

MUREP Other Opportunities (MOO)
Pathways in Mathematics Education and Remote Sensing (PiMERS)

2.3.5 Scientific/Technical/Management Section

As the main body of the proposal, this section must cover the following topics all within the specified page limit.

1. The objectives and expected significance of the proposed research

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.

PiMERS Objective 1 (Effective K-12 STEM Teacher Education): To identify and nurture pre-service mathematics education undergraduates and masters level students enrolled in the ECSU Mathematics Education program.

Students participating will represent those traditionally underrepresented in STEM fields including African Americans and women.

PiMERS Objective 2 (Engagement in STEM): To expand the availability and coherence of existing outreach investments of ECSU in northeastern North Carolina.

The proposed project will provide for the infusion of NASA content into STEM events involving large numbers of precollege minorities and girls. This includes the Celebration of

Women in Mathematics (400 middle and high school girls) and the Annual ECSU Research Week (Precollege Stem Day brings 900 middle and high school students). PiMERS staff will offer NASA workshops and seminars designed for these events and distribute NASA STEM educational materials to the participants, building upon previous NASA investments.

PiMERS Objective 3 (Undergraduate STEM Education): To improve retention rates among African Americans and Women freshmen and sophomores majoring in mathematics education.

Findings indicate that African American students' retention and academic achievement benefits from a program designed to integrate students into one of the core goals of higher education – research and the pursuit of knowledge [1,2]. When gender, race and ethnicity, income, high school average, and SAT totals are controlled in a linear regression model, both scholarships and other grants make a unique contribution to second-year retention [3, 7]. PiMERS is designed to use academic year research training activities to improve retention rates between freshman and sophomore African American and women. Provide scholarships for academic year ECSU students who in turn will attend regularly scheduled Tuesday and Thursday research training sessions. Sessions will begin in late August and end in early April. NASA LaRC seminars focused on the Research, Engineering and Science Directorates will be a part of the research training.

PiMERS Objective 4 (Serving Groups Traditionally Underrepresented in STEM Fields): To support the participation of both undergraduate and graduate African American and women students majoring in mathematics education and remote sensing.

Students selected to participate will represent those traditionally underrepresented in STEM fields. We anticipate 75% African American participation and 40% for women.

2. The technical approach and methodology.

PiMERS represents an aggressive effort to work in conjunction with Langley Research Center and ADAMI to improve the quality of STEM education in the United States, which support both NASA's strategic plan and the Administration's STEM policy. To accomplish this we will implement the following.

- (a) A PiMERS Scholarship and fellowship program
- (b) Celebration of Women in Math PiMERS workshops and Luncheon in the Fall
- (c) Research Week: NASA Day and Precollege Day events in the Spring
- (d) PiMERS 2-week Middle School Program during the summer
- (e) Academic Year Research Training Seminars during the Fall and Spring
- (f) PiMERS summer internships for 4 undergrads @ ECSU and LaRC

Full description of program components (a) through (f) can be found in section 5. General Plan of Work.

With regards to ECSU facilities and capabilities that would be used for carrying out the work, the extensive training capabilities within ECSU's Center for Remote Sensing Education and Research (CERSER) will prove invaluable. These capabilities include videoconferencing, remote sensing lab with a SeaSpace TeraScan ground stations and an

associated 15 seat visualization training lab; A Lego Robotics portable training laboratory; A Hand-held GPS portable training laboratory; and A Portable Graphics Calculator training laboratory. Other ECSU and CERSER facilities are described in the appendix.



(Shown above) Lego Robotics design training, Hand held GPS training, and SeaSpace TeraScan satellite data visualization training at ECSU. These resources and the resources at VASC and Langley Research Center will be devoted to this project.

Center of Excellence in Remote Sensing Education and Research (CERSER)

The goal of The Center of Excellence in Remote Sensing Education and Research (CERSER) is to develop and implement innovative and relevant education and research collaborations focused on polar, coastal, ocean, and marine research. CERSER maintains a suite of research, education and STEM outreach programs, which support student research and training.

With regards to educational capabilities, CERSER houses the only IEEE-Geoscience and Remote Sensing Professional (Chapter #03191) and Student (Branch #66221) chapters in North Carolina. GRSS is the fastest growing IEEE society. In the fall of 2014, Dr. Hayden was elected by the membership to serve on the Administrative Committee for this international society. <http://nia.ecsu.edu/ieee/index.html>

With regards to NASA Relevance, CERSER's past collaborations with NASA scientist have resulted in both research and education joint publications. This includes the discovery of a bay named after ECSU through collaboration with Dr. Bindschadler at GSFC [5]. A second joint publication with Dr. Omar Ali, LaRC Engineering Directorate and Dr. Linda Hayden at ECSU was titled *Collaborations Focused on Enhancing Undergraduate Involvement in Remote Sensing Applications to Atmospheric and Earth Science Research*. This paper was presented at the IEEE-GRSS IGARSS Conference, July 2006, Denver, CO [6]. **PiMERS will support the support the continuation of the NASA science relationships, which produces publication quality research.**

3. The perceived impact of the proposed work to the state of knowledge in the field.

As stated earlier, 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.

4. The relevance of the proposed work to past, present, and/or future NASA programs and interests or to the specific objectives given in the NRA;

Our past work with NASA GSFC and LaRC has resulted in publishable research results and the naming of a geographic feature for our university. PiMERS is an excellent opportunity to enhance this partnership first in the areas of mathematics education and remote sensing; and second in the areas of computational chemistry and aviation.

Dr. Omar Ali, in the Engineering Directorate of Langley and Dr. Linda Hayden, PiMERS principal investigator, have jointly published research on their Collaborations Focused on Enhancing Undergraduate Involvement in Remote Sensing Applications to Atmospheric and Earth Science Research [6]. PiMERS components for academic year and summer undergraduate research training and professional development were largely based on this past collaboration and is directly supportive of the PiMERS objective 3 aligned with the CoSTEM Undergraduate STEM Education and PiMERS objective 4 aligned with CoSTEM Serving Groups Traditionally Underrepresented in STEM Fields.

ECSU and GSFC joint research activities were documented in the paper titled Temporal Reduction and Loss of an Ice Shelf in Pine Island Bay, Antarctica: 1972 – 2003 in the June 2013 issue of the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing [5]. As a result of this study, the bay, which was progressively exposed over the 30 year period during which, the occupying ice shelf slowly retreated, was named by the US-Advisory Committee on Antarctic Names Board of Geographic Names for Elizabeth City State University and was entered into the Geographic Names Information System (GNIS), the nation's official geographic names repository. Dr. Robert Bindshadler who was then Chief Scientist of the NASA's Hydrospheric and Biospheric Sciences Laboratory branch of NASA GSFC worked collaboratively with ECSU on the Antarctic project and he submitted the request to the US-Advisory Committee to name the bay after our university.

ECSU has been awarded several education and technology cooperative agreements and grants. Although only one of these is current (*), they have all served to significantly provide STEM informal education in northeastern North Carolina. PiMERS builds on this legacy of success to collaborate with Langley and ADMI to identify and mentor a workforce of workers with advanced thinking, reasoning and problem solving skills.

NASA YEARS 1-5	NCC5-121/NCC5-533	2,045,000.00
NASA YEAR 6	NCC5-00533	350,000.00
NASA YEAR 7	NCC5-00533	350,000.00
NASA YEAR 8	NCC5-00533	350,000.00

NASA NRTS year 9	NNG04GC04A	100,000.00
NASA IEEE-GRSS SUPPORT	NNG05GJ83G	25,000.00
NASA RS EXPLORERS	NNG05GN38A	192,632.00
IGES EARTH	1004	45,000.00
Math of the Dismal Swamp	NAG5-9371	305,776.00
You Be The Scientist	NAG5-9372	284,791.00
NASA Innovations in Global Climate Change*	NNX11AM97A	761,856.00
		4,819,955.00

The Proposed PiMERS project is based on past successful NASA collaborations and has a high degree of relevance to specific objectives in this MUREP MOO announcement.

5. A general plan of work:

Specifically PiMERS aims to attract, retain, and support the success of students in Mathematics Education and Remote Sensing. Subsequently with the mentoring and guidance of the PiMERS staff these students will elect NASA-related careers. Additionally, while not being exclusive in its selection of participants, PiMERS does expect to serve 75% African American and 40% women.

Below are descriptions of the major activities that the principal investigator, program manager and Advisory Board members will work to successfully implement in an effort to address the four CoSTEM priorities which are written into the goals of this solicitation.

(a) PiMERS Scholarship and fellowship program

In compliance with 2 CFR § 200.466, Scholarships and student aid costs OMB policy, students receiving the scholarships and fellowships will conduct activities necessary to the PiMERS project and will be enrolled in the targeted mathematics education or remote sensing B.S. or M.S. degree programs. These award will be consistent the policies of the Office of Financial Aid at Elizabeth City State University and will be conditioned explicitly upon the performance of PiMERS requirements. PiMERS scholarships and fellowships will be direct awards to student accounts.

Masters of Science: PiMERS Fellowships (~10students/year)

The Mathematics and Computer Science Department of ECSU offers a Masters in Mathematics Program with concentrations in Mathematics Education, Applied Mathematics, Community College Teaching, and Remote Sensing. Its strong curriculum provides students with a high level of preparation for research as well as for professional employment with an emphasis on integrating theory and applications [4]. The programs provide a broad base of formal course work and research, and require students to complete a thesis or product of learning. The master's degree requires that the students 1) complete a minimum of 36 hours of graduate credit applicable to the program; 2) Complete a thesis or product of learning; 3) Maintain a minimum GPA of 3.0. Included is a 15-hour core of mathematics courses and 18 hours of remote sensing courses.

In Mathematics Teaching, graduate student who apply for the fellowship will be required to identify one or more NASA relevant educational modules, which they will implement with the

classes they teach. Thesis students can also receive the fellowship but will be required to include a NASA LaRC representative on the thesis committee. In addition to providing graduate fellowships directly to students, the courses marked with a star (*) are targeted for NASA Relevant content and curriculum enhancement.

Core Courses

- MATH 501 Advanced Linear Algebra
- MATH 503 Modern Algebra
- MATH 511 Real Analysis
- MATH 515 Applied Statistics
- MATT 699 Thesis*

M.S. Mathematics Applied Mathematics Concentration in Remote Sensing

- RS 501 Geophysical Remote Sensing*
- RS 502 Geographic Information Systems & Geographic Signal Processing
- RS 503 Digital Image Process & Analysis
- RS 504 General Analytic Methods of Remote Sensing
- RS 505 Geophysical Modeling
- RS 506 Microwave Remote Sensing Principals & Applications

M.S. Mathematics Education Core Requirements

- MATT 699 Action Research in Mathematics Education*
- MATT 520 Technology in Mathematics Teaching*
- MATT 530 Discrete Math for Teachers
- MATT 540 Research Methods I
- MATT 640 Research Methods II
- MATT 521 Research on Teaching and Learning Algebra and Geometry
- MATT 525 School Mathematics from an Advanced Perspective

	NASA Relevance Content
<p>RS 501 Geophysical Remote Sensing* Physical geography, cultural geology, and technical and space policy; aerospace remote sensing systems, fundamental electromagnetic field theory and RF circuit design; fundamental active and passive microwave remote sensing; basic concepts of signal processing. Fundamentals of remote sensing applications.</p>	<p>NASA Solve is a way for individual members of the public—not just big companies and organizations—to participate in problem solving with NASA. It provides the opportunity for everyone to be a part of the nation’s space program. NASA - LIDAR: In the Wake of the Storm www.nasa.gov/missions/earth/f_lidar.html LIDAR: In the Wake of the Storm -- Mapping system shows effect of Hurricane Isabel on North Carolina coastline CALIPSO: A Global Perspective of Clouds and Aerosols from... www.earthobservatory.nasa.gov/Features/CALIPSO/ The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite mission Remote Sensing: Feature Articles - NASA Earth Observatory earthobservatory.nasa.gov/Features/RemoteSensing/remote_08.php</p>
<p>MATT 699 Action Research in Mathematics Education*</p> <p>MATT 520 Technology in Mathematics Teaching* Selected topics in middle, high</p>	<p>Earth Math: Explores a few of the mathematical underpinnings that frequently come up in the study of Earth systems and Global Climate Change. Used as a supplement for teaching mathematical topics. The problems can be used to enhance understanding of the mathematical concepts, or as a good assessment of student mastery. Space Math: Contains ways to make math meaningful by providing students with problems and examples demonstrating its</p>

<p>school, and advanced mathematics chosen to demonstrate appropriate uses of technology, as well as effective organizations and presentation of mathematics for individual and group learning.</p>	<p>applications in everyday life. Earth Math offers math applications through strong motivation of discovery.</p> <p>MathTrax is a graphing tool for middle school and high school students to graph equations, physics simulations or plot data files.</p> <p>NASA Social program: Provides opportunities for NASA's social media followers to learn and share information about NASA's missions, people, and programs. NASA Social is the next evolution in the agency's social media efforts. NASA Social program includes both special in-person events and social media credentials for individuals who share the news in a significant way.</p> <p>The ESTEEM projects advance understanding of how to effectively teach global climate change concepts, increase climate literacy, and contribute to the development of a diverse future workforce in climate-related sciences.</p> <p>NASA Wavelength is a digital collection of Earth and space science resources for educators of all levels.</p> <p>MY NASA DATA lesson plans integrating authentic NASA satellite data into the school curriculum.</p> <p>The S'COOL Project involves students (ages 5-20+) in real science, making and reporting ground truth observations of clouds to assist in the validation of NASA's CERES satellite instruments.</p> <p>The Tri-Agency Climate Education (TrACE) Catalog provides search and browse access to a catalog of educational products and resources. TrACE focuses on climate education resources that have been developed by initiatives funded through NASA, NOAA, and NSF, comprising a tri-agency collaboration around climate education.</p>
<p>MATT 699 Thesis* Preparation of a thesis for the Master's degree. Graded Credit</p>	<p>PiMERS Advisory board will have input on thesis topics. Board members and other Langley representatives can serve on thesis committees.</p>

Undergraduate Level: PiMERS Scholarships ~5 students/year

In addition, at the undergraduate level, ECSU also offers a minor in GIS/Remote Sensing and a major in Mathematics Education. Students enrolled in these targeted undergraduate programs will be invited to participate in the PiMERS program and apply for the scholarship. These undergraduates will participate in a yearlong series of professional development and research training events. More information on the AY training can be found in section e) Academic Year Research Training Seminars.

Undergraduates, placed at LaRC as volunteers will assist LaRC personnel in preparation for and implementation of NASA relevant informal outreach activities including but not limited to:

LaRC Rockets to Race Cars: Rockets to Race Cars provides an understanding the science of racing, the forces of flight and motion, and learn how these forces lift planes into the air, and hold racecars tight to the track at amazing speeds. This is all being done by working with NASACAR driver Jimmie Johnson.

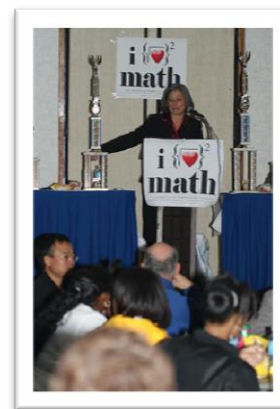
LaRC YOUth Day. This is a day that NASA employees invite youth to the center. The youth spend a day touring and participating in specially designed activities. YOUth Day is a way to inform the youth about NASA and for them to pass on what they have learned to others during the school year.

LaRC Day of Education: During the Day of Education volunteers from the NASA Langley Center contribute their time and expertise to talk with students about the value of education in science, technology, engineering, mathematics and many other fields. They also discuss their work and answer questions about NASA’s mission in aeronautics, exploration, and science. Day of Education is a chance for students and teachers to learn more about NASA and see that there is more to inner workings. Day of Education enhances communication among educators and community leaders.

(b) Celebration of Women in Math PiMERS workshops and Luncheon

Celebration of Women in Mathematics consists of a program of workshops, talks, and math competitions for middle/high schoolgirls and their teachers. The purpose of the program is to encourage young women to continue their study of mathematics and to raise the level of mathematics competency in Northeastern North Carolina.

NASA LaRC has provided portable displays including the “Women of NASA display; conducted workshops and were exhibitors during most of the past 20 CWM events. During the most recent CWM event over 400 girls and their teachers representing 14 middle and high school participated. Both Dr. Leah Vann from Langley (shown right) and Angela Mason, Decadal Survey Tier II Mission Manager for the Earth Science Projects Division/Earth Systematic Missions Organization at NASA Goddard Space Flight Center, have served as the luncheon the guest speaker.



PiMERS will allow us to continue to provide NASA Relevant content and speakers during the CWM. <http://nia.ecsu.edu/cwm.html>

(c) Research Week: NASA Day events

Annually ECSU conducts a weeklong celebration of research, partnerships and achievement. The theme for Research Week 2015 was “Endless Possibilities” to recognize the emphasis placed on student research coupled with faculty development. The first day of Research Week was devoted to exploring NASA relevancy: Past, Present and Future. Below is a table showing the events of that day. During Precollege Day of Research week, 900 local high and middle school students are invited to participate in a day of hands-on workshops, seminars, and a speaker. Shown right is Dr. Gamaliel Cherry from LaRC Office of Education.



PiMERS will permit ECSU to continue its focus on development of NASA relevance with respect to LaRC Education, Remote Sensing, Aviation and Computational Chemistry.

Morning Sessions	Afternoon Sessions
Monday April 13, 2015 - NASA Day Department Displays 9:00 am - 1:30 pm, Lobby, Jenkins Science Center Presiding: Dr. Jeanette Morris, ECSU Opening Session 10:00 - 10:30 am, Room 138, Jenkins Science Center	NASA Strategy Session 2:00 - 3:00 pm, Room 107, Gilchrist Educational Bldg Presiding: Dr. Linda Bailey Hayden Dr. Stephen Hale, Univ of New Hampshire, ESTEEM Dr. Edmond Koker, Computational Chemical @ ECSU Mr. Edward Swindell, Drones @ ECSU

<p>Presiding: Dr. Harry Bass, ECSU Provost Office Welcome: Dr. Stacey Franklin Jones, Chancellor The Occasion: Dr. Flora Brown, Provost</p> <p>NASA Opportunities Seminar 10:30 am - 12 noon, Room 138, Jenkins Science Center Presiding: Dr. Darnell Johnson Joeletta Patrick, NASA Minority University Research Program (MUREP) Manager Janet E. Sellars, Director LaRC Office of Education</p> <p>12 noon – 1:30 pm Refreshment Break</p>	<p>NASA Classroom Visitations 2:00 - 4:00 pm, Room 228, Dixon-Patterson Hall Presiding: Mr. Orestes Gooden, ECSU Aviation Mr. Roger Hathaway'72, LaRC MSI Liaison Officer Mr. Samuel James'87, Mech Eng Tech, LaRC</p> <p>NASA Exhibit and Open House 2:00 - 5:00 pm, G.R. Little Library Presiding: Dr. Juanita Midgette Spence Refreshments</p>
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(d) PiMERS 2 week Middle School Program

Twenty students from local middle schools will be invited to participate in this two week STEM program. Students completing the program will receive a certificate and an award of \$100. The middle school program will be held from 9am to 3pm Monday – Friday. Parents must agree to provide transportation to and from the ECSU site each day. Lunch will be provided.

Activities will involve mathematics and remote sensing/satellite lessons that are available through the NASA Educators site. Examples of on-line resources include:

- Remote Sensing concepts including hands-on GPS workshops
- Space Math II - Problem 22, A Bit of Satellite Math
- NASA GPS used in meteorology, seismology and flight research
- Make Your Own RXTE Satellite
- NASA's Exploring Space Through Math project activities

The middle school program not only will take full advantage of NASA online educational resources but also the resources available at the Virginia Air and Space Center (VASC). The Virginia Air & Space Center is the visitor center for NASA Langley Research Center and Langley Air Force Base. Located in Hampton, Virginia, the birthplace of America's space program, the Virginia Air & Space Center features interactive aviation exhibits spanning 100 years of flight, more than 30 historic aircraft, a hands-on space exploration gallery, unique space flight artifacts, and more! The Center is home to the Apollo 12 Command Module and the Orion PA-1 Test Vehicle.

(e) Academic Year Research Training Seminars

Supporting both the academic year program and the summer program will be a network of LaRC directorates and minority university faculty mentors. Identification of program participants is the primary responsibility of Elizabeth City State University personnel as well as the logistical arrangements required to support the programs.

Structured professional development activities and PiMERS research training activities provide mentors, increased oral and written communication skills. Association with both faculty mentors and NASA visiting lecturers are an integral part of the academic and summer experience. A detailed list of the professional development and research training activities that are an essential part of both' the academic year and summer programs follows [6]. Refreshments will be provided for participants.

Professional Development Activities

- Encourage and support membership in professional societies
- Encourage and support research presentations at appropriate venues
- Require attendance at seminars and visiting lectures
- Require participation in scientific writing and GRE preparation workshops
- Encourage and support internship applications
- Require frequent oral and written reports
- Celebration of accomplishments through awards and acknowledgements
- Encourage and support graduate school aspirations

Research Training Activities

- Organizing teams of 2-5 other undergraduates and one or more mentors
- Mentor supervision of problem definition, data collection and analysis
- Provide training on appropriate software and hardware
- Require review of the scientific literature
- Organize and support Next-level mentoring of pre-college students by undergraduates, undergraduates by graduates

(f) PiMERS internships for 4 undergrads @ ECSU and LaRC

The NASA Internship program is a paid educational, hands-on experience that creates opportunities for students to come to NASA Langley Research Center in Hampton, Virginia to conduct robust research and work on exciting projects while working side-by-side with NASA's finest scientists, researchers, engineers and mission support teams. The program is specifically open to undergraduate and graduate students year-round for the Fall, Spring and Summer sessions.

Students will be assisted in using the NASA's One-Stop Shopping Initiative (OSSI) site to create a student profile. Once the profile is created, the student will be direct to apply for up to 15 internship opportunities at Langley Research Center and other NASA Centers across the country. In addition, four students will be placed at NASA LaRC as volunteers with stipends to be paid by the PiMERS program. Langley Office of Education personnel will assist with the placement of these volunteers.

The PiMERS Advisory Board will include Representatives of LaRC and The Association of Computer and Information Science/Engineering Departments at Minority Institutions (ADMI). Dr. Ronald Blackmon, ECSU Director of Sponsored Programs will serve as chairman of the advisory board and will schedule a minimum of three meetings per year.

Dr. Linda Bailey Hayden will serve as the PiMERS principal investigator. She was awarded the NSF Presidential Award of Excellence in Science, Mathematics and Engineering Mentoring in 2003. She completed a ASEE Fellowship at NASA Langley in the area of STEM Education and has continued to build relationships with the LaRC Office of Education since that time. Dr. Hayden will be assisted, by a program manager (to be hired), as she directs the day-to-day operations of the grant. The PiMERS staff will work cooperatively with the ECSU Office of Sponsored Programs, Financial Aid Office, Admissions Office and the Business and Finance Office. She will represent PiMERS at all required NASA program meetings and submit monthly and annual reports as required. Monthly reports will use the

template provided by the MUREP Activity Manager and will brief this report at the monthly teleconferences as mandated by the cooperative agreement. Annual and monthly reports will contain project accomplishments as measured against proposed goals and objectives; the extent to which collaborations and partnerships have evolved along with metrics and planned activities.

PiMERS staff will work with the ECSU Research Week and Celebration of Women in Mathematics organizing committees to ensure that components of the project are implemented as described in this proposal. Research Week is held during the spring semester while the Celebration of Women in Mathematics is held during the Fall. See the scientific/technical management section for more details on the management structure.

Plan for sustainability and/or continuation beyond the funding period.

PiMERS staff and Advisory Board will work collaboratively sustain these efforts. Below is a partial list of anticipated sustainability efforts.

- Develop a campaign for sponsorship from local businesses for the CWM and Research Week
- Mentor and advise students as they apply for scholarships and fellowships beyond PiMERS. Sources will include NASA Internships, Fellowships, & Scholarships (NIFS) program at Langley Research Center.
- Spacegrant and VASC opportunities will also be perused by participants. ECSU is one of 13 Academic Affiliate which comprise NC Space Grant.
- Use the Distinguished Lecture Series with Advisory Board consultation to develop Research capabilities and the ability for ECSU to compete for funds outside of PiMERS funding. Focus will be on Infrared/Laser sensing Frank Peri contact, aviation and computational chemistry
- Student travel support will be sustained through applications to the IEEE-GRSS Minority Travel Program (directed by Dr. Hayden), funding from the Emerging Research National Conference in STEM and other appropriate venues that provide travel support opportunities for student research presentations.
- Promote NASA Social media and other free opportunities.

PiMERS External Evaluation

The proposed evaluation plan is comprehensive and appropriate for assessing the effectiveness of PiMERS Program in meeting its performance objectives. The various evaluation instruments and/or strategies employed by the project will be formative and summative in nature.

These formative and summative methods will clearly determine the success of the project in quantifiable and specific terms. It will include what was accomplished, how, when, areas of strengths and weaknesses, as well as recommendations for future planning. PiMERS will also reveal any unanticipated outcomes and the strategies employed, as a means to address these unanticipated outcomes will be clearly document.

As previously mentioned, an Advisory Board will be established. The PiMERS Advisory Board will provided an ongoing assessment of our proposed evaluation plan and will be given the authority to ensure that the plan is appropriate for the execution of the proposed goals, objectives and expected annual performance indicators. Outlined below, is annotated summary of the

formative evaluation strategies used to assess each of these goals, objectives, and expected annual performance indicators:

Formative Evaluation

1. List of Student, Faculty and Staff Activities
2. Webpages of all pertinent activities,
3. Tabulation and assessment of questionnaires, reaction surveys, program evaluations (including but not limited to the Celebration of Women, Academic Year REU, Research Week and PiMERS Summer Internship Experiences),
4. Continuous Monitoring and Documentation of PiMERS impact on its participants, campus-wide and community-at-large, and
5. Daily entry of debits and credits, weekly assessment of the budget, and review of monthly financial summary reports.

Summative Evaluation

1. Total number of that minorities, women and disabled students participating in NASA higher education projects,
2. Documentation of significant, direct student awards in higher education to (1) racially/ethnically underrepresented students and (2) women,
3. Total numbers and kinds of PiMERS elementary and secondary students who are traditionally underrepresented have participated in NASA STEM engagement activities,
4. Total number of fellowships and scholarships disseminated by virtue of this grant,
5. The retention and graduate rates of PiMERS participants,
6. The number and percentage of individuals who completed teacher pre-service and in-service teacher preparation programs and
7. Qualitative and quantitative evaluation of how has PiMERS has strengthening the curriculum and pathway in STEM.

NASA's Annual Performance Indicators are outlined in NASA's FY 2015 Complete Management and Performance Appendix.

FY 2015 and FY 2014 2.4.1: Assure that students participating in NASA higher education projects are representative of the diversity of the Nation. **PiMERS anticipates 75% African American participation and 40% for women.**

FY 2015 ED-15-1: Provide significant, direct student awards in higher education to (1) racially or ethnically underrepresented students and (2) women. **PiMERS will provide over \$160,000 in scholarships, work study and fellowships (~ 30% of its budget).**

FY 2015 ED-15-5: 600,000 elementary and secondary students participate in NASA STEM engagement activities. **The PiMERS Luncheon and workshops during the CWM will impact over 400 middle and high school students/year and their teachers. The precollege day during Research Week will impact over 900 precollege students/year while the other Research Week seminars and poster session's impacts 200 undergraduates.**

6. Data-sharing plan

For PiMERS, data sharing involves documentation of project activities through monthly teleconferences and annual reports. Data sharing will also be facilitated by the use of social

media and websites to document events. The project will have its own website at ECSU and will link to appropriately identified NASA websites.

The program evaluator will report acquired data to the principal investigator who will include that information in the monthly and annual reports to the funding agency. Articles reporting results will be submitted to selected journals for publication and submitted to both AGU annual conference and other venues.

7. The Scientific/Technical/Management

This proposed project represents a collaboration between Elizabeth City State University which houses the Center of Excellence in Remote Sensing Education and Research; The Association of Computer/Information Sciences and Engineering Departments at Minority Institutions (ADMI) composed of 54 minority serving institutions; and NASA Langley Research Center. A description of these institutions is given below.

Collaborator: ECSU

Elizabeth City State University is a growing coeducational undergraduate, public institution of higher learning...one of the sixteen (16) constituent institutions of The University of North Carolina. A Historically Black College, ECSU was founded as the Elizabeth City Normal School on March 3, 1891 for the specific purpose of "teaching and training teachers of the Black race to teach in the Common Schools of North Carolina". The University was granted full membership in the Southern Association of Colleges and Schools (SACS) in December, 1961. The SACS accreditation was reaffirmed most recently in 2011. The University is located in the beautiful coastal and rural, northeastern section of North Carolina. It serves as a state and regional university, serving the largely agrarian sixteen county regional community, as well as the remainder of the state and nation. Elizabeth City State University (ECSU) is proud that it has been ranked 'SECOND' by U.S. News & World Report in the category of public comprehensive universities in the south offering the bachelor's degree. There are 324 schools ranked in four geographic regions of the country for the Comprehensive Colleges Bachelor's category. Further, ECSU has been ranked among the top three universities in this category four out of the last five years.

U.S. News and World Report rank

- *U.S. News and World Report's* 2015 edition of Best Colleges ranked Elizabeth City State University #2 in the publication's category of Top Public Schools (Regional Colleges in the South). The publication ranked the university #20 among the 50 Historically Black Colleges and Universities evaluated. Between 1999 and 2014, ECSU repeatedly earned national acclaim in *U.S. News and World Report Magazine's* ranking of "Best Colleges."
- ECSU ranked among top 10 HBCUs that retain freshmen. *U.S. News and World Report's* 2014 edition of Best Colleges ranked Elizabeth City State University #6 on U. S. News' list of Historically Black Colleges where freshmen are most likely to return.

Washington Monthly rank

- For the third consecutive year, Washington Monthly ranked ECSU #1 among its baccalaureate colleges. This ranking appears in the 2014 edition of the college rankings guide of Washington Monthly. This guide measures institutions based on their contribution to the public good in three major areas: civic engagement, research and social mobility.

Collaborator: The Association of Computer and Information Science/Engineering Departments at Minority Institutions (ADMI)

The Association of Computer/Information Sciences and Engineering Departments at Minority Institutions (ADMI) was founded in August 1989. ADMI serves as a forum through which faculty and students in computer and information science/computer engineering departments at minority institutions work for the continued development of excellence in teaching, state-of-the-art curriculum and research.

Each year, the Association of Computer and Information Science/Engineering Departments at Minority Institutions (ADMI) hosts a symposium devoted to computing issues relevant to minority students, education and institutions. The symposium highlighted undergraduate and graduate research through oral and poster presentations and awards. ADMI presents a clear and important message for students through its strong efforts to prepare participating students for graduate school. An important facet of the symposium is the opportunity to explore collaborations between major research institutions and minority institutions. ADMI also conducts regional workshops at member sites to support in the professional advancement of faculty. PiMERS students will be invited to participate in both the oral and poster research sessions during the Annual ADMI Conference. Funds to support participation of PiMERS students are included in the budget. In addition ADMI will provide 2 representatives to serve on the PiMERS advisory board

Collaborator: NASA Langley Research Center

Langley Research Center (LaRC) is the oldest of NASA's field centers, located in Hampton, Virginia, United States. With regards to PiMERS objectives, LaRC is committed to research on aeronautic, Infrared and Laser Sensing and computational chemistry. In addition the NASA Langley Office of Education (OEd) strives to improve and endorse science, technology, engineering, and mathematics (STEM) education and career planning in the local community, as well as Langley's 5-state area, including Virginia, West Virginia, Kentucky, North Carolina, and South Carolina. The NASA Langley OEd engages in four lines of business to support the NASA education mission, including Educator Professional Development (EPD); NASA Internships, Fellowships and Scholarships (NIFS); STEM Engagement; and Institutional Engagement.

Three important steps have led to the development of the partnership between LaRC and ECSU. The first event occurred during the 2015 ECSU Annual Research Week during which Monday was deemed as NASA Day. Sessions included a "NASA Opportunities Seminar led by Joeletta Patrick, NASA MUREP Program Manager followed by a NASA Strategy Session, Classroom Visitations and a NASA Exhibit and Open House in the ECSU Library. Also participating in the Research Week NASA Day were Mr. Samuel James, Mechanical Engineer with LaRC, Mr. Roger Hathaway NASA Langley MSI Liaison and Janet E. Sellars, Director of NASA LaRC Office of Education.

That initial meeting was followed on April 28, 2015 when Elizabeth City State University (ECSU) hosted an on-site visit from Roger Hathaway (NASA/Langley) and a team of NASA officials who represent the Engineering, Research, and Science Directorates to observe our capabilities in Computer Science, Remote Sensing, Engineering Technology and Aviation. Each of the Departments provided a briefing on ECSU technical capabilities and student(s)

research projects. Staff with Center of Excellence in Remote Sensing Education and



NASA LaRC Research, Engineering and Science Directorate heads are shown with faculty and students during a recent strategy session held at ECSU. (Below) Chancellor Stacey Jones is shown with Roger Hathaway during that same strategy session. Photos were taken in the Center of Excellence in Remote Sensing Education and Research (CERSER) research laboratory.



Research (CERSER) gave talks about the Research conducted in the program.

The second meeting was immediately followed by a visit from ECSU faculty, staff, and students as a result of Langley's team visit on April 28th. That third session took place at the LaRC facility. ECSU Chancellor Stacey Jones led the delegation of 10 ECSU faculty and students. There were several areas of interest within the research programs at Langley that the University departments had identified and that were recommended by the LaRC visiting team thus allowing ECSU and LaRC to continue the dialogue.

