

(1) Title of the grant

**Engaging Minority University STEM Education Professors in the  
Science of Climate Change**

(2) Type of report:

**Summary of Research (Final)**

**Technical Publications and Reports**

(3) Name of the principal investigator

**Dr. Linda Bailey Hayden**

(4) Period covered by the report

**September 2011 through August 2015**

(5) Name and address of the recipient's institution

**Elizabeth City State University**

**Box 672 1704 Weeksville Road**

**Elizabeth City, NC 27909**

(6) Grant number

**NASA NICE NNX11AM97A**

## Final Report

Elizabeth City State University (ECSU) joined with the University of New Hampshire (UNH) under the NASA ESTEEM project (formerly known as NICE) to empower faculty of education programs at Minority Serving Institutions (MSI) to better engage their pre-service teachers in teaching and learning about global climate change through the use of NASA Earth observation sets. This project was designed to impact teaching first on college campuses within science education classes. Second, as pre-service teachers transition into in-service, the impact will extend to elementary and secondary schools. Our goals were to:

- Promote NASA climate and Earth system science literacy among MSI STEM education faculty.
- Promote MSI Faculty participation at AGU.
- Promote pre-service and in-service Teacher Professional Development using NASA programs/data.
- Promote NASA relevancy for all events and activities.
- Provide NASA support for the Annual Celebration of Women in Mathematics.

The project resulted in impressive results for the participants involved and also generated impressive steps forward in the collaborations between ECSU and NASA Langley Research Center (LaRC).

### Participant Results

In project years 1 and 2, a week-long workshop was offered to participating instructors (see below). Sixteen faculty with an appointment at an HBCU participated in each year. In year 1, the workshop was held at ECSU, and utilized the facilities and local environments of that institution. In year 2, the workshop was similarly held at UNH. The general workshop model consisted of intermixed lecture, fieldwork, hands-on learning activities and lesson plan demonstrates in the area of climate system education. Key workshop components included ...

- Introduction to Climate Change Science and Datasets
- Understanding Ocean Color/Optics
- Ocean Acidification
- Use of NASA's GIOVANNI (Online tool for Data Visualization)
- Current and Predicted Distribution of the World's Biomes
- Place-based determination of Carbon-storage in Woody Vegetation (i.e., trees)
- Satellite Imagery Analysis and Vegetation Indices
- GLOBE field data collection protocols
- Development of Academic Year Course Implementation Planning

The final workshop item, Development of Academic Year Course Implementation Planning, provided participants with an individualized and self-designed framework to help them design and structure changes and enhancements in their courses. Examples of the participants' course enhancements were presented at the 2014 Meeting of the American Geophysical Union (see below Papers and Presentations).

Several of the key and popular climate science activities were posted online (<http://studentclimatedata.unh.edu>) for participants' easy access and further dissemination to others. These activity modules were generated through the direction of Dr. Timothy Moore and Haley Wicklein with direct support from this grant. The modules utilize NASA data sets and tools, including NASA's Data Enhanced Investigations for Climate Change Education (DICCE) and GIOVANNI platforms. The following modules were uploaded for broad public dissemination ...

- Seasonal Cycles
- Major Boundary Currents
- Upwelling Zones
- Southern Ocean
- Inter-annual Variability

Versions of each module are presented for the Student and for the Teacher/Instructor. Companion

worksheets and teacher guides (pdf format) were developed and are posted. Additionally, activities are mapped to show how each module aligns with the Next Generation Science Standards. These instructional materials were fine-tuned in preparation for NASA product review, based on feedback from earlier submission of similar material. Submission for NASA product review will occur on the next cycle due date and project staff are committed to addressing reviewer comments to pass review.

The project engaged 32 faculty from 18 minority serving institutions. Those institutions included:

- |                             |                                |
|-----------------------------|--------------------------------|
| Alabama A&M Univ.           | Mississippi Valley State Univ. |
| Delaware State Univ.        | Norfolk State Univ.            |
| Fort Valley State Univ.     | St Augustine College           |
| Grambling State Univ.       | Talladega College              |
| Hampton Univ.               | Texas Southern Univ.           |
| Jackson State Univ.         | Tougaloo College               |
| Johnson C Smith State Univ. | Tuskegee Univ.                 |
| Morehouse College           | Virginia Union Univ.           |
| Morgan State Univ.          | Virginia State Univ.           |



The workshops provided the faculty with approaches to understanding climate change and its impacts on terrestrial and ocean ecosystems. The faculty conducted fieldwork that emphasizes place-based pedagogy. They worked with an ecological model in STELLA that utilizes authentic inputs from historical and future climate scenario parameters, with NASA satellite imagery data from the MODIS and SeaWiFS sensors, and discussed the challenges and approaches to integrating all or some of the lessons into their courses.

#### Evaluation:

Program Evaluation: Nancy Hurley with WestEd was the evaluator for this project. With the assistance of the program evaluator, the IRB application was completed and approved by the ECSU campus representative Dr. Kaur-Walker. WestEd also implemented pre-workshop surveys and focus group protocols for the summer workshops. In addition, the evaluators conducted telephone interviews. The purpose of the interview was to gather feedback about experiences at the workshop and since the workshop; how participants have used the new learning, skills or tools; successes and challenges of implementation; and any suggestions for improving the workshop. A copy of the evaluators report is attached.

#### NASA Relevant Results

NASA Relevancy: In addition to the impact that this project had on 32 faculty from 18 Minority Serving Institutions (MSIs), there has also been a very impressive set of NASA related outcomes. The project

received a no cost extension through August 2016 to allow time to plan and implement a NASA Research and Education day during the Annual Research Week Event on the campus of Elizabeth City State University.



Left are Roger Hathaway, NASA Langley MSI Liaison Officer, Samuel James, Mechanical Eng Tech, NASA LaRC, Joeletta Patrick, MUREP director, and Janet Sellars, Director NASA LaRC Office of Education during the 2015 ECSU Research Week Event. During Research Week 2015 the first of three NASA/ECSU strategy sessions was held. During the Strategy Session, Dr. Stephen Hale, University of New Hampshire gave an overview of this ESTEEM project while Dr. Edmond Koker discussed ECSU Computational Chemical interest and Mr. Edward Swindell, discussed our efforts targeting UAV technology. (Right) Jerome Mitchell and Ryan Lawrence who were awarded the NASA Earth and Space Science Fellowship are shown with Dr. Napoleon Paxton during a Research Week seminar. The second strategy session took place on the ECSU campus. At that time Deputy Directors for the Research, Engineering, Science Directorates and the STEM Special Programs Manager have all express a commitment to further development of the partnership. The three strategy sessions not only involved ECSU faculty and staff, but also the Office of Sponsored Research and ECSU Chancellor Stacey Franklin Jones. Shown below are highlights from the meetings at ECSU.



Damodar Ambur, Deputy Director Research Directorate, Frank Peri, Deputy Director, Engineering Directorate, Dave MacDonnell, Deputy Director Atmospheric Composition Branch were among those participating in the NASA/ECSU strategy sessions held first at ECSU and followed by ECSU faculty and Chancellors visit to NASA LaRC.

The strategy sessions resulted in a proposal to the NASA RESEARCH ANNOUNCEMENT (NRA) NNH14ZHA001N. This proposal titled *Pathways in Mathematics Education and Remote Sensing (PiMERS)*, represents a joint effort between Elizabeth City State University (ECSU) and NASA Langley Research Center (LaRC). In addition The Association of Computer and Information Science/Engineering Departments at Minority Institutions (ADMI) representing 54 MSIs will support this contribution to the NASA national efforts for achieving excellence in STEM education. PiMERS is a two-year project, which contributes to the effective implementation of NASA's educational goals and objectives using NASA's unique assets and capabilities in Mathematics Education and Remote Sensing. In addition PiMERS will provide the opportunity to include the areas of computational chemistry and aviation, through the PiMERS Advisory Board, future strategy sessions and NASA LaRC research seminars.

The intrinsic merit of the PiMERS project is foremost seen in the strong NASA relevant educational experiences that will be made available to African American and women students from middle school through graduate school level. Second, this project provides the exceptional opportunity to further the partnership between ECSU and the NASA Langley science, engineering and research directorates. NASA Langley will have active participation through the Advisory Board in the design of joint educational and research projects at ECSU. Finally PiMERS provides an excellent opportunity to align with the four White House Executive Orders for Minority Institutions to strengthen curriculum and curricular pathways in STEM, and attract, retain, and support the success of African Americans and women in STEM degree programs.

The goal of PiMERS is to demonstrate the potential to increase the number of African Americans and women in STEM education areas related to areas relevant to NASA in particular Mathematics Education and Remote Sensing of the environment. The PiMERS Advisory Board will further develop strategies addressing the joint LaRC and ECSU interest in aviation and computational chemistry. Four objectives are associated with this goal. They are aligned with the four Committees on STEM Education (CoSTEM) priorities. The proposal is pending at this time.

NASA Relevancy: Dr. Gamaliel "Dan" Cherry, NASA Educator Professional Development, Deputy discussed NASA Opportunities, A Catalyst for Change during the October 27, 2015 distinguished lecture. The Distinguished Lecture guest speaker, Dr. Gamaliel "Dan" Cherry, presented opportunities for internships, scholarships, and fellowships within NASA. Dr. Cherry received his doctorate degree in Instructional Design and Technology from Old Dominion University and has worked with NASA for ten years in the areas of Education and Human Resources. Dr. Cherry emphasized that students should fill in their profiles at NASA's One Stop Shopping Initiative Recruiting NASA Interns, Fellows, Scholars (OSSI NIFS) to be a part of the pool of potential applicants (<https://intern.nasa.gov/ossi/web/public/main/>). OSSI is a NASA-wide system for the recruitment, application, selection and career development of undergraduate and graduate students primarily in science, technology, engineering and mathematics disciplines. Shown below are highlights from the fall 2015 GRSS distinguished lecture with Dr. Cherry.



NASA Relevancy: During the 2015 and 2014 Celebration of Women in Mathematics, representatives from NASA LaRC conducted workshops for the 400 female participants and their teachers. LaRC set up a presentation in the exhibit hall. Shown below are highlights from the NASA STEM Careers exhibit showing LaRC interns Jessica Hathaway with Rosemary Smith their LaRC supervisor. LaRC intern Derek Morris is not shown.



Other NASA related outcomes are listed below. Highlights from these and other events related to this project can be found at <http://nia.ecsu.edu/nice/>.

- ECSU received a NASA Summer of Innovations mini-grant to conduct robotics laboratories in an after school setting at Elizabeth City Middle School (ECMS). Mrs. Wanda Hathaway ECMS science instructor and program participant served as ECMS contact for the SOI events. Dr. Ervin Howard, program participant, also assisted with the robotics outreach to ECMS.
- ECSU Aviation department received one of the MUREP Aerospace Academies awards. The goals of the program are to expand the nation's base for aerospace research and development, increase participation by faculty and students at minority serving institutions, and increase the number of undergraduate and graduate degrees in NASA-related fields awarded to students from minority serving institutions.
- ECSU and the Virginia Air and Space Museum supported participation of precollege students from Elizabeth City, NC and Portsmouth, VA during their Black History Celebration. On February 7th, 2015, students from the Elizabeth City River City YouthBuild attended the Virginia Air & Space Center Black History Month event celebrating African-American achievements in Science, Technology, Engineering, and Math (STEM). Students heard first-hand accounts of the Tidewater Chapter of Tuskegee Airman, the Red Tails, and their many achievements. There were hands-on displays and experiments as well as explorations of inventors such as George Carruthers, Lewis Howard Latimer, and Lonnie Johnson. Also participating were students from Portsmouth, Virginia led by Jessica Coker and Helen White. See highlights at <http://nia.ecsu.edu/ur/1415/150207vasc/>. The Youth wrote essay describing their experience at this event also supported by the Langley Research Center. The essay award ceremonies can be viewed at <http://nia.ecsu.edu/ur/1415/150511youthbuild/>
- On Tuesday, January 13th, Dr. Hayden, Dr. Cheryl Lewis, Andrew Brumfield, and Hagan Hodgkins. Attended the NASA Langley Sigma Series, a Forum on Science and Technology. This event was held at the Virginia Air & Space Center's Pearl Young Theater and featured Mr. Brian K. Stewart a Senior Researcher in NASA Langley's Research Directorate. The title of his presentation was: *Taking the Long View: How ISAAC Prepares LaRC for the Future.*

### A complete list of faculty participants

Name	Institution	Title	Email
Abunaemeh, Malek	Talladega College	Professor	abunaem@uah.edu
Bowman, Arthur	Norfolk State Univ.	Professor	awbowman@nsu.edu
Bradford, Sheryl	Elizabeth City State Univ.	Assistant Prof	sbradford@mail.ecsu.edu
Stevens, Candace	Mississippi Valley State U	Assistant Prof	ccarter@mvsu.edu
Coston, Yvonne	St. Augustine College	Asst. Prof.	YCoston@st-aug.edu
Crocker, Sherry	Fort Valley State Univ.	Assistant Prof	crockers@fvsu.edu
Dixon, Guana	Elizabeth City State Univ.	Assistant Prof	gdixon@mail.ecsu.edu
Dorsey, Waneene	Grambling State Univ.	Professor	dorseywc@gram.edu
Dujari, Anuradha	Delaware State Univ.	Professor	adujari@msn.com
Duncan, Jan	Alcorn State Univ.	Professor	jduncan@alcorn.edu
Fan, Chunlei	Morgan State Univ.	Professor	Chunlei.fan@morgan.edu
Figgers, Vanessa	Johnson C. Smith Univ.	Assistant Prof	vfiggers@jcsu.edu
Frink, Kaiem	Virginia Union Univ.	Instructor	Kaiem_frink@hotmail.com
Gadson, Melvin	Tuskegee Univ.	Professor	Mgadson8@aol.com
Hathaway, Wanda	Elizabeth City Middle Sch.	Science Teacher	whathaway@ecpps.k12.nc.us
Hill, Edward	Fort Valley State Univ.	Professor	hille@fvsu.edu
Hines, Krista S.	Hampton Univ.	Instructor	Krista.hines@hamptonu.edu
Howard, Ervin	Elizabeth City State Univ.	Instructor	emhoward@mail.ecsu.edu
Hughes, Steven	Alabama A&M Univ.	Assistant Prof	Steven.hughes@aamu.edu
Jaggers, Loretta	Grambling State Univ.	Professor	jaggerslw@gram.edu
Jones, Willie	Tougaloo College	Assistant Prof	Wjones.tc@gmail.com
Majid, Fayequa	Alabama A&M Univ.	Associate Prof	Fayequa.majid@aamu.edu
Marshall, Sophia	Tougaloo College	Assistant Prof	sslmarshall@gmail.com
Merriweather, Edwinta	Talladega College	Professor	edwinta@yahoo.com
Owens, Emiel	Texas Southern Univ.	Professor	owensew@tsu.edu
Ozbay, Gulnibal	Delaware State Univ.	Professor	gozbay@desu.edu
Remata Reddy	Jackson State Univ.	Associate Prof.	remata.s.reddy@jsums.edu
Sampson, Josiah	Elizabeth City State Univ.	Assistant Prof	jjsampsoniii@gmail.com
Spencer, Trina	Virginia State Univ.	Professor	tspencer@vsu.edu
Gurley, Kalota	Virginia Union Univ.	Assistant Prof	Ms_kstewart@yahoo.com
Darrell Wiker	Elizabeth City Middle Sch	Science Teacher	DWalker@ecpps.k12.nc.us
Webb, Charles	Alabama A&M Univ.	Instructor	Charles.webb@aamu.edu
White, Ronald	Norfolk State Univ.	Instructor	rlwhite@nsu.edu
Whiteman, Leslie	Virginia State Univ.	Professor	lwhiteman@vsu.edu

## Technical Publications and Reports

The project provided virtual, regional and national opportunities for dissemination of participant results.

National: The report titled *Engaging Minority University STEM Education Professors in the Science of Climate Change* as a report on the NASA NICE project #NNX11AM97A was presented by Dr. Steve Hale and Dr. Linda Hayden during the 2012 AGU conference. The report is available at <http://nia.ecsu.edu/ur/1213/121203agu>.

Participants attended the 2014 American Geophysical Union (AGU) Fall Meeting in San Francisco as representatives of the NASA Earth Systems, Technology, and Energy Education for MUREP (NASA ESTEEM) formerly NASA Innovations in Climate Education (NICE). The AGU Fall Meeting is the largest conference in the geophysical sciences with earth and space scientist, students, teachers, and others in attendance. Dr. Stephen Hale (UNH) was the moderator for the session "Climate Literacy: Minority Serving Institutions Pre-Service Teacher Preparation in Climate Literacy." An oral presentation was made at AGU on the Grambling State University (GSU) NASA ESTEEM project authored by Waneene Dorsey (GSU) and Tim Moore (UNH) and Gulnihal Ozbay from Delaware State University also gave an oral presentation. Other AGU presentations by program participants included.

Waneene Dorsey (Gambling State University)  
*Using NASA DICCE GIOVANNI to Prepare Pre-service STEM Teachers to Teach Climate Science*  
<https://agu.confex.com/agu/fm14/webprogram/paper/Paper10892.html>

Kaiem Frink (Virginia Union University)  
*STEM Education for Pre-Service Teachers*  
<https://agu.confex.com/agu/fm14/webprogram/paper/Paper6936.html>

Ervin Howard et al. (ECSU)  
*Utilizing the NASA Data-enhanced Investigations for Climate Change Education Resource for Elementary Pre-service Teachers in a Technology Integration Education Course*  
<https://agu.confex.com/agu/fm14/webprogram/paper/Paper2452.html>

Gulnihal Ozbay (Delaware State University)  
*Collaborative Education in Climate Change Sciences and Adaptation through Interactive Learning*  
<https://agu.confex.com/agu/fm14/webprogram/paper/Paper6262.html>

Loretta Walton-Jaggers (Gambling State University)  
*Pre-service Teachers Enhance Climate Literacy Through Writing Children's Books on Climate Literacy Concepts and Implementing Related Activities in the PK-12 Classroom*  
<https://agu.confex.com/agu/fm14/webprogram/paper/Paper22257.html>





National: Faculty participants and staff registered for and presented during the 2013 Climate Change Education Principal Investigators Meeting held at the Renaissance Arlington Capital View Hotel in Arlington, Virginia on October 7-9, 2013. The Climate Change Education Principal Investigators Meeting served as a working meeting of principal investigators and other key personnel of climate change education projects currently or recently funded by NASA, NOAA, and NSF. The purpose of this jointly held meeting was to facilitate synergy and collaboration among project partners as well as with other external networks to expand their projects' impacts and leverage results. This was the third such meeting and it focused on providing grant recipients with information on current climate change science findings, how communities are responding to those findings, and how projects can be scaled up and sustained. Additionally, the scientists, educators, and evaluators represented approximately 120 climate change education projects that shared information about their projects' impacts and lessons learned.



Regional: During ECSU Research Week 2014, participants conducted a STEM Research & Education Seminar I, which analyzed Best Practices for Incorporating NASA Climate Pedagogy. Presiding were Ms. Sheryl Bradford and Dr. Josiah Sampson. Presenting were Dr. Edward Hill (FVSU) and Mr. Ervin Howard (ECSU). Highlights are shown at [http://nia.ecsu.edu/ur/1314/rw14/thursday\\_2.html](http://nia.ecsu.edu/ur/1314/rw14/thursday_2.html)



Virtual: Faculty documented their efforts to teach about global climate change through the use of NASA Earth observation sets. Using our program website. The resulting reports and URLs are listed below.

<b>Report Titles</b>	<b>URL</b>
<i>Creating Climate Change Lessons for K-6 Learning using the Technology Integration Planning Model (TIP Model-Phase I)</i>	<a href="http://nia.ecsu.edu/nice/2013/cohort_howard/">http://nia.ecsu.edu/nice/2013/cohort_howard/</a>
<i>BIOL 315: Water Quality Management</i>	<a href="http://nia.ecsu.edu/nice/2013/dorsey_fall2013_bio1315/">http://nia.ecsu.edu/nice/2013/dorsey_fall2013_bio1315/</a>
<i>Incorporate the NASA NICE Climate Education Concepts into the Teacher Education component</i>	<a href="http://nia.ecsu.edu/nice/2012/121115gsu/">http://nia.ecsu.edu/nice/2012/121115gsu/</a>
<i>BIOL427 Science Process Skills and ELED328 Curriculum and Instruction in Elementary Grades during the Fall 2013 semester.</i>	<a href="http://nia.ecsu.edu/nice/2013/spencer_whiteman_update/">http://nia.ecsu.edu/nice/2013/spencer_whiteman_update/</a>
<i>Science Methods for Elementary and Middle Level</i>	<a href="http://nia.ecsu.edu/nice/2013/dujari_fall2013/index.html">http://nia.ecsu.edu/nice/2013/dujari_fall2013/index.html</a>
<i>Progress on Climate Change Education Activity at Delaware State University</i>	<a href="http://nia.ecsu.edu/nice/2013/cohort_ozbay/index.html">http://nia.ecsu.edu/nice/2013/cohort_ozbay/index.html</a>
<i>Implementation of Climate Change Education at Morgan State University</i>	<a href="http://nia.ecsu.edu/nice/2013/cohort_fan/">http://nia.ecsu.edu/nice/2013/cohort_fan/</a>
<i>Utilizing climate change during student teaching semesters of internship</i>	<a href="http://nia.ecsu.edu/nice/2013/cohort_duncan/update.html">http://nia.ecsu.edu/nice/2013/cohort_duncan/update.html</a>
<i>GE155: Use of GIOVANNI to determine changes in seasonal climate cycles in Northeastern North Carolina</i>	<a href="http://nia.ecsu.edu/nice/2013/cohort_bradford/update.html">http://nia.ecsu.edu/nice/2013/cohort_bradford/update.html</a>
<i>Use of the Pacing Field Resources (borrowed from the GLOBE Landcover Investigation) as well as the example of a field notebook page to apply to the mathematical concept, Measures of Central Tendency.</i>	<a href="http://nia.ecsu.edu/nice/2013/cs/">http://nia.ecsu.edu/nice/2013/cs/</a>
<i>Interdisciplinary Climate Change Awareness at VUU</i>	<a href="http://nia.ecsu.edu/nice/2013/cohort_frink/">http://nia.ecsu.edu/nice/2013/cohort_frink/</a>

In addition, a virtual seminar was held on November 15, 2012 between students in the Center of Excellence in Remote Sensing Education and Research (CERSER) program and students at Grambling State University as part of the American Education Week Teaching and Learning Symposium. The project at Grambling State University is headed by Dr. Loretta Jagers and served to document climate change activities that students in the Curriculum and Instruction Department (College of Education) implemented. Resources and activities from the program workshops were infused into the lessons presented. These virtual presentations included:

- Mrs. Shakeydra J. Hill - Climate Change and Hurricanes
- Ms. Yu Feng Huang-Hurricane Book
- Ms. Kaleisha Lewis-The Cause of Tornadoes
- Ms. Deanna Ellsworth-Hurricane Display Board
- Ms. Selea Hayes-Global Warming Display Board
- Mr. Johnathan Washington - Biology Board