

**GIS Symposium 2011:
Inspiration through Networking and Technology**
Rookery Bay National Estuarine Research Reserve
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Poster Presentations - Abstracts

1. Integration of GIS technology and Soil erosion models towards tropical watersheds management. Case of Upper Ruvu catchment in Tanzania

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Wami- Ruvu basin is approximately 66,820 km² and is drained by major rivers in eastern Tanzania, which are the major water supply source for major cities. Wami-Ruvu basin and its associated resources are critical important not only ecologically but also culturally, as people depend on it for their essential services. Water resource management at Wami-Ruvu basin is facing challenges related to land use and human activities. Increased activities in agricultural towards Uluguru mountains together with higher demand for water supplies have resulted in concerns about resource management. The sustainability of water resources in the basin as the result of different management practices needs to be studied and monitored with reliable baseline information. This study is identifying sediments potential sources in different land uses and sub-watersheds. The study used Universal Soil Loss equation (USLE) integrated in raster GIS environment to map soil erosion of the upper Ruvu Catchment. The final output is erosion risk map showing mean annual soil loss in tones per hector per year. The result shows the spatial variation of the erosion dependent on rainfall, land use, soil and management factors. It provides an estimate of the vulnerability of erosion and also numerical results that can be used for site evaluation and planning purposes and also for assisting in the decision process of selecting erosion control measures including comparing results with other field scale erosion models.

Key words: GIS models, erosion and sediments, tropical watersheds, Upper Ruvu catchment

2. Spatiotemporal Trends of Contaminants in the Broward County Portion of the Biscayne Aquifer

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The western portion of Broward County obtains drinking water from the unconfined Biscayne Aquifer which is also highly susceptible for contaminants. Since 2006, the Broward County Wellfield Protection Program has been monitoring businesses and utilities through the federally endorsed Source Water Assessment and Protection Program. The core of this program is continuous and reliable monitoring of regulated substances in drinking water that adversely affect human health. Contaminant sampling is accomplished by licensing selected businesses and utilities located within the

protected zones of the wellfield that use, store, and/or handle these regulated substances. Different regulated substances, or contaminants, are then associated with specific types of land use for tracking purposes. As contaminants enter the porous limestone aquifer they are able to diffuse rapidly. Many outside variables influence these spatiotemporal contaminant concentration trends within the aquifer. In this analysis, we tracked the spatiotemporal trends of certain regulated substance concentrations as they are influenced by changing land cover and varying rainfall volume. Remote sensing images, corresponding to specific time frames, were used to create land cover layers for western Broward County. GIS tools were utilized to generate average yearly runoff using the raw SFWMD rainfall data. The individual monitoring well, potable well and NPDES surface station locations were used to create a raster network of continuous contaminant detections for each time frame. The lateral movements of contaminants across the aquifer are trending in a southeast direction. In the case of nitrates the concentration trend change is linked with varying rainfall intensity. Further research regarding the vertical movement of contaminants as well as the identification of those areas susceptible to contaminant leaching will lead to a greater understanding of contaminant flow in this karst aquifer.

Key words: Biscayne Aquifer, GIS, contaminants, spatiotemporal trends, Broward

3. Analysis of Land Use Change and Possible Influence on Rainfall Pattern in South Florida

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Growing concerns over the possible impacts of anthropogenic land cover changes on ecohydrology of south Florida have motivated this research. It is said that expansion of urban and agricultural land at the expense of natural wetlands and forests introduces changes in heat budget of the area with reduced latent heat (heat of evapotranspiration) and raised sensible heat, resulting in decreased convective rainfall. This project analyzes spatial extent and distribution of land use - land cover change and changes in annual rainfall pattern in south Florida for the period of 1974 to 2006. Spatial analysis and geostatistical analysis tools of ArcGIS are used. Wetlands as well as urban impervious lands are found to be expanded with the expense of water bodies and green areas (forest, shrub, and grassland). It is also observed that the total annual precipitation is decreasing throughout the period. Finally, a conclusion has been made that the total annual rainfall does not exhibit direct influence of the land use change. The results indicate a need of long term analysis of seasonal rainfall, particularly of summer, and land use change instead of short term and annual only precipitation in order to scrutinize the influence of wetland loss and urban heat island on convective rainfall. This will also call for studying the interaction of the closely interfaced urban, agriculture and wetland ecosystems for possible horizontal advection.

Key words: remote sensing; urban; spatial analysis; land use; rainfall

4. Benthic Habitat Characterization in Estuarine Complexes of Southwestern Florida

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Systematic benthic sampling has been used to characterize sediment types and biological assemblages within Estero, Clam, and Naples Bays and a portion of the Ten Thousand Islands, and the distribution of benthic habitats within each system has been mapped using geographic information systems (GIS) software. Aerial photographs were used to delineate the shoreline boundary of the bays and subsequently establish the benthic sampling grid. A study area polygon was created by digitizing the shoreline via ArcView. East-west transects were systematically placed over the study area polygon and sampling sites were located at intervals along each transect. Sampling sites were uploaded to a handheld global positioning system with differential correction and sites were navigated in the field using the graphic display. A Ponar grab sampler was used to collect benthic substrate at each sampling site. A wet-sieving method was used to sort substrates and proportions of mud, sand, and shell were estimated from visual inspection of the portions remaining within the sieves. Presence of flora (macroalgae and seagrasses) and fauna (live bottom [sponges, gorgonians, tunicates, and bryozoans] and polychaete worms) was also noted at each site. Habitat data were entered into an Excel spreadsheet and the resulting habitat database was used to produce raster maps of the study areas using the ArcView Spatial Analyst extension. These studies have provided information on habitat distributions and biological effects of freshwater inflow alterations that are needed for the management and conservation of natural resources within the respective estuarine complexes.

5. Lost and Found: The Search for Jack Collier's Place and Other "Lost" Cultural Sites in Rookery Bay National Estuarine Research Reserve

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ArcGIS has proven to be instrumental in locating areas to survey for historic and prehistoric cultural resources within Rookery Bay National Estuarine Research Reserve (RBNERR) managed lands. John "Jack" L. Collier lived on Cannon Island, within RBNERR, in the early 1900's. The land was sold to develop the Hamill-Crayton subdivision. Historic deed research shows Roy Cannon bought two lots comprising Jack Collier's property and house. The subdivision failed and Roy Cannon was the island's only resident. The homestead site was forgotten until RBNERR staff stumbled upon the remains of a house with a partially standing brick chimney. After hearing of the "lost" Jack Collier's Place and the potential existing and unrecorded archaeology, the author embarked on an effort to locate the remains of the homestead. ArcGIS was

used to layer historic and modern aerial photography with LiDAR (Light Detection And Ranging) to locate potential historic and prehistoric sites. Three areas were identified for field survey and their coordinates were loaded into a Trimble GeoXT GPS. Field reconnaissance resulted in locating the house remains with the brick chimney as well as an adjacent tabby constructed cistern and a site that is very likely one of the two earliest homesteads in the Rookery Bay Reserve area, dating back to 1882. ArcGIS was an essential tool in finding these once “lost” homesteads.

6. Rookery Bay National Estuarine Research Reserve Habitat Mapping

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Located at the northern end of the Ten Thousand Islands on the Gulf coast of Florida, the Rookery Bay National Estuarine Research Reserve (RBNERR) represents one of the few remaining undisturbed mangrove estuaries in North America and the largest in the United States. A myriad of plants and wildlife, including 150 species of birds along with threatened/endangered plants and animals thrive in estuarine upland and island habitats comprising nearly 110,000 acres of hammocks, pinelands, scrub, mangrove forest, as well as fresh and salt water marshes. Estuarine habitats are ideal sites for gathering frontline data on the effects of climate change and sea level rise. The Institute for Regional Conservation (IRC) was contracted to develop baseline habitat maps of RBNERR’s plant communities. These habitat maps were created using ESRI ArcMap in correlation with recent and historic 1940 aerial photographs along with LiDAR data. Ground truthing was conducted for certain areas using a Magellan Professional Mobile Mapper GPS with ArcPad 9. Habitats were categorized using the Comprehensive Everglades Restoration Plan (CERP) hierarchical classification system which allows distinction between ecological communities, individual species and physical characteristics such as density and height. The resulting dataset enables RBNERR’s resource management and research teams to accurately assess and predict changes in habitats and to better understand the effects of sea level rise and climate change.

7. Hydrant Data Collection for Fire Response Zone Maps

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One of my first projects as an intern at the city was a fire hydrant data collection project. The task was to update an incomplete existing record of the city’s fire hydrants. A handheld Trimble GPS was used to collect points for just under 200 hydrants in the field. After tracking down all of the hydrants, the records were post processed Trimble

GPS Pathfinder Office Software. Following this step, the data was transferred into ArcMap10, which is run on the city's network and viewable through Citrix on a desktop computer. The data was collected for use by the fire department for an Insurance Services Office (ISO) map review. A series of maps were created displaying a now complete record of all of the hydrants in the city as well as fire response zones, fire stations, and buildings with a height of 35 feet or greater.

8. Implementing GIS for Construction Management, Operations, and Maintenance at the Key Largo Wastewater Treatment District

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The Key Largo Wastewater Treatment District (KLWTD) Regional Wastewater Project originated from recognition of the need to eliminate septic tanks and illegal cesspits that exist within Key Largo in order to restore the health and economic vitality of its near-shore waters. KLWTD has recently completed construction of a \$130,000,000 centralized wastewater collection and treatment system that includes over 90 miles of force main, vacuum main, and gravity main sewer lines; 2,800 vacuum pits; and 12,000 connections, as well as five vacuum pump stations and a 2.3 MGD regional wastewater treatment plant. ESRI ArcGIS and Trimble GPS have been used throughout the five year project as construction management tools, with the resulting geospatial database providing the foundation for the District's asset inventory and maintenance management system. Every component of the wastewater collection system was GPS located during construction and integrated into the District's GIS, along with record drawings, construction photos, shop drawings, and operations and maintenance manuals.

9. GIS Exercises for Mapping Sustainability in the Western Everglades

Dr. Marguerite S.E. Forest, Assistant Professor¹, and Kim Pierce, GIS Instructor²

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GIS Exercises are being developed for students in introductory level environmental science courses at Florida Gulf Coast University. All of the exercises focus on regional sustainability issues in southwest Florida, using spatial data from local, regional, state,

and national sources. Sample topics at various levels of development include Hurricanes & Storm Surges, Land Use & Water Quality, Population Growth (complete), Panthers & Habitat, Sea Turtle Nesting & Movements, and Sea Level Rise (in process). The focus is on basic spatial and technical skills, so these exercises do not require any prior training with the licensed ESRI ArcGIS software. Students can work at their own paces by following instructions in a step-by-step manner, answering relevant content questions, and producing a final project or map. Evaluation can be based on responses, project completion, or student assessment of learning gains. Initial results indicate high levels of student engagement, good understanding of the topics, and confidence in using basic GIS. These ArcGIS exercises will be adapted for use with free software packages and for use by non-formal environmental educators, middle and high school teachers, and their students. Pre- and in-service training sessions are being planned. Many other topics, such as Solar Energy, are being investigated. Integration of GPS data collection and processing skills is a high priority.