2010-2011 URE Academic Year Research Teams

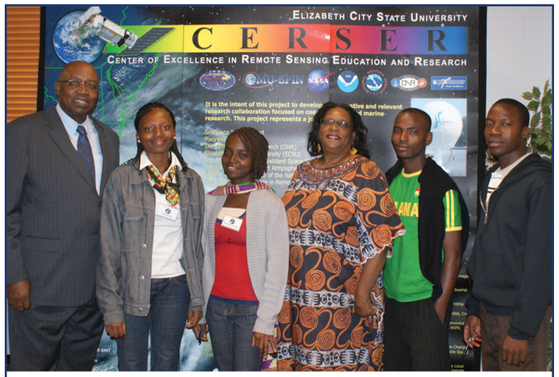
Impact, Mentor: De. Malcolm LeCompte
Michael Jefferson, Jr. — Ryan Lawrence
Joyce Bevins — Robyn Evans

Oceanography, Mentor: Dr. Jinchun Yuan
Justin Deloatch — Clarence Highsmith
MyAsia Reid — Chelsea Vick

Polar Grid, Mentor: Mr. Je'aime Powell
Jean Bevins — JerNettie Burney
Glenn Koch — Cedric Hall

Multimedia, Mentor: Mr. Jeff Wood
Patrina Bly — Autumn Luke
Stacey Newsome — Tasha Graham

Mathematics, Mentor: Dr. Darnell Johnson
Michael Austin — Ya'Shonti Bridges
Nadirah Cogbill — Rashad Williams



Dates to Remember

http://nia.ecsu.edu/events.html

May 23 – July 15, 2011
URE in Ocean, Marine, and Polar Science
Elizabeth City State University
http://nia.ecsu.edu/ureomps2011/

July 18-21, 2011
Teragrid'11
Salt Lake City, Utah
https://www.teragrid.org/

August 1-5, 2011
2011 IEEE International Geoscience & Remote Sensing Symposium
Sendai, Japan http://www.igarss11.org/

November 14 – 17, 2011
Supercomputing Conference 2011
Seattle, Washington http://sc11.supercomputing.org/

April 14-16, 2011
2011 ADMI Symposium
Clemson, South Carolina
http://admiusa.org/admi2011/

October 18, 2011
Celebration of Women in Mathematics
Elizabeth City, North Carolina
http://nia.ecsu.edu/cwm.html

2011
African Association of Remote Sensing of the Environment (AARSE)
http://www.itc.nl/aarse/

December 5-9, 2011
2011 American Geophysical Union (AGU) Fall Meeting
San Francisco, California http://www.agu.org/meetings/

For more information visit http://nia.ecsu.edu/ur.html or http://nia.ecsu.edu/ureomps2010/
Elizabeth City State University
Box 672 1704 Weeksville Road Elizabeth City, NC 27909 (252) 335-3696/voice (252) 335-3790/fax
ONR - URE/OMS N00014-01-1-0529 NSF REU grant ANT-0944255 CReSIS - NSF FY 2005-108CM1

E L I Z A B E T H C I T Y S T A T E U N I V E R S I T Y

Undergraduate Research Experience

Center of Excellence in Remote Sensing Education and Research

Summer 2010 Research Abstracts :: 2010-2011 Program Highlights

University of Ghana
Amadi Sefah-Twerefour - SR **Linda Buame** - SR **George Owusu** - SR **Prosper Adiku** - GRAD
MyAsia Reid - SR Mentor: Eric Akers ECSU-CReSIS

Autonomous Surface Vehicle

Sensors such as the Moderate Resolution Imaging Spectroradiometer (MODIS) and Sea-viewing Wide Field of View Sensor(SeaWiFS),require limited human efforts in acquiring data on water quality. However, these have associated errors with calibration due to the assumption of uniformity in pixel data. Surface vehicles with GPS have the capability of resolving this uncertainty by collecting geographically referenced data to enable accurate tracking of changes within an d between pixels. The purpose of this research was to build a prototype surface (Autonomous Surface Vehicle) that can navigate and collect continuous water samples in order to complement data from MODIS and SeaWiFS. The vehicle is routed using gyro and GPS, motor control, coordination of temperature sensor for data storage by an SD card is performed by a programmed microcontroller board. Testing was carried out on a pond close to the center and data on temperature was collected from GPS locations.Future work would focus on increasing sensor integrations and enabling buoy mode to allow for multiple data sets to make results more meaningful.

Patrina Bly - SR, MATH, ECSU
Mentor: Carlos Rivero
DOC/NOAA/NMFS/SEFSC

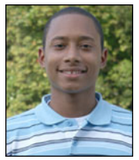
Spatial Assessment of the Gulf of Mexico & Coral Reef Fisheries with an Emphasis on the 2010 Deepwater Horizon Oil Spill

On April 22, 2010, British Petroleum operated Deepwater Horizon sank 40 miles off the coast of Louisiana. In a span of weeks the event led to the largest ecological disaster in United States history. To date, no definite numbers exists for the amounts of oil that were released into the Gulf of Mexico however, estimates exceed well past the million marks. On July 15, 2010, a temporary stop to the oil spill occurred with the placement of a cap. Currently, relief wells to allow permanent termination of the flow are being drilled with completion expected in August 2010.

Through the development of a spatial application, an assessment using GIS was made to view the extents of the 2010 Deepwater Horizon oil spill. Data concerning environmental factors, most of which concern identified National Marine Sanctuaries and cold water coral populations were collected from the National Oceanic and Atmospheric Administration and displayed. Daily imagery of the oil extents were provided on a weekly basis from an independent source, georeferenced, projected, and digitized using ArcMap. Using Oracle SQL developer, benthic permitted fisheries were identified within the vessel monitoring system (VMS) database, exported, integrated within Microsoft Access, and then imported into ArcMap to be projected to show locations of fishing grounds. In addition, the series of current fishery closures were adopted the from NOAA Fisheries Service, Southeast Regional Office, incorporated into the GIS application and viewed simultaneously as major component of the assessment.

The overall completion of this assessment is intended to yield a product that is conducive in viewing both deep sea coral populations and fisheries as it relates to benthic specified permitted vessels. In light of the Deepwater Horizon incident, the implementation of the assessment is to be utilized as an aid in viewing potentially at risk coral communities, fishing industry, and associated incident impact.

Justin Deloatch - Senior, CS, ECSU
Mentor: Dr. Jinchun Yuan
University of Hawaii at Mona
The Spectral Reflectance of Ship wakes between 400 and 900 nm



The objective of this research is to define the spectral reflectance characteristics of ship wakes at high spatial and spectral resolution, for the purposes of identifying maritime traffic using optical remote sensing data. The Hyperspectral Imager of the Coastal Ocean (HICO) was flown over the Hawaiian coast in April 2010. Hyperspectral images of the wake produced by the United States Coast Guard vessel, Kittiwake, traveling at speeds of 7, 14, and 21 knots were acquired. Analysis of the spectral reflectance data reveals a) that the spectral reflectance of the wake is distinct from that of background (i.e. deep ocean and sun-glint), and b) that systematic differences in the spectral reflectance properties of the wake, both along and across its long axis, as a function of vessel speed. Statistical analysis of the data indicate that the reflectance properties of the wake are significantly different to the ambient background but that the degree of difference decreases exponentially as spatial resolution increases. These results provides insights into how similar instruments operating from low Earth orbit can be expected successfully detect the presence of ships on the basis of the wake they produce.

Michael Jefferson - Senior, CS, ECSU
Mentor: Mark Fahnestock
University New Hampshire Research and Discover Program
Tracking Ice Flow in Two Greenland Outlet Glaciers

Using satellite imagery the activities of two Greenland outlet glaciers was investigated. Kangiata Nunata Sermia(KNS) located at Latitude(62.4), Longitude(-49.6) and Nunatakavsaup Sermia(NKS) located Latitude(74.6) ,Longitude(-56.0) were the sources of high variations in ice velocity changes between the years of 2001 to 2010. The changes in the ice velocities were investigated using a program written in MATLAB that tracked the most prevalent features in the ice. NKS which was the northernmost glacier was the source for the highest ice velocities through the years of 2002 and 2005. This change was primarily due to a large ice front retreat which directly affected the ice velocities throughout the years investigated. Through the years of 2002 to 2005 there was an increase in velocity of this glacier by 5 meters per year which is 1,875 meters per year. KNS showed a slight variation in velocity but this change was not a significant amount throughout the years that the data was available. As more glaciers accelerate, due to an inequality in the mass balance of these glaciers, the contribution of Greenland to sea-level rise will continue to increase.

Joyce Bevins - Junior, CS, ECSU
Mentors: Jong Youl Choi, Ruan Yang, and Seung-Hee Bae
STEM Indiana University of Bloomington
Data Point Visualization and Clustering Analysis

The purpose of this research project was to create a research tool for 3D data point visualization and clustering analysis, which is one of the most popular data analysis methods in bioinformatics and cheminformatics. For this purpose we have implemented the Barnes-Hut Tree algorithm in C# to visualize cluster structures of 3-dimenisional data and added the function to a visualization tool, called PlotViz, which is written in C# and Microsoft XNA graphic libraries, developed by the CGL research lab in Indiana University. We also performed clustering analysis of real research data used in IU bio and chem-informatics research groups. Among many clustering algorithms available, in our analysis, we applied two popular clustering algorithms, k-means and hierarchical clustering, by using R, which is a standard statistical analysis tool, and compared the qualities by measuring "withinness" which is the sum of Euclidean distances between cluster centers and points for each cluster group. The results are also compared by visualizing the data points in 3D by using PlotViz.

Jean Bevins - Junior, CS, ECSU
Mentors: Adam Hughes, Saliya Ekanayake
STEM Indiana University of Bloomington
Creating a Security Model for SALSA HPC Portal

The Primary Focus of this research project was to create a security model for the Service Aggregated Linked Sequential Activities (SALSA) HPC Portal, by using ASP.net, in conjunction with Microsoft SQL. The SALSA group members examine new programming models, involving parallel algorithms, applications, and libraries. The SALSA portal provides data-parallel algorithms running on a wide range of High Performance Computing (HPC) platforms. It allows users to carry out actions such as resource discovery, job submission and control, and data retrieval by abstracting much of the tedium involved in managing HPC jobs. This allows them to focus more on solving and developing software tools to address scientific computational problems. In the planning and implementation of the research project, a security case, and various use cases were conducted. These cases helped form the procedures for the overall research project. There were two primary aspects making up the Portal, which were creating the database and creating the actual security model.

2010 IEEE International Geoscince and Remote Sensing Symposium

Hawaii 2010 IGARSS

30th Anniversary :: July 25-30, 2010 :: Honolulu, Hawaii, USA
wwww.igarss10.org

On July 25-30, 2010 representatives from Elizabeth City State University attended the 2009 IEEE Geoscience and Remote Sensing Symposium in Honolulu, Hawaii. This was the 29th annual symposium for GRSS which brought together world-class scientists, engineers and educators engaged in the fields of geoscience and remote sensing. The 2010 Symposium theme was "Remote Sensing: Global Vision for Local Action."

The IGARSS'09 technical program contained traditional IGARSS topics and a broader program to reflect the theme. In addition to making oral and poster technical presentations, ECSU representatives managed the Education and Outreach section of the conference. Representatives who made presentations are shown below with their presentation titles.

Dr. Linda Hayden
PI, Center of Excellence in Remote Sensing Education and Research, ECSU
Hands-on GPS and Remote Sensing Training for High School Learners during IGARSS 2009 In Cape Town, South Africa

Je'aime Powell
Polar Grid Manager, ECSU
Multi-Channel Radar Depth Sounder (MCRDS) Signal Processing: A Distributed Computing Approach

Patrina Bly
NOAA, National Ocean Service
The Applicability of GIS and Remote Sensing in Identifying PBDES Sources Using NOAA National Status & Trends Mussel Watch Program Data

Chelsea Vick
Center of Excellence in Remote Sensing Education and Research, ECSU
Submerged Aquatic Vegetation Habitat Product Development: An Interdisciplinary GIS Experience

MyAsia Reid
Center for the Remote Sensing of Ice Sheets, University of Kansas
Automated Polar Ice Thickness Estimation from Radar Imagery

Sydney Paul
Hampton University
Investigation of Cirrus Clouds Using the CALIPSO LIDAR Data

Charles Luther
Minority Travel Program (MTP) Mentor
Progress in Arctic Sea Ice Remote Sensing

Jasper Lewis
Hampton University
Regional Aerosol Transport Study Using a Compact Aircraft Lidar

CReSIS Fall 2010 Distinguished Lecture Series

On Thursday, October 21, 2010, Dr. Kate Brodie of the Field Research Facility - USACE Coastal Hydraulic Laboratory at Duck, North Carolina, presented "Applications of Terrestrial LIDAR and X-Band Radar for Studying Coastal Morphology and Beach Erosion During Storms" as part of the continuing CERSER Distinguished Lecture Series sponsored by the IEEE-Geographic Remote Sensing Society and the Center of Excellence in Remote Sensing Education and Research (CERSER).

Dr. Brodie is a research oceanographer at the Field Research Facility (FRF) of the U.S. Army Corps of Engineer's Coastal Hydraulics Laboratory. The FRF is a unique facility located on the Atlantic Ocean in Duck, NC that has been conducting coastal research and collecting continuous observations of beach topography and nearshore waves since 1977. Dr. Brodie joined the staff in June, 2010, bringing expertise in coastal applications of state-of-the-art remote sensing technologies such as X-Band radar and terrestrial LIDAR.

CReSIS Spring 2010 Distinguished Lecture Series

On Tuesday, March 2, 2010, Dr. David Goodenough of the University of Victoria presented "Methods and Systems for Applications" as part of the continuing Distinguished Lecture Series sponsored by the IEEE-Geographic Remote Sensing Society. Dr. Goodenough is an Adjunct Professor of Computer Science, Faculty of Engineering, at the University of Victoria and Past President of the IEEE-GRSS. He was introduced by Dr. Barry Rock of the University of New Hampshire who joined the lecture by video link. Mr. Charles Luther closed the program with encouragement to the students present to strive further in their quest for knowledge.

Dr. Goodenough's current research interests focus on hyperspectral and radar remote sensing of forests and intelligent systems for extracting information from satellite and aircraft remote sensing data in combination with GIS. The applications of this research include forest and environmental monitoring, climate change information products such as aboveground carbon, and GRID systems and supercomputing for image analysis. These applications deal with pattern recognition, image analysis, artificial intelligence, geomatics, high-bandwidth communication and GRID architectures.

Adapting to Global Recovery: Strategies for Resource Building

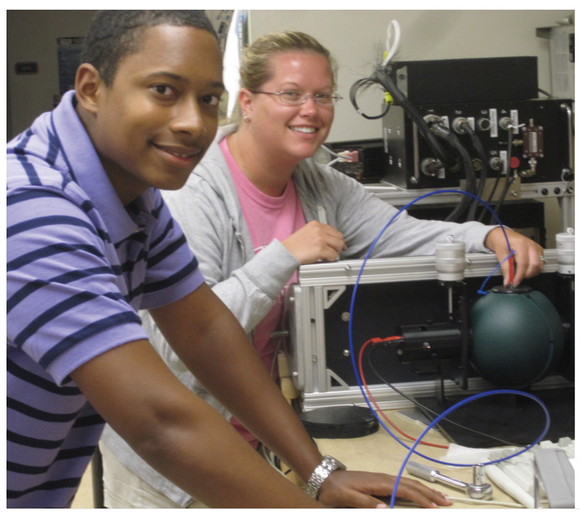
Guest Speakers for "Adapting to Global Recovery: Strategies for Resource Building" included Dr. Cora B. Marrett, Acting Director, National Science Foundation, and Mr. Willis Jenkins, of the Heliophysics Division of NASA's Science Mission Directorate. Dr. Marrett and Mr. Jenkins also visited the CERSER PolarGrid laboratory in Lane Hall. Dr. Hayden made a short presentation on the PolarGrid/CReSIS program at ECSU followed by an update from Mr. Je'aime Powell on the computing cluster at ECSU. CReSIS partners from the University of Kansas also joined the session via Polycom.

Cedric Hall - Senior, MATH, ECSU, Mentor: J. Salisbury
University New Hampshire Research and Discover Program
Correspondence Between Net Oxygen Production and Measurements of Inherent Optical Properties

Data was collected onboard a Lagrangian cruise in order to find correlations and relationships between a biological oxygen stock and inherent optical properties in the Gulf of Maine. A buoy drifting at 12 meters was tracked during a two and a half week process. Using a CTD (Conductivity, Temperature and Depth) profiler along with an IOP (Inherent Optical Property) profiler, were able to take profiles of the Gulf of Maine according to the location of the buoy.

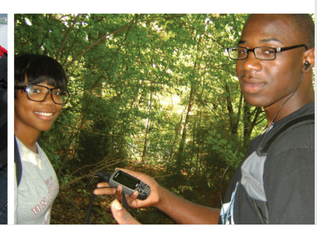
Upon completion of the cruise, we went into the data processing stage. We used MatLab as a platform to read the data from our profiling machines, and manipulate it to search for relationships. We wanted to integrate our variables down the euphotic zone, which is where light is equal to 1% of the surface light. The importance of the euphotic zone is that this is where oxygen production and consumption happens due to biology (Photosynthesis and Respiration). Using a MatLab formula we were able to derive integrated stocks of each of the variables and developed plots.

Our graphs consisted of concentrations, inventories, and rates of change. The IOP profiling machine produced hundreds of variables, however we only viewed a few such as absorption, attenuation and particle backscattering at different wavelengths, chlorophyll fluorescence, and a couple more. Of the variables viewed, particle backscattering at 555 nanometers gave us the best relationship to oxygen. We developed temporal differencing plots in order to see whether or not this relationship remained consistent throughout the day, and we found that as the oxygen stock changed, so did the particle backscattering stock.



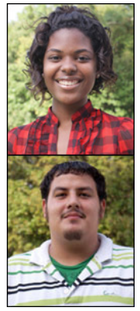
JerNettie Burney - Junior, CS, ECSU
Nadirah Cogbill - Sophomore, MATH, ECSU
Mentors: Marlon Pierce, Y. Ma, X. Gao, J. Wang
Research Experience for Undergraduates, IU Bloomington
Evaluation of Cloud Storage for Preservation and Distribution of Polar Data

The team goal was to find a service that could both store large amounts of data that Polar Grid has collected, and also be sure that the data will be preserved for researchers in the future to continue to use the data. For this reason, the team looked to a cloud storage service for the solution. Cloud storage is the storing of data that is accessible as a service by the use of a network. In this case, the team decided to research online storage using Amazon Web Services (AWS) and researched what AWS was, how reliable it was, how much data could be stored, and if data would be lost over an extended period of time. AWS is a cloud computing platform that is offered by Amazon.com that is made up of different computing services that are also known as web services. Within AWS, there is a service called the Simple Storage Service (S3) that is a user-friendly way of storing data over the Internet. The project shifted to investigate more about what is S3 and if it provided the services needed to aid PolarGrid. There were questions pertaining to S3 that the group researched. One of the questions was the guarantee of the reliability that S3 mentioned in their Service Level Agreement, which is the service terms promised to the user. Also, there was mentioning of a "durability" guarantee of the service by 99.9999999%. What did Amazon mean by "durability"? What does that percentile guarantee? Is that percentile guaranteed over a lifetime or only a few days? What is the likelihood of losing irreplaceable field data over various time scales (years, decades, and longer)? Financially, the group was to investigate how cost efficient it would be for Polar Grid to use this service. Polar Grid uses 26 Terabytes and over 300,000 files, and it was the duty of the group to investigate how Polar Grid would be charged; would it be for how much data will be stored, how much time the data will be stored in this service, or both. For this project, the aim of the group was to have these questions answered so that Polar Grid may have a secure place to store its mounds amount of data.



Robyn Evans - Junior, MATH, ECSU **Michael Austin** - Junior, CS, ECSU
Mentor: Xiaoming Gao, Yu Ma, Marlon Pierce, Jun Wang Research Experience for Undergraduates, IU Bloomington

Visualization of Ice Sheet Elevation Data Using Google Earth & Python Plotting Libraries



Polar Grid is a National Science Foundation (NSF) MRI funded partnership of Indiana University and Elizabeth City State University whose purpose is to provide technical and information technology support for the Center for Remote Sensing of Ice Sheets (CReSIS). CReSIS's goal in turn is to provide better understanding of the behavior of ice sheets and the consequences of glacial melting on global sea levels. To do this, CReSIS makes precise field measurements of ice sheet thickness in both Greenland and Antarctica to determine the shape of the underlying rock beds in order to build better models of glaciers that match their observed rapid changes. PolarGrid must provide tools that process and manage the data and make it accessible to both scientists and the general public.

Both CReSIS and the PolarGrid Project partner together offering research in a selection of majors for students and faculty to work with various scientist and engineers to aid the constant study of what different factors may play a part in the ongoing change of the climate. During the 2010 STEM Summer Scholars undergraduate research experience at Indiana University, students were tasked with creating visual representation of the ice thickness and bed elevation of the Greenland ice-sheet. A dataset consisting of the latitude, longitude, thickness, elevations, and surface elevation was used to create both a contour and heat map.

The visualizations were created by utilizing Python and Google earth. Python was used to filter the raw data provided on the CReSIS website. The team then took this data and created KML files and imported them into Google Earth. From this point, contour plots and heat maps were created using the matplotlob function within Python. The images were then overlaid on top of the CReSIS data in Google Earth. These visual representations were created to test the efficiency of this method and for students and teachers to use for future research.

Jamal Pearce (SAC), TeAirra Brown (NSU), Ronald Williams (FSU), Mentor: Mr. Jeff Wood

Establishing a Baseline of Water Quality along the Coast of Northeastern North Carolina in Response to the Deepwater Horizon Oil Spill

Deepwater Horizon was an ultra-deepwater, semi-submersible, offshore drilling oil rig used for oil exploration and production purposes. The oil rig was owned by Transocean and was under contract to British Petroleum (BP). On April 20, 2010, the Deepwater Horizon had a wellhead blowout which caused an oil spill in the Gulf of Mexico. This incident caused a total of eleven deaths and injured seventeen of the workers. The Deepwater Horizon blowout is the largest oil spill in U. S. history.

The Deepwater Horizon was located north of the Gulf Stream Loop Current which is a warm ocean current that begins its path within the Gulf of Mexico. The Loop Current flows northward between Cuba and the Yucatan Peninsula, eventually curving east and south along Florida's coast and exiting through the Straits of Florida. The Gulf Stream then follows the coastlines of the United States and Newfoundland before crossing the Atlantic Ocean. These currents have the potential to bring oil from this spill to the Outer Banks of North Carolina.

This project sought to establish a baseline on a range of data correlating to water composition along the Outer Banks of North Carolina from Ocracoke Inlet to Corolla with concentrated sampling from Ocracoke Inlet to Cape Hatteras. The spectral fluorescence data was the main indicator for the presence of crude oil. The data obtained predates any appearance of oil from the Deepwater Horizon oil spill on the outer banks of North Carolina. The compilation of data will allow researchers to analyze variations between the baseline and future data collected.

Derrick Griffin (ECSU), Joshua Rhodes (ECSU)
Mentor: Dr. Leonid Sokoletsky

Particulate Properties of the Dead Sea Retrieved by the Physical Optics Method

It is a well-known fact that the Dead Sea located in Jordan, Israel is one of the saltiest lakes in the world, whose salinity is approximately 30%. Such a huge salinity makes it almost biologically lifeless. However this lake contains large quantities of different minerals and some quantity of dissolved organic matter. Minerals of the Dead Sea are important for medicinal and cosmetics purposes. Unfortunately, the Dead Sea is slowly drying up and soon it will no longer be around in years to come. We can help preserve the Dead Sea and it's important that we use its wealth more rationally to prevent or delay its death. Thus it is imperative that we find answers to the following questions: Which minerals are exactly dispersed within the water? What are the minerals concentration and their vertical and horizontal space distribution? We must find if this solution is unique and stable?

Matravia Seymore (ECSU), Joseph Jackson (MVSU), John Bell (MVSU), Mentor: Dr. Je'aime Powell

Generation of Titanic Prime Numbers through High Performance Computing Infrastructure

The focus of the project was to generate a titanic prime number by using high performance computing resources. What makes prime numbers significant is their use in modern computers for the encryption of data. The generation of primes are particularly computing intensive the larger the prime. This makes titanic primes (thousand digit prime numbers) a perfect candidate for distribution through grid infrastructure. In order for the demands of the project to be met, a prime number generator had to be created. Multiple computer languages such as Javascript, Java, and C++ were tested for use in an attempt to develop a generator. Functionality was verified first through the terminal and then by job submission to Elizabeth City State University's VikeGrid (a Condor based computer cluster). Overall, the results indicated the successes of the project and the improvements needed for continued work.

Dalesha Cartman (MVSU), Marvin Elder (MVSU)
Mentor: Dr. Yolanda McMillian

The Results of Data Collected from Surveys to Predict the Effectiveness of Undergraduate Research Experience in Ocean, Marine, and Polar Science Program (2009) and Virtual Conferences (2010)

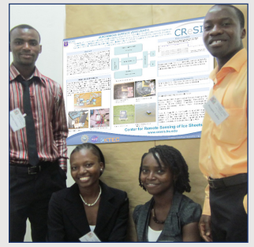
The Undergraduate Research Experience in Ocean, Marine, and Polar Science (URE OMPS) program is set up to promote the professional development of undergraduate students through their participation in ocean, marine and polar science research. Each student was assigned to a specific research team, where they worked closely with the assigned faculty.

An additional component of the program was the opportunity for students to participate in virtual seminars. These seminars allowed the students to become more familiar with topics such as global warming and ice sheets, and it also allowed students to interact with the nation's most prominent scientists.

The primary focus of the research project was three–fold. First, research was conducted on the role of the Institutional Review Board (IRB). During the research of the IRB, mock IRB approval applications were submitted for review. These actions had to be taken before any research could begin.

Second, the focus of the research project was to assess the hypothesized success of both the URE OMPS program and the virtual seminars through a comprehensive data analysis of questionnaire responses using experimental statistics.

Third, the design of experimental questionnaires was explored. Demographic, Likert Scale, open and close -ended survey questions were all used for questionnaires that were administered after the virtual seminars. Calculations of the statistical measures were done using the one sample and two sample tests for observational data using the statistical software packages Excel-StatPlus, and Minitab.



Linda Buame, George Owusu, Amadi Sefah-Twerefour, and Prosper Adiku presented their research at the International Conference on Appropriate Technology in Accra, Ghana November 24-27, 2010.

Kiara T. Jones (SAC), Ryan D. Lawrence (ECSU)
Mentor: Dr. Malcolm LeCompte

Survey of Post Last Glacial Maximum Environment: Unusual Soil Constituents in Rocky Hock Bay Stratigraphy

Throughout North America's eastern coastal plain are found a variety of features attributed to ice age climate. These include many elliptical, shallow depressions collectively called Carolina Bays, hypothesized to have been formed by the strong, sustained winds and arid, cold climate characteristic of glacial epochs (Raisz, 1934, Johnson, 1942 and Kaczorowski, 1977). This view eclipsed the 1933 proposition by Melton and Schriever, and expanded by Prouty (1934, 1953), that extraterrestrial debris produced by an aerial meteorite or comet explosion in the vicinity of the Great Lakes during the late Pleistocene formed the bays. Recent discovery that a number of the bays were found to contain material associated with extraterrestrial impacts including carbon and magnetic spherules, glass-like carbon, charcoal and nanodiamonds reinvigorated the debate over the bay's origins (Firestone, et. al. 2007).

To confirm the bays were receptacles for impact material, soil samples were previously taken from Rocky Hock Bay in Edenton, NC. Sequential soil samples were excavated near the bay's center and core samples extracted near the bay's rim. The samples were examined to determine the presence of carbon-associated markers and to measure the density of magnetic grains and grain-size distribution. Magnetic spherules were found among the smaller size portions of the magnetic grains and spherule density estimated. The geochemistry of a magnetic spherule was determined using scanning electron microscopic energy dispersive x-ray spectroscopy (SEM-EDS).