Magnesium. Battelle Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California; May 22-25, 2006 (Oral Presentation)
19. DeVor, Robert; Carvalho-Knighton, Kathleen M.; Geiger, Cherie L. and Clausen, Christian A. "Kinetic and Mechanistic Study of the Degradation of PCB-151 by MgPd." 70th Florida Academy of Sciences Annual Meeting. Melbourne, FL, March 2006. (Oral Presentation)
20. DeVor, Robert, Aiken, Brian; Holland, Erin; Maloney, Phil; Geiger, Cherie L.; Clausen, Christian A.; Talalaj, Luke; and Carvalho-Knighton, Kathleen M. "Kinetics and mechanistic study of the dechlorination of three monochlorobiphenyl congeners using mechanically alloyed palladized magnesium." 71st Florida Academy of Sciences Annual Meeting. St. Petersburg, FL, March 2007. (Oral Presentation)
21. DeVor, Robert, Kathy Carvalho-Knighton, Brian Aitken, Phil Maloney, Erin Holland, Lukasz Talalaj, Christian A. Clausen, Cherie L. Geiger. Mechanism of the Degradation of Individual PCB Congeners using Mechanically Alloyed Mg/Pd in Methanol. *Environ Sci Tech*. In review.
22. DeVor, Robert, Kathy Carvalho-Knighton, Brian Aitken, Phil Maloney, Erin Holland, Lukasz Talalaj, Seth Elsheimer, Christian A. Clausen, Cherie L. Geiger. 2008. Dechlorination Comparison of Mono-substituted PCBs with Mg/Pd in Different Solvent Systems. *Chemosphere*. 73 (6): 896-900.
23. Dixon, B and Earls J. 2008. An estimation of Regional Soils Erosion Vulnerability using RUSLE-V. In press. Papers of IASTED International Conference on Applied Simulation and Modeling. Corfu, Greece, June 23rd – 25th.
24. Dixon, B, R. Stetson and S. Smith. 2007. Creating a Soil Erosion Vulnerability Map at 3 Different Resolutions for the US Southeast" Florida Academy of Sciences Annual Meeting St. Petersburg, FL. March.
25. Dixon, B. 2007. Fractal Dimension Analysis of Wetlands: a joint venture between applied mathematics and theoretical physics. Applied Mathematics Summer Workshop hosted by Applied Mathematics Research Center, sponsored by Department of Defense. August 24th – 26th. Dover, Delaware. (Invited Speaker).

26. Dixon, B. and Earls, J. 2007. Examining Spatio-Temporal Relationships of landuse change, population growth and water quality in the SWFWMD [Interdisciplinary Environmental Review (IER). Vol. IX (no.11):71 - 93.
27. Dixon, B. and Earls, J. 2008. Resample or not?! Effects of Resolution of DEMs In Watershed Modeling [Accepted, In press: Hydrologic Processes].
28. Dixon, B. and J. Earls. 2006. Examining Spatio-Temporal Relationships of landuse change, population growth and water quality in the SWFWMD Interdisciplinary Environmental Association, Kona, HI, June 21-23.
29. Dixon, B., Stetson, R. and Smith S. 2007. Examining Resolution Effects on the Prediction of the Revised Universal Soil Loss Vulnerability Equation (RUSLE-V). Florida Society of Geographers Annual Meeting, Jacksonville, FL. February.
30. Earls , J and Dixon, B. 2006. Comparison of annual calibration of SWAT model at differing resolutions. In (Mark Colosimo & Donald F. Potts, eds). Adaptive Management of Water Resources. AWRA Summer Specialty Conference MT, June 26-28. ISBN: 1-882132-71-8.
31. Earls, Dixon, Bradley. 2008. AWRA Spring Specialty Conference - GIS and Water Resources V. Comparing SWAT Overall Drainage Basin Predictions with Individual Sub-basin Predictions. Published on Conference CD. San Mateo, CA. Mar 17-19.
32. Earls, J and B. Dixon. 2007. Application of the Soil and Water Assessment Tool (SWAT) in modeling the effects of landuse change on watershed hydrology. Vol. 30, pages 541-522. In (L. Harrington & J. Harrington, Jr, eds.). Papers of The Applied Geography Conferences. Indianapolis, IN. Oct 17-20.
33. Earls, J and B. Dixon. 2007. Applied Geography Conference. Application of the Soil and Water Assessment Tool (SWAT) in modeling the effects of landuse change on watershed hydrology. Indianapolis, IN. Oct 17-20.
34. Earls, J and B. Dixon. 2007. ASPRS Conference. Sensitivity Analysis of the SWAT Model to the Resolution of Input, Calibration and Validation of Data. Tampa, FL. May.
35. Earls, J and B. Dixon. 2007. Spatial Interpolation of Rainfall Data Using ArcGIS: A Comparative Study. 27th Annual ESRI International User Conference [In press] San Diego, June 18-22, 2007.
36. Earls, J and Dixon, B. 2006 The Influence of Resolution on the SWAT Model: Examining Neighboring Basins. Spring Specialty Conference GIS and Water Resources IV. Houston, TX, May 8-10. (Oral Presentation)
37. Earls, J and Dixon, B. 2006. A comparison of Model-Predicted Evapotranspiration by the SWAT Model with real and Modeled Meteorology. 18th World Congress of Soil Science, Philadelphia, PA. July 10th – July 14th.
38. Earls, J and Dixon, B. 2006. An Evaluation of the SWAT Model Sensitivity and autocorrealtion to Regression Analysis of Flow Data for Charlie Creek, Central FL. Applied Geography Conference, Tampa FL. Oct 11 – 14. (Oral Presentation)
39. Earls, J and Dixon, B. 2006. Comparison of annual calibration of SWAT model at differing resolutions. Adaptive Management of Water Resources, AWRA Summer Specialty Conference MT, June 26-28. (Oral Presentation)
40. Earls, J and Dixon, B. 2006. The Influence of Resolution on the SWAT Model: Examining Neighboring Basins. In (Maidment, David R. and John S. Grounds III, eds). GIS and Water Resources IV. Proceedings of the American Water Resources Association's 2006 Spring

- Specialty Conference. American Water Resources Association, Middleburg, Virginia, TPS-06-1, CD-ROM. ISBN 1-882132-70-X
41. Earls, J and Dixon, B. 2006. The Influence of Resolution on the SWAT Model: Examining Neighboring Basins. Spring Specialty Conference GIS and Water Resources IV. Houston, TX, May 8-10.
 42. Earls, J. & B. Dixon. 2007. Annual Meeting Association of American Geographers. 2007. Evaluation of Drainage Basin Delineation: ArcHydro & the Soil & Water Assessment Tool (SWAT). San Francisco, CA. April 19-22.
 43. Earls, J. & B. Dixon. 2007. Florida Academy of Sciences. Effects of Input Resolution on Streamflow Predicted by the SWAT Model. USF St. Petersburg, FL. March.
 44. Earls, J. & B. Dixon. 2007. Florida Society of Geographers Conference. "Evaluation of the Sensitivity of Fractal Dimension Analysis for Classification of Natural vs. Artificial Wetlands. Jacksonville, FL. February.
 45. Earls, J. & B. Dixon. 2008. Ocean Sciences 2008 Meeting. The Effects of Landuse and Soil Characteristics On Nutrient Loading Using the Soil & Water Assessment Tool (SWAT): A Comparative Study. Orlando, FL, Mar 2-7, 2008.
 46. Earls, J. and B. Dixon, 2007. Evaluation of the Sensitivity of Fractal Dimension Analysis for Classification of Natural vs. Artificial Wetlands. Presented at Florida Society of Geographers Annual Meeting, Jacksonville, FL, February.
 47. Earls, J. and B. Dixon. 2008. A Comparison of SWAT Model-Predicted Potential Evapotranspiration Using Real and Modeled Meteorological Data. Vadose Zone Journal: Multiscale Mapping Issue, May 2008. 7(2):570-580.
 48. Earls, J. and B. Dixon. 2008. Assessing Model-Predicted Flow in a Watershed: Basins and Sub-basin Scale Issues. *In Progress*.
 49. Earls, J. and Dixon, B. 2005. A comparative study of the effects of input resolution on the SWAT model. Pages 213 – 222. In (C. A. Brebbia, and J. S. Antunes do Carmo eds.) River Basin Management III. WIT Press, Southampton, UK.
 50. Earls, J. and Dixon, B. 2006. Utilizing SWAT to Model Spatio-Temporal Influences on River Basins at Differing Resolutions. Annual Meeting Association of American Geographers, Chicago, IL Mar 7-10. (Oral Presentation)
 51. Earls, J. and Dixon, B. 2007. Using the Fractal Dimension to Differentiate Between Natural & Artificial Wetlands. [Accepted, *In Press: Interdisciplinary Environmental Review (IER)*].
 52. Earls, J., B. Dixon, F. Bradley. AWRA Spring Specialty Conference - GIS and Water Resources V, San Mateo, CA. 2008. Comparing SWAT Overall Drainage Basin Predictions with Individual Sub-basin Predictions. Mar 17-19.
 53. Earls, J., Dixon B. and Hernandez-Cruz, L. 2008. Using ERDAS Imagine to Derive Impervious Surfaces from High Resolution Aerial Photography and LiDAR. AAG, Boston, MA, Apr 15-19.
 54. Earls¹, J and Dixon, B. 2006 The Influence of Resolution on the SWAT Model: Examining Neighboring Basins. Spring Specialty Conference GIS and Water Resources IV. Houston, TX, May 8-10.
 55. Earls¹, J and Dixon, B. 2006. A comparison of Model-Predicted Evapotranspiration by the SWAT Model with real and Modeled Meteorology. 18th World Congress of Soil Science, Philadelphia, PA. July 10th – July 14th.

56. Earls¹, J and Dixon, B. 2006. An Evaluation of the SWAT Model Sensitivity and autocorrelation to Regression Analysis of Flow Data for Charlie Creek, Central FL. Applied Geography Conference, Tampa FL. Oct 11 – 14.
57. Earls¹, J and Dixon, B. 2006. Comparison of annual calibration of SWAT model at differing resolutions. Adaptive Management of Water Resources, AWRA Summer Specialty Conference MT, June 26-28.
58. Earls¹, J. and Dixon, B. 2006. Utilizing SWAT to Model Spatio-Temporal Influences on River Basins At Differing Resolutions. Annual Meeting Association of American Geographers, Chicago, IL Mar 7-10.
59. Gore, J. Dixon, B, and A. Casper. 2006. Assessing Florida's large rivers: GIS-based data-mining and the impacts of the Atlantic Multi-decadal Oscillation. Great River Ecosystems Reference Condition *Workshop*, January 10-11, 2006, Cincinnati, OH.
60. Gore, J.A. and M. Kelly. Tenth International Symposium on Regulated Streams. 2006. Stirling, Scotland. Presented Paper: The Atlantic Multidecadal Oscillation (AMO) and its influences on instream flow analysis and management decisions: Examples from Florida, USA, rivers. (Oral Presentation)
61. Gore, J.A., Dixon, B, and A. Casper. 2006. Assessing Florida's large rivers: GIS-based data-mining and the impacts of the Atlantic Multi-decadal Oscillation. Great River Ecosystems Reference Condition Workshop, January 10-11, 2006, Cincinnati, OH. (Oral Presentation)
62. Gore, James A. Brown Bag presentation, "River Flow, How Low Can We Go," <http://www.stpt.usf.edu/brownbag/MFL.htm>. (Oral Presentation)
63. Hall, M.L., R. Conmy, A.F. Casper, P. Coble and E. T. Steimle. Feb 2007. Unmanned Surface Vehicles as Environmental Monitoring and Assessment Tools. Proceedings of the Coastal Environmental Sensor Network Annual Meeting, Boston MA.
64. Halle, Brittany, Carvalho-Knighton, Kathleen M.; Geiger, Cherie L. and Clausen, Christian A. "Dehalogenation of PCBs with zero valent bimetallic emulsion systems." 71st Florida Academy of Sciences Annual Meeting. St. Petersburg, FL, March 2007. (Poster Presentation)
65. Hartmann, Carey, and Krest, Jim. Effects of waste water dispersal from Piney Point Phosphate Plant into Bishop Harbor. 3rd Annual Meeting in Miniature, University of South Florida St. Petersburg, March 2007. (Oral Presentation)
66. Hydroperiods: A preliminary investigation, Final Report for South Florida Water Management District, West Palm Beach, FL, 63 pp., 2007.
67. Johns, Rebecca A. "The Potential of Geographic Analysis in Solving Environmental Dilemmas," presented at the Annual Conference of the Interdisciplinary Environmental Association, Orlando, FL, June, 2005. (Oral Presentation)
68. Johns, Rebecca A., 2005. "The Potential of Geographic Analysis in Solving Environmental Dilemmas." *Interdisciplinary Environmental Review*. Vol. VII, No. 2, pgs. 13-33. (Publication)
69. Kelly, M. and J.A. Gore. Tenth International Symposium on Regulated Streams. 2006. Stirling, Scotland. Presented Paper: Florida river flow patterns and the Atlantic Multidecadal Oscillation (AMO). (Oral Presentation)
70. Lecher, Alanna and James Krest. Tracking Submarine Groundwater Discharge into the Gulf of Mexico. 4th Annual Meeting in Miniature, University of South Florida St. Petersburg, March 2008. (Oral Presentation)

71. McGraw, Rachel. Orthophosphate distribution in Cockroach Bay, Bishop Harbor, and Tampa Bay. ESP&G Senior Project Presentation and Report, August 2006. (Oral Presentation and Report)
72. Pomeroy, Lawrence R., D'Elia, Christopher F., Schaffner, Linda C. 2006. Limits to top-down control of phytoplankton by oysters in Chesapeake Bay. *Mar. Ecol. Prog. Ser.* 325: 301–309. (Publication)
73. Riedinger-Whitmore, M.A., T.J. Whitmore, and J.M. Smoak. 2006. Nutrient threshold levels for shifts to cyanobacterial dominance: a paleolimnological survey of shallow, productive Florida lakes. 10th International Paleolimnology Symposium, Duluth, MN, June 25-29. (Oral Presentation)
74. Simmons, Candice, Carvalho-Knighton, Kathleen M.; and Pyrtle, Ashanti J. "UPTAQ - Understanding the Profile of Tampa Bay's Aquatic Quality Program: Bridging Elementary Education and University Research" National Association of Black Geologists and Geophysicists (NABGG) 2008 Technology Conference. Atlanta, GA (Poster Presentation)
75. Smoak, J.M., Gore, J.A. and C. Clayton; Paleoreconstruction of Tree Island
76. Smoak, J.M., Waters, M.N., Binhe, G. and C. Coronado; Ecological Shifts on an Everglades Tree Island Over the last 100 years, Greater Everglades Ecosystem Restoration Conference, Naples, FL, 2008.
77. Smucker, Thomas, Johns, Rebecca, Mustafa, Daanish, Dorsey, Joseph, Krest, James, and Miller, Drea, Connelly, Shanon and Rumschlag, Joshua. "The Social and Environmental Dimensions of Xeriscaping in St. Petersburg Florida: A Pathway for Ameliorating Coastal Environments," a poster presentation at the Annual Meeting of the Florida Society of Geographers, St. Petersburg, Florida, February, 2006. See: <http://www.stpt.usf.edu/cspace/xeriscaping.pdf>. (Oral Presentation)
78. Steimle, E., Fries D. and Hall, M., "Guided Surface Vehicle as a Mobile Instrument Package for Port and Homeland Security" at Pittcon 2006, March 16, 2006, Orlando, FL. (Poster)
79. Steimle, E., Oceanology International 06 21st - 23rd March 2006, London, United Kingdom, "Guided Surface Vehicle as Mobile Instrument Platforms" (Presentation)
80. Steimle, E., Oceans 2006, Boston, MA, "Unmanned Surface Vehicles for Environmental Monitoring and Assessment." (Oral Presentation)
81. Steimle, E., Restore America's Estuaries conference in New Orleans, LA, December 9-13, 2006. (Oral Presentation)
82. Steimle, E., seminar at USF-St. Petersburg, Oct. 19, 2006 entitled "Guided Surface Vehicles for Environmental Monitoring and Assessment." (Oral Presentation)
83. Stetson, R and B. Dixon. 2007. Resolution Effects on the Prediction of RUSLE in 3 different Physiographic Regions of the US" American Association of Geographers Annual Meeting, San Francisco, CA. April.
84. Talalaj, Luke; Halle, Brittany R.; DeVor, Robert; Carvalho-Knighton, Kathleen M.; Geiger, Cherie L.; and Clausen, Christian A. "Dehalogenation of PCBs with zero valent bimetallic systems." 231st ACS National Meeting, Atlanta, GA, March 26, 2006 (Poster)
85. Talalaj, Luke; Halle, Brittany R.; DeVor, Robert; Carvalho-Knighton, Kathleen M.; Geiger, Cherie L. and Clausen, Christian A. "Dehalogenation of PCBs with zero valent bimetallic systems." 70th Florida Academy of Sciences Annual Meeting. Melbourne, FL, March 2006. (Oral Presentation)
86. Waters, M.N. and J.M. Smoak; Calculating Historic Nutrient Loading in Water

87. Waters, M.N., Smoak, J.M. and C.J. Saunders; Reconstructing Primary Producer Communities in Water Conservation Area 2A in Relation to Phosphorous and Hydroperiod, Greater Everglades Ecosystem Restoration Conference, Naples, FL, 2008.
88. Whitmore T.J., M. Brenner, K.V. Kolasa, W.F. Kenny, M.A. Riedinger-Whitmore, J.H.
89. Whitmore, T.J., J. M. Smoak, M. A. Riedinger-Whitmore, and E. Goddard. 2006. Arsenic contamination of lake sediments in Highlands County, Florida, U.S.A.: an historic record of mobility from watershed soils. Poster presented at the 10th International Paleolimnology Symposium, Duluth, Minnesota, June 25-29, 2006.
90. Whitmore, T.J., M.A. Riedinger-Whitmore, J.M. Smoak, K.V. Kolasa, E.A. Goddard and R. Bindler. 2008. Arsenic contamination of lake sediments in Florida: evidence of herbicide mobility from watershed soils. *Journal of Paleolimnology* 40: 860-884 DOI 10.1007/s10933-008-9204-8

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Relevant Web Sites:

The C-SPACE Program's website can be found at <http://www.stpt.usf.edu/cspace>.