

**NASA Goddard Space Flight Center (GSFC)
Wallops Flight Facility (WFF)
& Marine Science Consortium (MSC)**

Research Collaboration



ANNUAL REPORT 2013

This report describes the collaborative research activities that took place in calendar year 2012 and which are planned for calendar year 2013.

August 2013



The 30-acre, \$15 million modern campus for the MSC provides educational programs and classes focused on coastal and marine environments.



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*This publication was designed by
Darlene Farris-LaBar
Associate Professor of Art
East Stroudsburg University of Pennsylvania*

LETTERS OF SUPPORT

The following are letters of support from Mr. William Wrobel, Director, Suborbital and Orbital Projects Directorate, NASA Goddard Space Flight Center's Wallops Flight Facility and Dr. F. Javier Cevallos, President MSC Board of Directors.



National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

July 25, 2013

Reply to Attn of: 802

Dr. F. Javier Cevallos
President
Kutztown University of Pennsylvania
15200 Kutztown Road
Kutztown, PA 19530

Dear Dr. Cevallos:

NASA Goddard Space Flight Center's Wallops Flight Facility (WFF) is proud of our partnership with the Marine Science Consortium including its members of the Pennsylvania State System of Higher Education in ongoing faculty/student research programs with WFF mentors. We have had some recent successes as outlined in this report.

We endeavor to work together on research projects that serve the mission of NASA and provide excellent opportunities for faculty and students within the state system.

We are especially looking forward to increasing future technical collaboration in areas such as data collection and studies related to climate change; coastal zones; habitat shifts; and algorithm, instrument, and small satellite development. Questions of a technical nature may be addressed to Mr. Scott Schaire, Technical Manager in the Advanced Projects Office, by phone at 757-824-1120 or by e-mail at scott.h.schaire@nasa.gov.

Sincerely,

William A. Wrobel
Director of Wallops Flight Facility

Enclosure

cc:
802/Mr. Schaire

The Marine Science Consortium

March 18, 2013

The Marine Science Consortium offers outstanding educational programs and courses that connect people to the diverse natural and cultural resources of the mid-Atlantic coast. Throughout its 45 years of operation, The Marine Science Consortium (MSC) has forged strong partnerships. Its connection to NASA's Wallops Flight Facility is one of the most important for the creation of exciting research and collaboration opportunities.

MSC and NASA's partnership encompasses the provision of physical space for MSC's fleet of research vessels and use of NASA lands for field study and research in pristine coastal habitats. These critical resources support MSC's mission to provide high-quality educational programs and classes for thousands annually.

In addition to physical resources, MSC and NASA collaborate on research projects in a variety of areas and disciplines. These projects offer faculty and students from MSC's member universities the opportunity to work with NASA's world class scientists and resources to do everything from launch experiments into space to conducting measurements on areas of the Eastern Shore to obtain better a better understanding of how climate change and sea level rise will affect this most vulnerable of regions. Whether researchers are studying cosmic rays or Fowler's toads they are adding to our knowledge of science through successful interactions between students, university faculty, and NASA scientists.

I continue to marvel at the outcomes of the MSC/NASA partnership as it grows and produces new experiences for students and new scientific results through the combination of our deep pool of knowledge and resources. Certainly, through our continued collaboration, we will achieve greatness in our scientific endeavors.

Sincerely,

Dr. Javier Cevallos
President MSC Board of Directors

34001 Mill Dam Road Wallops Island, VA 23337
Phone 757-824-5636 Fax 757-824-5638

CONTACTS

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Amber Parker

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Email: execdirector@msconsortium.org

NASA GSFC WFF

Science on the Shore Coordinator

Mike Bonsteel

Telephone: 757-824-1724

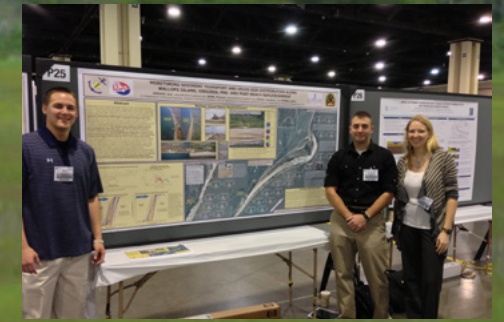
Email: michael.c.bonsteel@nasa.gov



Kate Masury (MSC staff) holding an Eastern Racer, *Coluber constrictor*



KU students Eric Wink and Tom Bond with Dr. Sean Cornell (SU) using Ground Penetrating Radar



KU students Eric Sergent and Thomas Bond with Dr. Adrienne Oakley posing in front of their poster at the National Geological Society of America meeting in Charlotte, NC (November 2012)



NASA GSFC WFF Objectives

NASA GSFC WFF OBJECTIVES

The NASA GSFC WFF purpose of this research collaboration with MSC is to promote student development in the sciences and faculty research in areas of interest to NASA. The primary vision of NASA GSFC WFF is to be a national resource enabling responsive low-cost aerospace science and technology research. NASA GSFC WFF supports the following NASA mission themes:

Enabling Scientific Research:

Support the Science Mission Directorate by providing low-cost, highly capable suborbital and orbital carriers, mission management, and mission services to enable Earth and space science research.

1. Provide research carriers and science platform missions, including sounding rockets, balloons, aircraft, and carriers for orbital missions, and provide brokering services for other carriers such as Uninhabited Aerial Vehicles (UAVs) and non-NASA aircraft.
2. Develop new technologies and applications for NASA GSFC WFF carriers such as use of balloons for planetary and Earth science missions, and sounding rockets for planetary entry demonstrations.
3. Develop, manage, and implement small orbital science missions.
4. Provide specialized mission services through use of the NASA GSFC WFF Test Range.
5. Conduct Earth science measurements supporting global climate change and coastal research.
6. Lead the application of balloon technology to planet Exploration missions as selected or assigned.



Enabling Aerospace Technology and Facilitating the Commercial Development of Space:

Support the Aerospace Technology and Exploration by providing advanced aerospace technology development, testing, operational support, and facilitation of the commercial launch industry to enable frequent, safe, and low-cost access to space.

1. Serve as a NASA test site for demonstrating space launch technologies.
2. Support development advanced range technologies that improve safety and reduce launch costs.

Enabling Education, Outreach, and Innovative Partnerships:

Support other NASA goals and objectives by providing science and technology education programs including innovative partnerships with academia, other Government agencies, and industry.

1. Provide student flight projects to teach students the processes associated with conducting aerospace and scientific research.
2. Seek new opportunities to collaborate with regional colleges and universities, especially Historically Black Colleges and Universities (HBCUs).
3. Continue efforts with NASA GSFC WFF tenants and regional government organizations to create new business opportunities for NASA GSFC WFF.



NASA GSFC WFF Horizontal Integration Facility

MSC Objectives

The Marine Science Consortium in Wallops Island, VA, is a nonprofit marine and environmental science facility.

The consortium is a residential marine science and environmental learning center and field station used by students and faculty from 13 member educational organizations throughout the mid-Atlantic. In addition, it offers school, adult, and family programming related to the nature resources of the mid-Atlantic region. Eight of its members are Pennsylvania State System of Higher Education universities. Many of its members are also non-coastal, making it a critical resource for students to gain hands-on experience in their field of study.

Since its inception more than 40 years ago,

the consortium's mission has been to provide a perfect site for field and laboratory investigation of the coastal ecosystems.

The MSC mission is to provide outstanding multi-disciplinary, educational and research opportunities that celebrate the rich natural, cultural, economic, and technological resources of the mid-Atlantic Coastal region through field-based and hands-on learning, often in affiliation with multiple public and private partners.

The MSC's prime objectives are:

- Excellence in Teaching and Learning
- Expanded research opportunities
- Modernize facilities, provide for MSC staff development and retention and provide high quality student/participant life
- Self-Sufficiency

Excellence in Teaching and Learning

Programs will include dynamic field-based instruction for university students, pre-college students and adult populations in the marine, environmental and other sciences related to the unique natural and human resources of the mid-Atlantic coast and Eastern Shore, as well as activities associated with NASA and other partners, together with experiences in the liberal arts.

Modernize facilities, provide for MSC staff development and retention and provide high quality student/participant life.

The MSC will continue to develop its facilities and create an environment conducive to high quality experiences in all aspects of student life.

Expanded Research Opportunities

The MSC will strive to establish expanded research opportunities, intended to spur greater student interest in science, technology, engineering and math (STEM) fields and to enhance faculty expertise. The MSC will enhance program visibility and expand collaborations involving MSC member institutions' faculty and students and regional partners such as NASA and the Chincoteague National Wildlife Refuge (CNWR).

Self-Sufficiency

The MSC will grow and improve as an organization through good stewardship of existing resources and the development of new revenue streams.

Nonreimbursable Umbrella Space Act Agreement



Louis Hinds (Refuge Manager, CNWR), William Wrobel (Director, NASA GSFC WFF), and Amber Parker (Executive Director, MSC) signing the Nonreimbursable Umbrella Space Act Agreement.

This agreement enables technical collaboration between NASA GSFC WFF, the MSC, the U.S. Fish and Wildlife Service (USFWS), East Stroudsburg University of Pennsylvania and Millersville University of Pennsylvania. The common mission is to expand coastal zone research on the Eastern Shore, to gain a better understanding of the environment, to best utilize the facilities and capabilities of each organization for scientific research, and to inspire the next generation of scientists and engineers. Climate change and sea level rise is a global concern. Sea level rise could decimate existing

tidal flats, salt marsh, and brackish marsh communities in the Wallops Island, Virginia region, including the CNWR. NASA's Wallops Island, a barrier island on the Atlantic Ocean, has hundreds of millions of dollars invested in NASA launch related and Navy infrastructure. NASA GSFC WFF is very interested in monitoring, mapping and reducing the erosion of the beach, and in being a good environmental steward. This agreement empowers faculty and students to be passionate and enthusiastic about scientific research, discovery, and engineering.

The first collaborative project involved the processing of Light Detection and Ranging (LiDAR) data to construct a digital elevation model (DEM) that could be used to predict the consequences of sea level rise in the region of Wallops and Assawoman Islands. Faculty and students have developed a digital surface model (DSM) from the NASA LiDAR data and accurately mapped the location and elevation of the features in the Assawoman Island area owned by the USFWS and the surrounding NASA Wallops Island beaches.



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MARINE SCIENCE CONSORTIUM MEMBERS

Bloomsburg University of Pennsylvania (BU)

California University of Pennsylvania (CaU)

Cheyney University of Pennsylvania (CU)

East Stroudsburg University of Pennsylvania (ESU)

Kutztown University of Pennsylvania (KU)

Lock Haven University of Pennsylvania (LHU)

Millersville University of Pennsylvania (MU)

Saint Francis University (SFU)

Shippensburg University of Pennsylvania (SU)

Slippery Rock University of Pennsylvania (SRU)

West Chester University of Pennsylvania (WCU)

West Virginia University (WVU)

Wilkes University (WU)

York College (YC)



Eric Sergent and Dr. Adrienne Oakley (KU) on replenished beach (May 2012)

PROFILE, MR. ERIC SERGENT

INSPIRING THE NEXT GENERATION

Mr. Eric Sergent is a senior at Kutztown University majoring in Geology. Five years ago as a first year student, Eric, like many students, was unsure of his career goals and was unable to find focus in his studies as a Marine Science major. Despite struggling through his first year, he began to find footing after taking a Marine Geology course. Although quiet in class, during a weekend field trip to Wallops Island, Eric showed interest in field studies. It was here that he came alive. Eric displayed incredible enthusiasm and confidence that was not as evident in the classroom. So when Dr. Adrienne Oakley, in collaboration with colleagues at NASA, MSC, and Shippensburg University initiated a multi-year project to investigate the Wallops Island shoreline prior to and following the planned beach replenishment, it was no surprise that Eric jumped at the chance to assist in this field research.

Since 2011, Eric has spent his spring breaks, numerous weekends, and significant portions of his summer vacations helping to carry out the field work, and data analysis since the project's inception. Working around his collegiate wrestling schedule, he has managed to attend several research symposia, research planning meetings, and has even developed his own research component funded by an undergraduate research grant through Kutztown University. His project specifically focused on sedi-

ment transport and grain size analysis along the Wallops Island shoreline. Eric collected, sieved, and analyzed hundreds of sand samples beginning in March 2011 in order to map sedimentation patterns on Wallops Island both prior to and after beach replenishment. In November, 2012, Eric's research was presented at the Geological Society of America Annual Meeting held in Charlotte, North Carolina. His poster titled, *A Comparison of Sediment Transport and Grain Size Distribution Along Wallops Island, Virginia, Pre and Post-Beach Replenishment*, was well received and he attracted interest from leading coastal scientists who were extremely interested in the Wallops Island project. He was also lucky to have had the opportunity to meet with graduate school representatives about possible M.S. and Ph.D. degree options.

Throughout his work on this project, Mr. Sergent has shown significant growth in skills, focus, and knowledge. He has even taken on the role of research mentor to other students who will work on the project in the future. Through this research and the emphasis on hands-on learning introduced in upper division courses, Eric has clearly found his niche and discovered his passion for fundamental geoscience research. As such, Eric is now in the process of applying to graduate school where he plans to work toward a master's degree where he can continue his research in Geology.

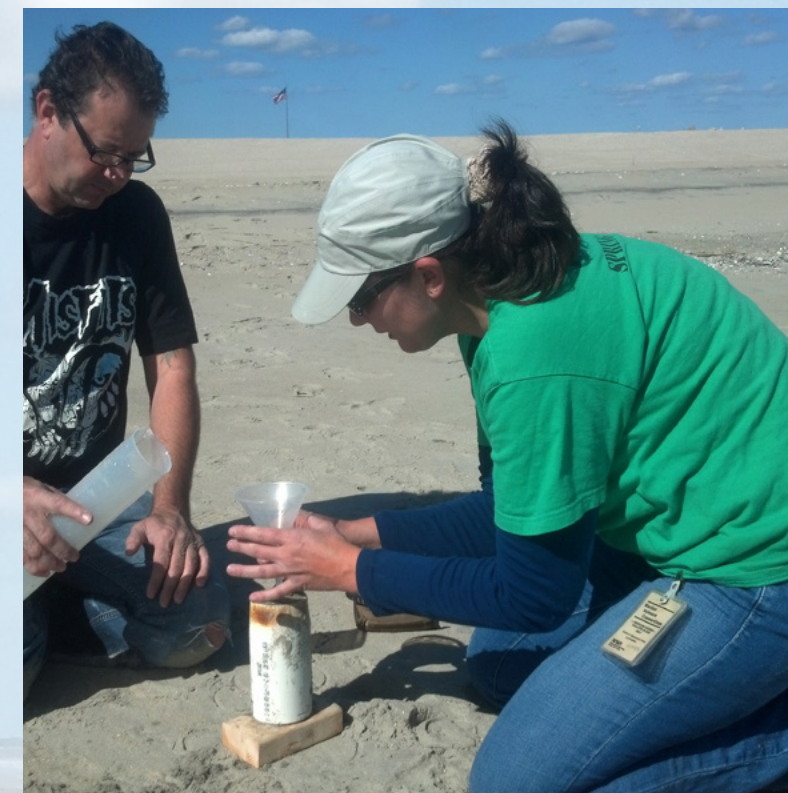
PROFILE, MRS. DANA HESTON

INSPIRING THE NEXT GENERATION

Mrs. Dana Heston is a non-traditional student at Shippensburg University and finished her B.S. in Geoenvironmental Studies in spring 2013. Mrs. Heston began taking college courses in 1991 at Sierra College in California, and despite being a full-time mom and assisting her husband with a busy flooring business; she has remained dedicated to the goal of receiving a Bachelor's degree. So in 2011, when her family moved to Pennsylvania, she was finally able to enroll fulltime at Shippensburg University. From her very first semester at SU, Dana has shown herself to be an extremely hardworking and conscientious student. She has fully engaged in her coursework and was initiated as a member of Gamma Theta Upsilon Honor Society as a result of her excellent grade point average. She has tirelessly shown true grit and determination in the face of many obstacles. Through it all, Mrs. Heston has shown herself to be a clear leader in the classroom where she often sets the bar for professional behavior and performance amongst her peers.

Outside of the classroom, as a second semester junior, Mrs. Heston began to take every opportunity to expand her skills and knowledge by serving as a field research assistant to other undergraduate and graduate students as well as faculty members. In this capacity, Dana has become familiar with geophysical field methods (i.e., Ground Penetrating Radar, Electrical Resistivity, etc.) and associated technology. Mrs. Heston took two courses at the MSC in the summer of 2012, one of which was Coastal Zone Resource Management. Through this course, she was introduced to the Wallops Island shoreline monitoring project and expressed an interest in carrying out an independent research project in support of this effort. Dana's project was initiated in October 2012 and has been ongoing throughout the winter and spring of 2013 through financial support obtained from two undergraduate research grants made available at Shippensburg University.

More specifically, Mrs. Heston's project has developed and implemented a protocol for mea-



Dana Heston (SU) holds a funnel while performing an in-situ porosity investigation as a part of her research on water infiltration rates in the Wallops beach (natural vs. replenished)

suring hydrogeologic parameters impacting infiltration of groundwater into the Wallops Island barrier island aquifer. Her study has focused on measuring infiltration rates and in-situ porosity of the natural beach system compared to the replenished beach in an effort to assess the potential impact of the newly replenished beach on the surface aquifer. Her research project titled, *Hydrogeological Investigation of Infiltration Rates in Natural and Man-Made Beaches at Wallops Island, Virginia*, was presented at the Geological Society of America Northeast Section Annual Meeting in Bretton Woods, New Hampshire in March 2013.

As a result of her coursework and research experiences, Dana has become particularly interested in hydrogeologic field methods and now plans to pursue an advanced degree in this area. She has already been accepted to the M.S. program at SU and will begin graduate studies in the fall.

2012 PROJECTS

This past year there were four research projects in collaboration between MSC and NASA GSFC WFF:

CubeSat Development

LiDAR Data Processing

Surface and Sub-Surface Mapping in the Coastal Zone of Wallops Island NASA Flight Facility: Monitoring Storm Response and Sea-Level Rise

Coastal Barrier Island Herpetofauna

CubeSat Development

Faculty Member

Dr. Haklin Kimm (ESU)

Wallops Mentor

Joel Simpson

Project Description

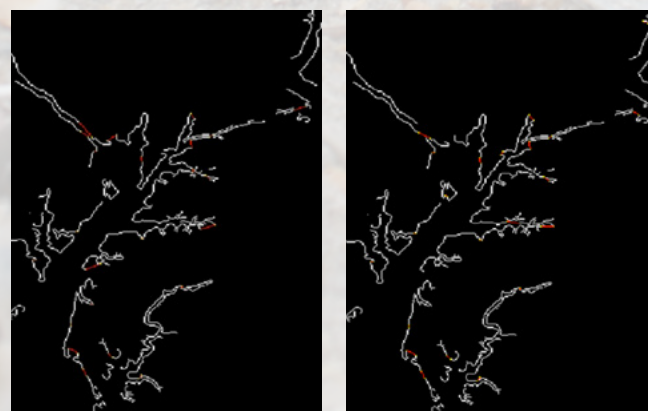
The research team has been reorganized last fall semester to keep working on the CubeSat projects. During the last fall semester, four students had been recruited – 2 computer science graduates and undergraduates each; and they had been trained on the PICKit2 programming, which is mandated for working on the CubeSat projects. At this time 2 graduate students are working on their thesis related to the CubeSat projects that the team had been working before; and we are still working on the projects as follows.

Accomplishments

The PocoSat 1 has been assembled to take pictures using C329 CMOS camera and transmit the picture images with a VHF/UHF band – Tinytrak 4, YAESU VX-3RIE radio. The picture image is hoped to be taken from the PocoSat 1 successfully and transmitted by Tinytrak 4 modem to a ground station. However, the PocoSat 1 is still in need of functional testing. There has been research related to PocoSat 1 project last semester: MatLab program development upon costal line image analysis – reconnecting broken edges of the coastline satellite images by applying heuristics. The preliminary research has been published and presented at the 10th IASTED International Conference on Visualization, Vision and Image Processing, Banff, Canada, July 3-5, 2012. The extension of this research has produced more encouraging outcomes upon the coastline satellite image analysis- edge linking algorithms using Markov Chains; and the heuristics based upon regres-

sion analysis have been developed. The developed heuristics for edge-linking algorithms have shown much improvement as shown in next figure, where the results of the implementation of two algorithms are compared side by side.

The PocoSat 2 is assembled to collect data on typical conditions upon launch for a CubeSat of average mass and proportions during a sounding rocket test. The PocoSat 2's payload is the Sparkfun SEN-10125: a "9-axis" sensor, in the sense that it provides three 3-axis sensors: an accelerometer, gyroscope, and a magnetometer. The accelerometer capabilities are supplied by an ADXL345 chip which offers 9-bit resolution. MXH2040 S-band and antenna are equipped on top of a Pumpkin CubeSat Kit. There has been interesting research related to PocoSat 2 project: developing multifunction GPS embedded Wrist Device for Runners; the on-going work of this research has been published and presented at the 16th IEEE International Symposium on Computer Electronics, Harrisburg, PA, June 2-4, 2012. The extension of this work has been invited to publish to the Journal of Consumer Electronics Times this semester. The part of PocoSat 2 work also has led us to initiate research on wireless small robot systems using Android and Bluetooth communications.



Local information vs. general information of directionality

LiDAR Data Processing

Faculty Member

Dr. Shixiong Hu (ESU)

Wallops Mentor

Scott Schaire

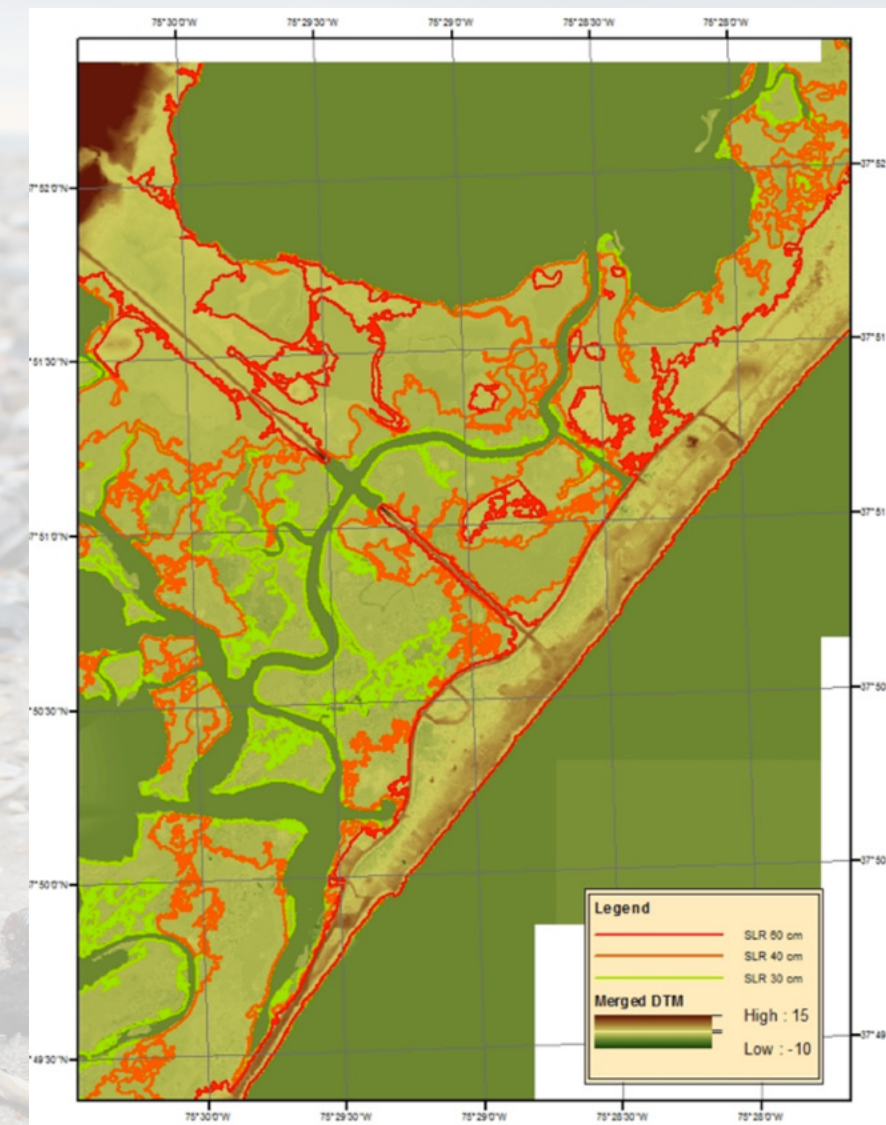
Project Description

The Virginia Eastern Shore/Delmarva Peninsula is an ideal test location for developing adaptive conservation approaches, particularly for migratory birds and their habitats.

Specifically, it is:

1. An internationally important coastal site for migratory wildlife populations
2. Part of a larger regional complex that functions as migratory staging sites between arctic and Central and South America
3. Supports vulnerable populations of piping plover, red knot and oystercatchers all vulnerable and threatened species
4. A data-rich environment-this provides us with opportunity to advance our knowledge and ability
5. A site of major cross-jurisdictional collaborations among federal and non-federal agencies

This project is using existing data including remote sensing LiDAR data (provided by NASA GSFC WFF) and The Nature Conservancy (TNC) to map current distributions of important coastal habitats, develop vegetation specific algorithms to reduce errors in calculation of elevations during the processing of LiDAR data, detail the likely areas of greatest impact from rising sea levels, quantify the rate of habitat change, and identify areas that may become important wetlands as the coastal systems attempt to migrate inland. These are all essential precursors to the effective management and protection of future coastal habitats of the Delmarva Peninsula under climate change.



Inundation area under different SLR scenarios based on DTM data

Accomplishments

1. Students constructed and placed reflectors in strategic locations for Airborne Topographic Mapper (ATM) LiDAR data collection using a miniaturized ATM on a UAV.
2. Obtained LiDAR data collected from miniaturized ATM on UAV.
3. Simulated inundation area under different scenarios (i.e., SLR of 30, 40 and 60 cm).
4. Shared DTM and DSM data.

Surface and Sub-Surface Mapping in the Coastal Zone of Wallops Island NASA Flight Facility: Monitoring Storm Response and Sea-Level Rise

Faculty Members

Dr. Adrienne Oakley (KU)
Dr. Sean Cornell (SU)

Wallops Mentor

Josh Bundick

2011-2012 Research Students

Jackie Chariw (KU)
Sarah Krueger (SU)
Eric McGilliard (SU)
Lisa Nocco (SU)
Matthew Sabetta (KU)
Eric Sergent (KU)
Jada Williams (SU)
Veronica Woodlief (SU)

2012-2013 Research Students

Thomas Bond (KU)
Aaron Bollinger (KU)
Tyler Clemens (SU)
Ryan Haas (SU)
Clayton Helm (SU)
Dana Heston (SU)
Nick Mathews (KU)
Eric Sergent (KU)
Eric Wink (KU)
Michael Stefanic (SU)

Project Description:

Coastal areas are continuously threatened by shoreline change and storm events. The barrier island of Wallops Island, Virginia, is home to NASA GSFC WFF. NASA GSFC WFF has been battling shoreline erosion and inundation by storms since the facility's inception over 60 years ago. This is because barrier islands are dynamic systems formed by the interaction of longshore currents, waves, wind, and

tidal energies that erode, transport, and deposit sediments. By absorbing the impact of high energy marine processes (waves, storm surges, longshore currents, etc.) active off the coast, barrier islands reduce erosion of the mainland. However, they are susceptible themselves to significant change on daily, monthly, and seasonal time scales. It becomes very important to investigate and document barrier islands such as these not only so that the processes that build islands can be understood, but so coastal resource managers can understand how (and if) we can safely manage both living and non-living resources located on and near these islands.

The principle goal of this research is to contribute to the ongoing efforts to document shoreline processes on Wallops Island and monitor recordable changes in marine shelled taxa. These efforts included both surface and sub-surface mapping investigations of Wallops. In 2011 a series of survey transect sites were established along the shoreline where topographic mapping and sub-surface geophysical mapping (via ground penetrating radar, GPR) could take place on repeating intervals and following significant storm events, i.e., Hurricanes Irene and Sandy. We also installed four shallow water wells outfitted with data loggers to measure tide and ground water levels, as well as changes in groundwater relative to major storm event components, i.e., rainfall vs. salt-influenced storm surge inundation. These investigations will help determine seasonal changes in groundwater flow, barrier island topography, shoreline position, and any changes in sediment grain size and/or distribution. The research also included mapping the spatial and temporal distribution of important species (mole crabs, coquina clams, horseshoe crabs, etc.) that play important roles in the food chain of various shorebirds that live within or otherwise utilize the shore environment.

Year-round monitoring of the shoreline along NASA GSFC WFF from March 2011- March 2012 allowed us to establish baseline conditions

prior to beach replenishment. We are currently working on the development of a comprehensive model for erosion and accretion patterns on seasonal and inter-annual time scales along the Wallops Island shoreline. Continued monitoring efforts from March-December 2012 have focused on investigating the impacts of beach replenishment on this system. During the course of this study, we have also focused on the response of the WI shoreline to two significant storm events, Hurricanes Irene and Sandy. These storms significantly altered the shore face and dune system on the island and caused overwash and salt water intrusion into the fresh water lens. GPR surveys allow us to map the freshwater-saltwater interface in order to investigate any changes in the flow of freshwater through the barrier island as a result of climate change and storm events. The geological and geophysical data, combined with the biological census reports documenting the relative abundance of key taxa, provide a comprehensive understanding of the impacts of shoreline change as a result of natural processes, i.e., longshore drift, sea level rise, and storm events, and anthropogenic processes, i.e., beach replenishment and shoreline alteration. In summer 2012, students from KU built a land based vibracore system to extract continuous sediment core samples, up to three meters in length. We chose our core sites to fall within the major environments of the barrier island system. Our vibracore sites run roughly NW-SE across the northern reach of Wallops Island from the back salt marsh to the modern dune line. The overall goal of the vibracore research project is to investigate storm overwash and rates of barrier island rollover on Wallops Island. In addition to contributing to the overall study of barrier islands, these data will help to inform NASA of the risks associated with Sea Level Rise (SLR), increased storm frequency, and barrier island migration. The results and knowledge gained from these activities are essential to future planning and storm response along the Wallops Island shoreline.

Conference Presentations

*Bold italics indicates student author

Bond, T., Sergent, E., Oakley, A., and Cornell, S.R., 2013, Grain Size Distribution and Sediment

Transport Patterns Along Wallops Island, Virginia: Pre- and Post-Beach Replenishment, and Post-Hurricane Sandy, *Abstracts with Programs-Geological Society of America 45 (1), p. 93. GSA*

Northeastern Section Annual Meeting.

Chariw, J. E.; Sabetta, M. J.; Oakley, A. J.; Cornell, S. R.; 2012, Monitoring In Situ Tidal Range and Surface Aquifer Recharge and Discharge on Wallops Island, Virginia, 2012 *ASLO-AGU Ocean Sciences Meeting*, Abstract ID:11742.

Heston, D.; Cornell, S.R., Oakley, A., **Heston, W.L., and Hawbaker, J.D.,** 2013, Hydrogeologic investigation of infiltration rates in natural and man-made beaches at Wallops Island, Virginia, *Geological Society of America Abstracts with Programs-45 (1), p. 94. GSA Northeastern Section Annual Meeting.*

McGilliard, E., Cornell, S. R., and Oakley, A., 2012, High resolution GIS mapping of shoreline change at Wallops Island, Virginia: A preliminary investigation of the impact of Hurricane Irene, *Geological Society of America Abstracts with Programs 44 (2), GSA Northeastern Section Annual Meeting.*

Nocco, L.M., and Cornell, S.R., 2012, Biostratigraphic Investigation of Horseshoe Crab (*Limulus Polyphemus*) Death Assemblages after Hurricane Irene, *Geological Society of America Abstracts with Programs*, Vol. 44, No. 2, p. 63 **GSA Northeastern Section Annual Meeting.**

Sergent, E., Bond, T., Oakley, A., and Cornell, S.R., 2012, Monitoring Sediment Transport and Grain Size Distribution along Wallops Island, Virginia, Pre and Post-Beach Replenishment, *Abstracts with Programs, Geological Society of America Annual Meeting*, Charlotte, North Carolina, Vol. 44, No. 7, p.

Wink, E.R., Oakley, A., Cornell, S.R., & **Bollinger, A.,** 2013, Investigating Barrier Island Migration and Storm Overwash on Wallops Island, VA, Through Vibracoring, *Geological Society of America Abstracts with Programs-45 (1), p. 94. GSA Northeastern Section Annual Meeting.*

Williams, J., Cornell, S. R., and Oakley, A., 2012, Preliminary Investigation of a Barrier Island Beach Aquifer at Wallops Island, Virginia Using Ground Penetrating Radar, *Geological Society of America Abstracts with Programs-44 (2), GSA Northeastern Section Annual Meeting.*

Woodlief, V. A.; Cornell, S. R.; **Sabetta, M.; Sergent, E.; McGilliard, E.;** Oakley, A., 2012, A GIS Analysis of the Chincoteague Inlet Eddy And Its Impact On the Shoreline Morphology of Northern Wallops Island, Eastern Shore Virginia, 2012 *ASLO-AGU Ocean Sciences Meeting*, Abstract ID:1121.



Dr. Oakley (KU) and students on NASA GSFC WFF beach

Coastal Barrier Island Herpetofauna

Faculty Members

Dr. Pablo R. Delis (SU)
Dr. Walter E. Meshaka (State Museum of Pennsylvania, Harrisburg, PA)

Wallops Mentor

Joe Mitchell

Project Description

Long-term ecological studies are highly desirable yet relatively scarce in the literature. The goals of this project are to inventory the amphibians and reptiles of the southern barrier islands beginning with Wallops Island and to monitor a subset of the herpetofauna. Results from our study, including a comparison of the biodiversity of the barrier islands with that of the adjacent mainland, will provide land managers from state and federal agencies with the sorts of information necessary to further agency management goals with respect to effective management of the natural resource. A combination of sampling techniques will provide multiple layers of data to assess status of species with respect to their presence and, for some species, population dynamics. Involvement of students and colleagues and sharing results through publications and outreach will enhance the understanding, the management, and the public appreciation of this interesting biological resource. The study area provides a living laboratory, large and protected, to ascertain the composition of and the responses by segments of this community to natural and human-mediated perturbations to their environment and, in so doing, provides the information necessary for effective conservation measures of sensitive species.

Accomplishments

After two years of surveys at Wallops Island, we are reaching a better understanding of its herpetofaunal community. Currently, a total of 4 species of snakes have been identified in the island. In 2012 alone, 14 new individual snakes have been captured and marked, bringing the total number of marked snakes in the island to 24. Up to today, no recaptures have been made suggesting potentially large populations. A new species of snake, the Common Garter Snake (*Thamnophis sirtalis*) was detected from road surveys in September. The most abundant snake, 80% of captures in 2012, was the Eastern Racer (*Coluber constrictor*) followed by the Eastern Hognose Snake (*Heterodon plati-*

rhinos). The Eastern Rat Snake, (*Scotophis alleghaniensis*) appears to be the one rarest of the species, and in 2012 no new individuals of this species have been captured. Of the two species of turtle in the island, the most abundant seems to be the Eastern Mud Turtle, (*Kinosternum subrubrum*), although the Diamondback Terrapin (*Malaclemys terrapin*) visited the island seasonally and nested intensively, mostly in June. No lizards have yet been detected in the island. A new species of amphibian, identified through calling surveys, the Green Treefrog (*Hyla cinerea*), has been added to the 3 species already detected on Wallops Island in 2011. The most common species of amphibian in terrestrial habitats remains the Fowler's Toad (*Anaxyrus fowleri*). The most abundant species in aquatic environments seems to be the Southern Leopard Frog (*Lithobates sphenoccephalus*). This species produced the earliest and largest breeding event of the island based on egg masses counts, in March 3. Although Spring Peepers (*Pseudacris crucifer*) were found, and reproductively active, in this date in the mainland, they have yet to be identified in the island. Unlike in 2011, no Red-back Salamanders (*Plethodon cinereus*) were detected in 2012.



Egg mass from Southern Leopard Frogs, *Lithobates sphenoccephalus*



Grant Melville (MSC staff) holding an Eastern Mud Turtle, *Kinosternum subrubrum*



Green Treefrog, *Hyla cinerea*, mating in 2012 surveys

Atlantic Estuarine Research Society (AERS)

The Fall Meeting of the Atlantic Estuarine Research Society (AERS) was held in Chincoteague, VA, from Oct. 11-13, 2013. The meeting was hosted by AERS members Julie Ambler and Ajoy Kumar from Millersville University and the MSC, Tiffany Moisan from the NASA GSFC WFF, and AERS colleagues from nearby institutions. The meeting began with a Thursday night opening reception hosted by Amber Parker, Executive Director at MSC.

On Friday morning at the Chincoteague Center, four keynote speakers began the meeting with talks about, Ecosystem Sustainability & Resilience: From Genetics to Populations, Habitats & Function. Their talks covered a wide range of current topics that are especially relevant for the Eastern Shore. Mark Luckenbach (Director, Eastern Shore Lab, Wachapreague, VA, Virginia Institute of Marine Science) used the Delmarva Peninsula as a model system to explain ecological and social sustainability and resilience in shellfish aquaculture. Michael Peek (William Paterson University, NJ) discussed how the diversity of American Beachgrass from different geographic areas can affect dune restoration. Rob Condon (Dauphin Island Sea Lab, AL) discussed the role of anthropogenic stressors on ecosystem functioning in terms of global jellyfish blooms and oil spills. Louis Hinds (Refuge Manager, CNWR) emphasized how the Delmarva Peninsula is a strategic habitat for the Atlantic Flyway. Mark Brush, AERS President, gave a talk commemorating the many contributions of his former advisor, friend, and colleague, Scott Nixon (University of Rhode Island) to understanding coastal ecosystems.

After lunch on Friday we had a special session on, Observation of Environmental Impacts from Space, with Tiffany Moisan giving the first talk, *Strong temperature gradients in the Mid-Atlantic Bight affect phytoplankton taxonomic composition in cyanobacteria: implications for carbon*



NASA GSFC WFF beach

cycle dynamics. She then introduced NASA scientist and former astronaut Piers Sellers of the Goddard Space Flight Center who gave a special seminar titled, *Modeling and Observing the Climate system.* The meeting had 114 attendees and featured 24 contributed talks (14 by students), and 30 contributed posters (18 by students).

Field trips were sponsored by the MSC, CNWR, and NASA GSFC WFF before the meeting on Thursday afternoon and after the meeting on Saturday afternoon. Meeting attendees toured Wallops Island to see the scientific and military sites including a complete replica of a ship on land! Later they walked along the beach at Wallops Island to find many horseshoe crab carapaces and shells of all kinds. AERS member Chris Swarth led an early morning birding trip on the CNWR. Kevin Holcomb arranged a field trip to the CNWR visitor center and gave a talk. Ali Redman from the MSC arranged a boat trip to the salt marsh channels.

AERS is grateful to the meeting sponsors, including CERF (Coastal Estuarine Research Federation, national group of AERS), the Chesapeake Bay Program, the Delaware Center for the Inland Bays, the MSC, the Maryland Coastal Bays Program, Maryland Sea Grant, the Richard Stockton College of New Jersey, The Nature Conservancy, Virginia Coast Reserve, the Virginia Institute of Marine Science, and YSI.



Coastal Zone Research Symposia

In May 2012 and May 2011, successful Coastal Zone Research Symposia were held at the MSC where faculty and students, NASA GSFC WFF, USFWS, and the U.S. Department of Agriculture Animal and Plant Health Inspection Service shared the results of their projects and collaborations. Approximately 100 people attended each event. There was wide diversity of research represented. It demonstrated the health and growth of the MSC along the relationships with NASA and other regional organizations.

Below is the agenda from the May 2012 Coastal Zone Research Symposium.

- **8:30 am – 8:50 am: Check-in and Registration**
- **8:50 am – 9:20 am: Welcome:**
 - Amber Parker, Executive Director of the MSC
 - Thomas Tauer, MSC Liaison to NASA GSFC WFF and Assistant Provost, ESU
 - William Wrobel, Director NASA GSFC WFF
 - Walt Petersen, Office Head, Wallops Science Branch, NASA GSFC WFF
 - Louis Hinds, Refuge Manager of CNWR Complex, CNWR & Eastern Shore of Virginia Wildlife Refuge
- **9:20 am – 9:40 am:**
 - Presentation: Wallops Coastal Zone Mapping Report Part I: Water-level Monitoring, Coastal Hydrographic Assessment, and Shoreline Grain Size Analysis and Transport by Adrienne Oakley, Department of Physical Sciences, KU
- **9:40 am – 10:00 am:**
 - Presentation: Wallops Coastal Zone Mapping Report Part II: Subsurface Mapping, Beach Community Monitoring, and Hurricane Irene Storm Response and Recovery by Sean Cornell, Department of Geography & Earth Science, SU

- **10:00 am – 10:20 am:**
 - Presentation: The Beach Nourishment Project at NASA GSFC WFF and its Environmental Components by Michael Bonsteel Health, Safety, and Environmental Specialist II, NASA GSFC WFF
- **10:20 am – 10:40 am:**
 - Presentation: Projecting the Impacts of Climate Change and Identifying Adaption Options at the CNWR by Ajoy Kumar, Department of Earth Sciences, MU and Shixiong Hu, Department of Geography, ESU
- **10:40 am – 11:00 am:**
 - Break: Posters on Display
- **11:00 am – 11:20 am:**
 - Presentation: Mini-Airborne Topographic Mapper (ATM) LiDAR – Capabilities and Results from Recent Demonstration Flights by Michael Hitch, Technology Manager, Suborbital and Special Orbital Projects, NASA GSFC WFF
- **11:20 am – 11:40 am:**
 - Presentation: Inexpensive Tethered Aerial Data Gathering Platform by Jeffrey Sumey Department of Applied Engineering and Technology, CU
- **11:40 am – 12:00 pm:**
 - Presentation: Kites for Science – Advancing Earth Research Observation Kites and Tethered Systems by Geoff Bland, Research Engineer, Earth

Sciences Field Support Office,
NASA GSFC WFF

- **12:00 pm – 1:00 pm:**
 - Lunch: Posters on Display
- **1:00 pm – 1:20 pm:**
 - Presentation: Reliable Cube/ Small Sat Bus System Development and Systems Integration by Haklin Kimm, Department of Computer Science, ESU
- **1:20 pm – 1:40 pm:**
 - Presentation: NASA Coastal Research Education Experience: A Collaborative, Hands-on Approach to Learning by Brian Campbell, NASA Senior Earth Science Education Specialist, NASA GSFC WFF
- **1:40 pm – 2:00 pm:**
 - Presentation: From Drop To Drain: Water at Wallops by Owen Hooks, Air & Water Programs Manager, NASA GSFC WFF
- **2:00 pm – 2:20 pm:**
 - Presentation: Chesapeake Habitat Conservation Framework: Designing Sustainable Landscapes Pilot in the Pocomoke and Nanticoke River Systems by Michael Slattery, Chesapeake Bay Coordinator, USFWS

- **2:20 pm – 2:40 pm:**
 - Presentation: Chesapeake Bay Nutria Eradication Project by Steve Kendrot, Supervisory Wildlife Biologist, U.S. Department of Agriculture Animal and Plant Health Inspection Service, Wildlife Services
- **2:40 pm – 3:00 pm:**
 - Break: Posters on Display
- **3:00 pm – 3:20 pm:**
 - Presentation: Status and Conservation of the Wallops Island Coastal Barrier Island Herpetofauna by Pablo Delis, Department of Biology, SU
- **3:20 pm – 3:40 pm:**
 - Presentation: Investigations of Island Dwarfism in Fowler's Toad on Barrier Islands of the Eastern Shore by John Hranitz, Department of Biological & Allied Health Sciences, BU
- **3:40 pm – 4:00 pm:**
 - Presentation: Citizen Science at the MSC by Anne Armstrong, Education Programs Manager, MSC
- **4:00 pm:**
 - Concluding Remarks by Thomas Tauer, MSC Liaison to NASA GSFC WFF and Assistant Provost, ESU

Through the Coastal Zone Research Symposia and the partnership it represents, NASA GSFC WFF, MSC, CNWR, and USFWS are empowering faculty and students to be passionate and enthusiastic about scientific research, discovery, and engineering.



2013 PROJECTS

The following four projects are planned to continue in 2013:

CubeSat Development

LiDAR Data Processing

Coastal Barrier Island Herpetofauna

Surface and Sub-Surface Mapping in the Coastal Zone of Wallops Island NASA Flight Facility: Monitoring Storm Response and Sea-Level Rise

CubeSat Development

Faculty Member
Dr. Haklin Kimm (ESU)

Wallops Mentor
Joel Simpson

Project Description

The research team has been reorganized last fall semester to keep working on the CubeSat projects. During the last fall semester, four students had been recruited – 2 computer science graduates and undergraduates each; and they had been trained on the PICKit2 programming, which is mandated for working on the CubeSat projects. At this time 2 graduate students are working on their thesis related to the CubeSat projects that the team had been working before; and we are still working on the projects as follows.



PocoSat 2

ESU PocoSat 1 and PocoSat 2

The PocoSat 1 has been assembled to take pictures using C329 CMOS camera and transmit the picture images with a VHF/UHF band – Tinytrak 4, YAESU VX-3RIE radio. The picture image is hoped to be taken from the PocoSat 1 successfully and transmitted by Tinytrak 4 modem to a ground station. However, the PocoSat 1 is still in need of functional testing. There has been research related to PocoSat 1 project last semester: MatLab program development upon costal line image analysis – reconnecting broken edges of the coastline satellite images by applying heuristics. The preliminary

research has been published and presented at the 10th IASTED International Conference on Visualization, Vision and Image Processing, Banff, Canada, July 3-5, 2012. The extension of this research has produced more encouraging outcomes upon the coastline satellite image analysis- edge linking algorithms using Markov Chains; and the heuristics based upon regression analysis have been developed. The developed heuristics for edge-linking algorithms have shown much improvement.

The PocoSat 2 is assembled to collect data on typical conditions upon launch for a CubeSat of average mass and proportions during a sounding rocket test. The PocoSat 2's payload is the Sparkfun SEN-10125: a "9-axis" sensor, in the sense that it provides three 3-axis sensors: an accelerometer, gyroscope, and a magnetometer. The accelerometer capabilities are supplied by an ADXL345 chip which offers 9-bit resolution. MXH2040 S-band and antenna are equipped on top of a Pumpkin CubeSat Kit. There has been interesting research related to PocoSat 2 project: developing multifunction GPS embedded Wrist Device for Runners; the on-going work of this research has been published and presented at the 16th IEEE International Symposium on Computer Electronics, Harrisburg, PA, June 2-4, 2012. The extension of this work has been invited to publish to the Journal of Consumer Electronics Times this semester. The part of PocoSat 2 work also has led us to initiate research on wireless small robot systems using Android and Bluetooth communications.

The ESU CubeSat team is expected to continue their efforts on the CubeSats so that the capable students for the projects, who can stay with the team for a year or more, shall be recruited and educated for the project. There should be a constructive way of recruiting and containing the students for the project so that the team can be revamped for the fruitful completion of the CubeSat projects.

LiDAR Data Processing

Faculty Member
Dr. Shixiong Hu (ESU)

Wallops Mentor
Scott Schaire

Project Description

The Virginia Eastern Shore/Delmarva Peninsula is an ideal test location for developing adaptive conservation approaches, particularly for migratory birds and their habitats.

Specifically, it is:

1. An internationally important coastal site for migratory wildlife populations
2. Part of a larger regional complex that functions as migratory staging sites between arctic and Central and South America
3. Supports vulnerable populations of piping plover, red knot and oystercatchers all vulnerable and threatened species
4. A data-rich environment-this provides us with opportunity to advance our knowledge and ability
5. A site of major cross-jurisdictional collaborations among federal and non-federal agencies

This project is using existing data including remote sensing LiDAR data (provided by NASA GSFC WFF) and The Nature Conservancy (TNC) to map current distributions of important coastal habitats, develop vegetation specific algorithms to reduce errors in calculation of elevations during the processing of LiDAR data, detail the likely areas of greatest impact from Sea Level Rise (SLR), quantify the rate of habitat change, and identify areas that may become important wetlands as the coastal systems attempt to migrate inland. These are all essential precursors to the effective management and protection of future coastal habitats of the Delmarva Peninsula under sea level rise. We are also in the process of comparing LiDAR data collected from a manned airplane to a miniaturized ATM flown on a UAV.

Planned Accomplishments

Obtain financial support to hire students and acquire specialized software to convert the LiDAR data collected from the miniaturized ATM into the same format as obtained via manned flight using larger ATM. The goal is to compare data accuracy between the two ATM's.



Wildlife of the Eastern Shore

Surface and Sub-Surface Mapping in the Coastal Zone of Wallops Island NASA Flight Facility: Monitoring Storm Response and Sea-Level Rise

Faculty Members

Dr. Adrienne Oakley (KU)
Dr. Sean Cornell (SU)

Wallops Mentor

Josh Bundick

2012-2013 Research Students

Thomas Bond (KU)
Aaron Bollinger (KU)
Tyler Clemens (SU)
Ryan Haas (SU)
Clayton Helm (SU)
Dana Heston (SU)
Nick Mathews (KU)
Eric Sergent (KU)
Eric Wink (KU)
Michael Stefanic (SU)

Project Description:

Coastal areas are continuously threatened by shoreline change and storm events. The barrier island of Wallops Island, Virginia, is home to NASA GSFC WFF. NASA GSFC WFF has been battling shoreline erosion and inundation by storms since the facility's inception over 60 years ago. This is because barrier islands are dynamic systems formed by the interaction of longshore currents, waves, wind, and tidal energies that erode, transport, and deposit sediments. By absorbing the impact of high energy marine processes (waves, storm surges, longshore currents, etc.) active off the coast, barrier islands reduce erosion of the mainland. However, they are susceptible themselves to significant change on daily, monthly, and seasonal time scales. It becomes very important to investigate and document barrier islands such as these not only so that the processes that build islands can be understood, but so coastal resource managers can understand how (and if) we can safely manage both living and non-living resources located on and near these islands.

The principle goal of this research is to contribute to the ongoing efforts to document shoreline processes on Wallops Island and

monitor recordable changes in marine shelled taxa. These efforts included both surface and sub-surface mapping investigations of Wallops. In 2011 a series of survey transect sites were established along the shoreline where topographic mapping and sub-surface geophysical mapping (via ground penetrating radar, GPR) could take place on repeating intervals and following significant storm events, i.e., Hurricanes Irene and Sandy. We also installed four shallow water wells outfitted with data loggers to measure tide and ground water levels, as well as changes in groundwater relative to major storm event components, i.e., rainfall vs. salt-influenced storm surge inundation. These investigations will help determine seasonal changes in groundwater flow, barrier island topography, shoreline position, and any changes in sediment grain size and/or distribution. The research also included mapping the spatial and temporal distribution of important species (mole crabs, coquina clams, horseshoe crabs, etc.) that play important roles in the food chain of various shorebirds that live within or otherwise utilize the shore environment.

Year-round monitoring of the shoreline along NASA GSFC WFF from March 2011- March 2012 allowed us to establish baseline conditions prior to beach replenishment. We are currently working on the development of a comprehensive model for erosion and accretion patterns on seasonal and inter-annual time scales along the Wallops Island shoreline. Continued monitoring efforts from March-December 2012 have focused on investigating the impacts of beach replenishment on this system. During the course of this study, we have also focused on the response of the WI shoreline to two significant storm events, Hurricanes Irene and Sandy. These storms significantly altered the shore face and dune system on the island and caused overwash and salt water intrusion into the fresh water lens. GPR surveys allow us to map the freshwater-saltwater interface in order to investigate any changes in the flow of freshwater through the barrier island as a result of climate change and storm events. The geological and geophysi-

cal data, combined with the biological census reports documenting the relative abundance of key taxa, provide a comprehensive understanding of the impacts of shoreline change as a result of natural processes, i.e., long-shore drift, sea level rise, and storm events, and anthropogenic processes, i.e., beach replenishment and shoreline alteration. In summer 2012, students from KU built a land based vibracore system to extract continuous sediment core samples, up to three meters in length. We chose our core sites to fall within the major environments of the barrier island system. Our vibracore sites run roughly NW-SE across the northern reach of Wallops Island from the back salt marsh to the modern dune line. The overall goal of the vibracore research project is to investigate storm overwash and rates of barrier island rollover on Wallops Island. In addition to contributing to the overall study of barrier islands, these data will help to inform NASA of the risks associated with Sea Level Rise (SLR), increased storm frequency, and barrier island migration. The results and knowledge gained from these activities are essential to future planning and storm response along the Wallops Island shoreline.

Future Goals:

Research efforts, provided funding is made available, will continue through the upcoming year to focus on:

- 1) Continued total station mapping of beach topography, and GPS mapping of shoreline features, i.e., high tide line, storm tide wrack, low tide line, etc.
- 2) Evaluation and refinement of sediment transport models through mathematical modeling of wave hydrograph data collected using data loggers, and aerial imagery, to be coordinated by Dr. Ben Galluzzo (SU)
- 3) Evaluation and refinement of hydrologic data and Ground Penetrating Radar imagery to establish groundwater flow parameters (in situ porosity, permeability, direction of flow) and map the freshwater aquifer and its behavior in response to rainfall/drought, storm

surge, and tidal fluctuations.

- 4) Shell bed analysis. Students have already mapped the occurrence of shell bed samples and established qualitative trends in biodiversity and relative abundance data. Statistical analyses will be completed in order to determine the composition of shallow marine benthic communities and their distribution patterns immediately offshore.
- 5) Repetition of sediment sampling and analyses in the wake of shoreline replenishment activities to determine sediment transport rates to better inform longevity of replenishment effectiveness.
- 6) Procurement and evaluation of recent aerial photography to investigate near-shore circulation patterns (flow paths of normal and reversed long shore currents, inlet eddies, wave refraction patterns, etc.)
- 7) Integration of historical climate records of significant storm events with shoreline change assessments and tide monitoring records. These will then be used to formulate a storm response categorization to help inform mitigation and storm response planning strategies for NASA GSFC WFF.



KU students and Dr. Adrienne Oakley pose with the vibracore tripod in the phragmites stand along the helipad road

Coastal Barrier Island Herpetofauna

Faculty Members

Dr. Pablo R. Delis (SU)
Dr. Walter E. Meshaka (State Museum of Pennsylvania, Harrisburg, PA)

Wallops Mentor

Joe Mitchell

Project Description

Long-term ecological studies are highly desirable yet relatively scarce in the literature. The goals of this project are to inventory the amphibians and reptiles of the southern barrier islands beginning with Wallops Island and to monitor a subset of the herpetofauna. Results from our study, including a comparison of the

biodiversity of the barrier islands with that of the adjacent mainland, will provide land managers from state and federal agencies with the sorts of information necessary to further agency management goals with respect to effective management of the natural resource. A combination of sampling techniques will provide multiple layers of data to assess status of species with respect to their presence and, for some species, population dynamics. Involvement of students and colleagues and sharing results through publications and outreach will enhance the understanding, the

management, and the public appreciation of this interesting biological resource. The study area provides a living laboratory, large and protected, to ascertain the composition of and the responses by segments of this community to natural and human-mediated perturbations to their environment and, in so doing, provides the information necessary for effective conservation measures of sensitive species.

Planned Accomplishments

A combination of incremental sampling techniques provides the best opportunity to detect the presence of amphibians and reptiles as well as to provide a quantifiable measure of their abundances and population trends.

Opportunistic calling surveys- To detect the presence of frogs and toads, nocturnal chorus surveys will be employed during each of the four seasons at sites along wetlands. (To continue from 2011 into 2013)

Dip net and turtle trap sampling- To detect the presence of amphibians primarily at the larval stage and secondarily to detect aquatic reptiles, this year with focus on aquatic turtles. (Effective May, July, and September 2013)

Opportunistic road night cruising- To detect terrestrial and aquatic active amphibians and reptiles, stretches of roads will be traveled during each of the four seasons specifically at night and after intensive rains. Data will be entered as GPS points denoting specific finds. (To continue from 2011 into 2013)

Cover boards- To detect amphibians and reptiles and provide a passive technique for monitoring species. (To continue monthly from 2011 into 2013)

Drift fences/pitfalls/funnel trapping- To detect amphibians and reptiles and provide a more intensive technique for monitoring species in highly productive areas. (To be enacted in May 2013)

Transects- To detect amphibians and reptiles on designated high value habitats, transects will be searched for actively moving individuals as well as for individuals under cover (To continue into 2013).

Herpetofaunal communities will continue to be assessed using, list of species, richness, and biodiversity indices. A more complete species list will be developed to compare the barrier island habitats with those of the adjacent mainland. More refined measurements of population structure will be accomplished within different habitats and for key species of the barrier islands. This research is now becoming more targeted and intensive in 2013.



Dr. Pablo Delis (SU) teaching herpetological techniques to Field Methods class at Wallops Island

2014 POTENTIAL PROJECTS

The following three projects have been identified by NASA GSFC WFF as potential projects and will be discussed further with MSC faculty to determine if there is interest:

Distributed Wind Monitoring System for Wallops Island Experiment

Shoreline Restoration and Infrastructure Protection Program (SRIPP) Animal Colonization Project

Finer Resolution NOAA (National Oceanic and Atmospheric Administration) SLOSH (Sea, Lake and Overland Surges from Hurricanes) Model for Local Coastal Zone



Distributed Wind Monitoring System for Wallops Island Experiment

Wallops Mentor
Geoff Bland

Project Description

The MSC may be a great candidate for studying the local wind field of Wallops Island. Recent work by MSC includes a study of the Wallops Island dune topography, with some correlation to wind measurements. An expansion of this work might encompass several continuous measurement sites, as well as provisions for vertical profiling. Local scale variations in wind strength and direction can be difficult to monitor, but knowledge of trends and characteristics can be important. Multiple instrumented sites with 100 meter grid spacing, for example, will yield details with resolution that are difficult to obtain from space or aircraft. Use of portable towers, kites, or tethered balloons can also be combined to capture the variation with altitude.

Information on the occurrences of sea breezes, storm impacts, and general land influences may assist in Wallops launch range activities, as well as possibly contributing to the understanding of

potential variations in erosion. This work may also highlight the potential of such a measurement technique for broader applications. Wind variation in the vicinity of airports, for example, is a potential concern that may be evaluated with a distributed sensor technique. Likewise, volcano or chemical plume tracking might benefit from portable systems that can achieve a three dimensional picture, particularly with a larger scale measurement system array. Instrumentation and data systems; field deployment strategies; and data capture and analysis can all be explored and matured with a Wallops Island experiment. An area of possibly 1000 x 1000 meters will be sufficient to begin this experiment, perhaps to the north, well away from other activities.

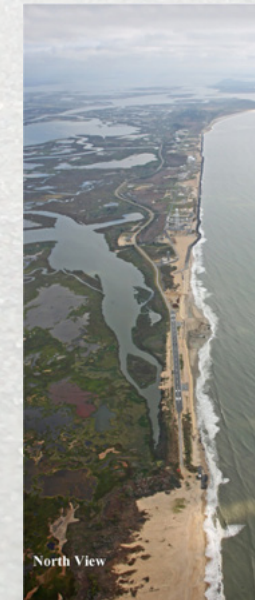
Any preliminary or proof-of-concept work conducted by MSC in anticipation of future NASA solicitations will most likely be beneficial. Additionally, once a distributed wind monitoring capability is operational and proven, it may be suitable for NASA research activities such as those outlined in the 2011 solicitation, "Impacts of Climate Variability and Change on NASA Centers and Facilities (ROSES A.30)."

Finer Resolution NOAA (National Oceanic and Atmospheric Administration) SLOSH (Sea, Lake and Overland Surges from Hurricanes) Model for Local Coastal Zone

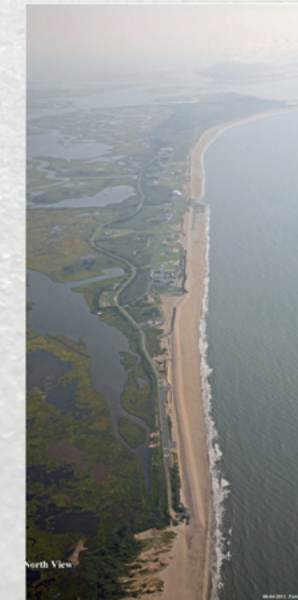
Wallops Mentor
Josh Bundick

Project Description

Coastal zone research ongoing by MSC and other organizations could be used to build finer resolution data inputs (e.g., topography and bathymetry) for the NOAA SLOSH model that would be beneficial for predicting storm-induced flooding on Assawoman, Chincoteague, Assateague, and Wallops Islands.



Before 2011



After August 2012 before Hurricane Sandy



November 2012 after Hurricane Sandy

Shoreline Restoration and Infrastructure Protection Program (SRIPP) Animal Colonization Project

There is the possibility of a project to study colonization of the beach nourishment project site by animals. This work would build upon current study of the project site by the MSC, Assessing Coastal Environment Change: Monitoring Storm Response, Sea Level Rise, and Biodiversity on Wallops Island, Virginia. Because the SRIPP is a 50-year project, the potential exists for a multi-decadal study of initial site colonization and subsequent recolonizations following renourishment and storms.

The study would be comprised of three sites: 1) north/recreational beach (control), 2) middle beach (Test A), and south beach (Test B).

The rationale for these choices is based mainly on the pre-nourishment substrate. The north beach is used as a control because it does not require any nourishment and represents a natural beach (though it is accreting with material which may be different than that which was present in the middle or south beaches). The middle beach is a primary test because it is generally all new material with little-to-no intertidal base. In other words, this area is brand new beach of a different material than that which existed in the past. The south beach is an interesting site because it contains the additional variable of a previously-existing substrate. That is, colonization may differ here because the fill material is being placed upon existing intertidal sand.

At each site, the following variables should be assessed: a.) existing beach fauna (particularly ghost crabs, mole crabs, and coquina clams), b) existing offshore aquatic species, c) existing shorebirds, d) sand grain size, e) mineralogy, f) beach profile (using UAV LiDAR), g) sediment profile, h) water table.

This baseline data could then be compared to: a.) surveys for beach fauna, aquatic species, and shorebirds (weekly or monthly, depending on the species) for the first year following the initial nourishment, b) changes in beach profile (annual or semi-annual), c.) changes in sediment profile (annual), d.) changes in water table (quarterly), e.) surveys for species following storm events and renourishment

projects, f.) changes in b, c, and d following storm events and renourishment projects. Any variation in b, c, or d among sites should have an effect on use by animals.

There are three key questions (from which hypotheses could be generated) which should be answered by the study: Are there significant differences in? 1.) the populations of ghost crabs, mole crabs, and coquina clams and shorebird populations among three sites and in the fish community offshore of each of these sites, 2.) the ability of terrestrial, intertidal, and aquatic communities among three sites to recover following storm events and beach renourishment, and 3.) the use of the three sites by shorebirds and sea turtles for nesting?

Actual techniques for data acquisition in a local project would have to be developed with any partner institutions or agencies. Surveys for vegetation are not included since the nourishment site is to be planted, but that may be an interesting area of study as well.

From an ecological standpoint, the most valuable foundation species for establishment of functioning communities on nourished beach sites are mole crabs (*Emerita talpoida*) and coquina clams (*Donax variabilis*). NASA GSFC WFF would be most interested in the use of the beach by piping plovers (*Charadrius melodus*) and sea turtles, including loggerheads (*Caretta caretta*) for nesting, as well as by piping plovers and red knots (*Calidris canutus rufa*) as a foraging site. A short list of "species of interest" is as follows: 1.) Coquina clams (*Donax variabilis*), 2.) Mole crabs (*Emerita talpoida*), 3.) Ghost crabs (*Ocypode quadrata*), as an indicator of in fauna availability, including coquina clams and mole crabs, 4.) Piping plovers (*Charadrius melodus*), 5.) Red knots (*Calidris canutus rufa*), 6.) Sanderlings (*Calidris Alba*), another in fauna abundance indicator species, 7.) Logger head sea turtles (*Caretta caretta*).

Studies of offshore species could be conducted as well, either separately or in conjunction with terrestrial/intertidal species surveys.



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Science on the Shore

The Science on the Shore series is a collaborative effort of NASA, MSC, USFWS, TNC, and the Eastern Shore Community College (ESCC). This program offers the Eastern Shore community educational presentations and kid-friendly activities based on local science-based research and ecology. Each partner organization sponsors research and science activities, providing opportunities for hands-on participation and attendance at unique speaker series including presentations by world-class scientists. All in all, 2012 was a busy year for Science on the Shore, with events ranging in scope from local interest to global matters.

An event was held on May 19th at the NASA WFF Visitor Center. It was titled, *Native Plants: They're Shore Beautiful!* Anne Armstrong of the MSC and Plant ES Natives campaign discussed the use of native plants in residential settings. Children planted and took home seeds of native flowers.

On June 15th and 16th, the Chincoteague Natural History Association held a workshop by award-winning coastal geologist Dr. Orrin Pilkey. Dr. Pilkey gave two presentations, titled, *Barrier Islands of the World* and *Dynamic Changes on Barrier Islands*. Attendees were treated to a beach walk with Dr. Pilkey to observe characteristics of change on two beaches.

In celebrating the fiftieth anniversary of the publication of her seminal work, the Chincoteague Natural History Association hosted a on August 24th presentation titled, *Rachel Carson: The Legacy of Silent Spring*. The presentation was given by Patricia DeMarco, Director of the Rachel Carson Institute in the School of Sustainability and the Environment at Chatham University.

On October 20th, the Marine Science Consortium held its annual Open House event. Activities included boat trips to Cockle Creek, beachcombing on Wallops Island, and a variety of activities and exhibits for children.

In coordination with its 2012 climate change workshop, NASA WFF hosted an event on November 13th at the Visitor Center titled, *Climate*

Change, Global and Local. The event included two talks regarding climate change. The first was by Dr. Joel Scheraga, the Senior Advisor for Climate Adaptation in the EPA's Office of Policy in the Office of the Administrator, and contributor to the Nobel Prize-winning 2007 United Nations Intergovernmental Panel on Climate Change. The second talk was by Skip Stiles, Executive Director of Wetlands Watch, a local grassroots-level organization focused on wetland protection and sea level rise awareness.

Following the impacts of the 2012 hurricane season, NASA and the MSC hosted a presentation on December 13th titled, *Impacts of Hurricane Sandy on Assateague and Wallops*. Kenny Volante of NASA discussed the emergency preparedness actions required for WFF to respond to the threat of Hurricane Sandy and the damage it caused. He was followed by Kevin Holcomb of the USFWS, who addressed impacts of Hurricane Sandy on Assateague Island and recovery efforts implemented by his agency.



MSC guests examine species netted from Cockle Creek



Pumpkins carved at the MSC Open House

2014 AND BEYOND

NASA GSFC WFF is an appealing and fun place to visit and naturally inspires the next generation of scientists and engineers. The plans for 2014 and beyond are exciting with plans for primarily meeting the following objectives:

NASA GSFC WFF: Enabling Education, Outreach, and Innovative Partnerships:

Support other NASA goals and objectives by providing science and technology education programs including innovative partnerships with academia, other Government agencies, and industry.

It is expected that the collaboration with USFWS, ESCC, and TNC will become stronger through continuation and expansion of Science on the Shore, coastal zone research and other future collective projects.

MSC: Expanded Research Opportunities:

The MSC will strive to establish expanded research opportunities, intended to spur greater student interest in science, technology, engineering, and math (STEM) fields and to enhance faculty expertise.

It is expected that the technical cooperative projects will continue and grow and that MSC engineering and science contributions will increase as follows:

- CubeSat Development** – MSC developing and launching a CubeSat.
- Instrumentation development** – Success with miniaturization leads to further science applications.
- Coastal Zone Research** – Success with data collection, algorithm development and processing leads to further joint projects with the USFWS, TNC, and other institutions, as well as to other science missions.



Dr. Thomas Tauer (MSC Liaison to NASA GSFC WFF) near the Global Hawk UAV





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