NOAA-Center for Earth System Sciences and Remote Sensing Technologies

Five-Year Implementation Plan
RESUBMIT
(2016-2021)

Submitted by:

Lead Institution
The City College of City University of New York, NY

Partner Institutions
Hampton University, VA
San Diego State University, CA
University of Maryland Baltimore County, MD
University of Puerto Rico, Mayaguez, PR
University of Texas, El Paso, TX

To:
The NOAA Educational Partnership Program with Minority Serving Institution (EPP/MSI)

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## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>4</td>
</tr>
<tr>
<td>Preamble</td>
<td>9</td>
</tr>
<tr>
<td>CESSRST Mission</td>
<td>10</td>
</tr>
<tr>
<td>CESSRST Value Statements</td>
<td>10</td>
</tr>
<tr>
<td>CESSRST Goals and Objectives</td>
<td>11</td>
</tr>
<tr>
<td>CESSRST Key Personnel Team</td>
<td>12</td>
</tr>
<tr>
<td>A Snap-Shot of the Implementation Plan</td>
<td>12</td>
</tr>
<tr>
<td>CESSRST National Confederation/Consortia</td>
<td>14</td>
</tr>
<tr>
<td>CESSRST Organization Chart</td>
<td>15</td>
</tr>
<tr>
<td>CESSRST Program Elements</td>
<td>15</td>
</tr>
<tr>
<td>1. Education and Training</td>
<td>15</td>
</tr>
<tr>
<td>2. Recruitment, Retention and Success</td>
<td>23</td>
</tr>
<tr>
<td>3. Professional Advancement and Career Engagement (PACE)</td>
<td>27</td>
</tr>
<tr>
<td>Science – Collaborative Research</td>
<td>36</td>
</tr>
<tr>
<td>Theme I: Coastal Resilience</td>
<td>36</td>
</tr>
<tr>
<td>Theme II: Atmospheric Hazards</td>
<td>40</td>
</tr>
<tr>
<td>Theme III: Water Prediction and Ecosystem Services</td>
<td>44</td>
</tr>
<tr>
<td>Integrating Social Sciences into CESSRST Research and Education Training</td>
<td>47</td>
</tr>
<tr>
<td>CESSRST Postdoctoral Plan</td>
<td>51</td>
</tr>
<tr>
<td>Data Management and Sharing Plan</td>
<td>53</td>
</tr>
<tr>
<td>Science Data Sharing and Management Plan</td>
<td>53</td>
</tr>
<tr>
<td>Students Data Management and Longitudinal Tracking</td>
<td>54</td>
</tr>
<tr>
<td>Research Data sharing plan and the CESSRST product data delivery methods</td>
<td>55</td>
</tr>
<tr>
<td>CESSRST Management</td>
<td>57</td>
</tr>
<tr>
<td>Sub-Committee and Boards – Roles and Charter</td>
<td>58</td>
</tr>
<tr>
<td>Deliberate plans for collaborations with other CSCs, NOAA, and external entities</td>
<td>64</td>
</tr>
<tr>
<td>NOAA Engagement in Evolving Best Practices for potential careers at NOAA or other NOAA mission-aligned career opportunities</td>
<td>66</td>
</tr>
<tr>
<td>CESSRST Institutional and Sustainability Plan</td>
<td>66</td>
</tr>
<tr>
<td>Program Outputs and Outcomes</td>
<td>68</td>
</tr>
<tr>
<td>CESSRST Financial Management</td>
<td>71</td>
</tr>
</tbody>
</table>

2
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected CESSRST Implementation Plan Milestone Chart: 2016-2021</td>
<td>71</td>
</tr>
<tr>
<td>List of Acronyms</td>
<td>77</td>
</tr>
<tr>
<td>Appendix I: Special Award Conditions</td>
<td>80</td>
</tr>
<tr>
<td>Appendix II: Detailed Summer Bridge Program Schedule</td>
<td>99</td>
</tr>
<tr>
<td>Appendix III: REsearch Topics – summer Bridge 2017</td>
<td>101</td>
</tr>
<tr>
<td>Appendix IV: Summer 2017 Core Competency Schedule</td>
<td>102</td>
</tr>
<tr>
<td>Appendix V: Detailed 5-year Milestone, Outcome and Student Need chart</td>
<td>106</td>
</tr>
<tr>
<td>Appendix VI: Resources and Facilities</td>
<td>109</td>
</tr>
<tr>
<td>Some of the CESSRST Outreach Events</td>
<td>111</td>
</tr>
<tr>
<td>Recruitment Resources from the CESSRST affiliated Universities</td>
<td>112</td>
</tr>
<tr>
<td>Major Recruitment Events/Fairs</td>
<td>113</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

The NOAA-Center for Earth System Sciences and Technologies (CESSRST) supports the National Oceanic and Atmospheric Administration (NOAA) in its commitment to workforce diversity by striving to educate and train large numbers of students, particularly those from the underserved and underrepresented minority communities. The goal is to prepare the next generation of engineers, scientists and technologists in NOAA sciences. Through a consortium (see consortium list) of academic institutions, led by the City College of the City University of New York, CESSRST recruits, educates, trains, and graduates an increasing number of underrepresented minority student through rigorous academic programs and research affiliates. Included in the CESSRST consortium are well known Minority Serving Institutions (MIS), Hispanic Serving Institutions (HSI), and Historically Black Colleges and Universities (HBCU) strategically chosen to incorporate the geographic diversity of the nation and serve areas with large concentrations of Under Represented Minority (URM) students, guaranteeing a diverse pipeline of students trained in NOAA sciences. CESSRST students must meet rigorous academic requirements that are complemented by hands-on participation in state-of-the-art research that is tightly coupled with NOAA interests. These research projects are enhanced by building effective partnerships between CESSRST faculty, NOAA scientists, and industrial partners who serve as co-mentors for CESSRST students. Over the course of the five-year implementation plan (2016-2021), the center’s activities will be delineated, monitored and evaluated under three major program elements: (1) Education and Training; (2) Science – Collaborative Research and (3) Management.

Education and Training

CESSRST helps NOAA achieve its mission of preparing a diverse Science, Technology, Engineering and Math (STEM) workforce that understands, and engages in NOAA sciences to address environmental problems. CESSRST’s unique and holistic education and training framework supports NOAA’s education goals and includes three foundational cross-disciplinary research activities (see research themes, p. 36) implemented Center-wide. The education and training plan includes three strategic initiatives to (1) recruit and retain students, (2) develop core competencies, and (3) support academic and professional advancement.

Recruit and Retain

Building a NOAA ready workforce requires strong recruitment and effective retention. Priority number one is the establishment of an aggressive recruiting program to attract the best and brightest students into majors and programs at CESSRST institutions. Once recruited, the center must ensure the students remain at CESSRST institutions by conducting retention activities throughout a student’s academic tenure that support academic, professional and social success.

Core Competencies

There are four technical or academic competencies which drive the CESSRST core curriculum: (1) Remote Sensing; (2) Socio-economics Drivers and Impacts of Earth System and Environmental Science; (3) Environmental Modeling and Algorithm Development; and (4) Data Analysis and Visualization. (See education and training implementation plan, p. 29)
**Professional Advancement**

CESSRST students participate in year-round professional development including career and academic seminar series spanning the broad spectrum of NOAA STEM and Social Sciences. Students also gain job-relevant experiences through experiential learning activities in university research laboratories, and NOAA laboratories and facilities alongside a NOAA mentor. The NOAA mentor will collaborate with the student’s institutional mentor to assure the NOAA mission-relevance of the student’s project. Each student’s education experience ends with job placement assistance.

**Measuring Success**

Monitoring and evaluation of project outcomes for each student continues throughout the tenure of the project. Placement of students in the workforce and post-graduate tracking is included as part of the overall evaluation of CESSRST-related outcomes. By continuous monitoring of education and research activities, the center remains prepared to improve its programs along the way. Longitudinal tracking provides longer-term evaluation of the program and helps identify the program’s strengths and areas for improvement. These studies also determine CESSRST’s ability to meet the diverse workforce requirements of NOAA and the nation by feeding back to CESSRST’s recruitment and retention activities.

**Collaborative Research**

Research is the primary way that the Center engages students with NOAA missions and scientists and engineers. These experiential learning opportunities ensure that our graduates are prepared to join the NOAA STEM workforce. It is also a component of graduate training leading to Masters and PhD degrees. CESSRST research occurs in three interconnected themes addressing high priority long-term goals for NOAA: from “Resilient Coastal Communities and Economies” to "Weather-Ready Nation” to “Integrated Water Prediction” to “Climate Adaptation and Mitigation”. Additionally, a strong focus and expertise on remote sensing observations, advanced observing systems and big data analysis, allows CESSRST to respond to NOAA’s agency wide need for improved “Observing, Modeling and Engaging” capabilities.

Across all themes, CESSRST collaborative research directly aligns with NOAA's Vision of Environmental Intelligence and supports NOAA's leading role in addressing societal problems through integration of remote sensing technologies with multidisciplinary research in environmental systems, socioeconomic drivers, and solutions. CESSRST research themes inspire CESSRST students to study the Earth as an integrated system across traditional boundaries and foster an interdisciplinary, holistic understanding of the major environmental challenges faced by the society, enriched with experiential learning opportunities in environmental satellite related research.

**Research Themes**

*Theme I. Coastal Resilience*: Through a combination of coastal observations, advanced modeling, development of new remotes sensing tools, and assessment of environmental and socioeconomic efficacy of developed approaches for mitigating these stressors, this research addresses a high research priority for NOAA.
**Theme II. Atmospheric Hazards:** Severe weather and air quality events have major ecological, human-health, and socio-economic impacts. Anthropogenic and natural emissions drive air quality and climate change, which in turn drive severity and frequency of future weather events. GHGs, ozone, and aerosols play an important role in global climate change, but the impact of aerosols on climate remains the largest uncertainty in climate forecasts. Theme II uses innovative technology and integrative observations to study atmospheric processes and trace constituents, validate satellite products, and improve model predictions.

**Theme III. Water Prediction and Ecosystem Services:** The most significant factor in human vulnerability to climate is the impact of climate variability and change on water resources. Given the challenge of making precise predictions about this detrimental risk, Theme III focuses on developing a unified water prediction system using remote sensing of earth systems while improving how scientists observe and predict the processes associated with climate drivers. This theme supports NOAA’s goals of Climate Adaptation and Mitigation, and Weather Ready Nation.

The projects organized under the three research themes are collaborative with scientists from NOAA National Environmental Satellite, Data, and Information Service (NESDIS), NOAA Oceanic and Atmospheric Research (OAR), and other NOAA line offices. Each has crosscutting and interacting components incorporating multiple themes, CESSRST institutions and, as appropriate, in coordination with other NOAA Educational Partnership Program (EPP) Collaborative Science Centers (CSCs). Every research theme enables crosscutting CESSRST Social Science research by addressing clearly outlined societal impacts. Details on the implementation and evaluation plan can be found at the end of the Science – Collaborative Research section (see p. 36).

**Center-Wide Social Science Framework**

CESSRST research maintains a strongly integrated social science component. Across all themes, research projects are synergetic with NOAA’s Social Science goals of defining and measuring (1) the impact of research products on society while, and (2) how the research supports societal decision-making. The social science framework aligns with the Decision Science, Risk
Assessment and Risk Communication directives (or mandates) as outlined in the Strategic Research Guidance Memorandum.

**General Scope**

CESSRST research focuses on adaptability and resilience to climate and weather stressors in coastal urban areas. Each project explores risk and assesses how changing climate and weather impact human communities and ecosystems. Our research provides scientific findings for planning, decision-making, and policy recommendations and better understanding of societal implications. CESSRST’s highly diverse pool of students complete training in interdisciplinary science and technology that has both environmental and socio-economic importance. All research activities respond to NOAA’s education mission “to advance environmental literacy and promote a diverse workforce in ocean, coastal, Great Lakes, weather, and climate sciences.”

**Integration of Social Sciences into CESSRST Education:** Educational and curricula activities increase integration of the social sciences into CESSRST research projects and mission. These activities include:

- Frequent roundtable discussions and seminar presentations on social science issues relevant to CESSRST research and education
- Integrating pertinent existing social science courses into curricula of undergraduates, graduate, and doctoral students
- Developing applicable new social science courses
- Organizing a robust program of visits by NOAA social scientists to CESSRST campuses for seminars, lectures, and possibly longer-term teaching modules
- Scheduling visits by CESSRST students and researchers to NOAA to better understand and experience how NOAA integrates the social sciences in their research and applications
- Convening a major CESSRST social science research forum to showcase the work being undertaken by CESSRST students and scientists

**Integrating Social Sciences into CESSRST Research:** In addition to the social science framework developed for CESSRST educational curricula and activities, all CESSRST research projects comprehensively incorporate social science theory and applications, and highlight the benefits of such integration in terms of policy ramifications and broader scope of research impacts for the nation. These projects provide valuable training for the students who are involved directly in the research and will have a wider educational component extending to students benefitting from the new courses. Examples of proposed CESSRST projects that have a significant component of social science include:

- Addressing Present and Future Climate Change Associated Urban Stormwater Challenges: A Coupled Environmental and Socioeconomic Systems Approach
- Ecosystem Health Towards Sustainability: Water Quality Indicators in Urban Coastal Ecosystems
- Impacts of Climate Change: Vulnerability and Resiliency of Coastal Populations
- The Human Impact on Terrestrial Hydrography: Global Water Transfers
These projects lend themselves easily and effectively to a social science framework and may be used as pilot projects for the successful integration of social sciences for all CESSRST research projects.

**CESSRST Management**

While managing a large and detail-oriented Cooperative Science Center brings with it some inherent challenges, however, CESSRST brings to this proposal a highly experienced and competent management team. This competency is based on a proven record of accomplishment of 15 years and experience in advancing NOAA’s goal to produce a highly skilled and diverse workforce while simultaneously advancing NOAA Sciences in Remote Sensing Sciences and Technologies. The City College of the City University of New York will serve as the lead institution for the proposed consortium (Hampton University, University of Puerto Rico at Mayaguez, San Diego State University, University of Texas at El Paso, and University of Maryland Baltimore County). CESSRST will also incorporate additional CUNY colleges and other partner institutions into the consortium to bridge activities between community college and senior college. Our Education and Outreach section links together committees and sub-committees, creating clear communication strategies and collaborative approaches within CESSRST, with other CSCs, with NOAA Management, and Scientists and External Stakeholders to create a sustainable and strategic plan to achieve the program outcomes.

**CESSRST Monitoring and Evaluation (M&E) of Program Outcomes:** Monitoring and evaluation of CESSRST program elements plays an integral role in the development and sustainability of CESSRST. At the outset, the external evaluator will work closely with the CESSRST management team to develop a monitoring plan for the program elements: recruitment, education and training, science competencies, and CESSRST collaborations. Monitoring of periodically recurring tasks allows results, processes and experiences to be documented and used as a basis to steer decision-making. Monitoring allows CESSRST to check its progress against the implementation plan. The external evaluator works with CESSRST faculty, researchers, and collaborators to develop a competency framework that defines the knowledge and skill sets that CESSRST undergraduate and graduate students need in order to succeed in a competitive NOAA STEM workforce. This competency framework serves as the baseline to monitor student progress toward academic and professional goals. The evaluation plan assesses outcomes and impacts of program elements.

**Outcomes**

CESSRST outcomes focus on the relationships between (1) the results of the program, (2) the effects produced by the program, and (3) the overall impact of CESSRST on its undergraduate and graduate students. An evaluation of CESSRST alumni will highlight the impact of CESSRST in training a highly skilled workforce that supports NOAA’s mission. The Internal Review Board will approve data collection instruments. An outline of the plan is at the end of the Management section (see p. 72).
**CESSRST Institutional Sustainability Plan**: The CESSRST Strategic Plan aligns with City College of New York’s (CCNY) Strategic Plan “Vantage Point 2022,” developed in 2015. CESSRST goals and objectives directly align with CCNY’s Strategic Plan. These include *Experiential Learning, Professional and Career Development, Cutting Edge and Interdisciplinary Collaborative Research and Education Programs*, and the focus on *Enhancing Diversity and Inclusion*.

**Sustainability Plan Initiatives**
CESSRST Sustainability Plan includes:
- New Academic Initiatives (new degree programs with NOAA science related curricula)
- Working with Community Colleges to build a sustained and diverse pipeline of students
- Developing state-of-the-art research infrastructure that facilitates student and faculty research
- Establishing a data sharing portal for enhancing cross-cutting and collaborative research, as well as providing the scientific community and the public access to the research output and products
- Developing education and research partnerships and proposals across the CESSRST institutions and partners that can lead to leveraged funding during the five-year period of performance and beyond
- Creating NOAA Citizen Science, Public Outreach activities to increase NOAA visibility across CESSRST institutions, affiliated university, and local community.

**PREAMBLE**

The NOAA-CESSRST 2016-2021 Implementation Plan provides a comprehensive description of the Center's strategies, approach and milestones to successfully address its key Program Priorities and Outcomes. The implementation plan specifically addresses the **who, where, when and how** the Center will plan, implement and evaluate its main research, education and outreach activities, with a foremost objective that directly aligns with NOAA’s Education Goal to develop a *diverse and highly skilled future workforce that pursues careers in disciplines that support NOAA's mission*.

CESSRST will educate, train, and graduate a diverse and highly skilled future workforce in the disciplines that support and align with NOAA’s strategic missions. These graduates will arrive at NOAA and other employment sectors, with significant and successful experience in critical NOAA disciplines achieved through participation in state-of-the-art research aligned with NOAA’s Mission and Strategic Priorities, through collaborations with Academia, NOAA, Private Sectors and other external stakeholders. CESSRST Center will support NOAA’s mission *“to understand and predict changes in Earth's environment and to conserve and manage coastal and marine resources to meet nation's economic, social, and environmental needs”* by training a diverse group of successful students’ in disciplines that will augment NOAA’s future workforce - by leading successful research and developing collaborations that will contribute to the improvement of NOAA’s products and services. Through a combination of excellent and focused instruction and collaborative research projects aligned with NOAA’s research, development and service missions, CUNY and its partners in CESSRST will provide increased numbers of graduates from traditionally underrepresented minority communities with the skills and experience necessary to augment NOAA’s future workforce.
The conceptual framework (Figure 1) indicates the action plan (and milestone chart) that has been created to help CESSRST members prioritize and implement the plan which will be internally monitored and evaluated to ensure CESSRST members achieve the intrinsic merits and goals. The Plan will serve as a five-year road map of the proposed CESSRST Strategic Plan and serve as a unified structure to help track progress and accomplishments of the program outcomes. The successful implementation of the plan requires coordination and strong collaboration across the entire CESSRST and substantial involvement, collaboration and engagement of NOAA and its stakeholders - to serve its primary beneficiaries – the students, who are the next generation scientists and engineers trained in NOAA sciences by CESSRST faculty advisors and NOAA scientists/mentors.

**CESSRST MISSION**

To educate, train and graduate a diverse and competent cadre of students and create a diverse and skilled workforce in NOAA related STEM disciplines through participation in state-of-the-art research that is aligned with NOAA’s goals in Climate Mitigation and Adaptation, Weather-Ready Nation, Healthy Oceans and Resilient Coastal Communities, and the recent NOAA’s Strategic Research Guidance Memorandum.

**CESSRST VALUE STATEMENTS**

- Create a robust center-wide science, social science and education framework that aligns with NOAA’s education and science strategic missions.
- Create a synergy between CESSRST and the University Strategic mission and core values.
- Create a climate of diversity, inclusion, and positive learning for students and early career scientists.
- Inspire leadership and create innovative and forward thinkers.
- Address attainment gaps and create strategies to address STEM diversity and job skill deficiency gaps.
- Create a world-class cadre of young, NOAA science competent scientists and engineers, especially students from underrepresented minority groups.
The Overarching goals and objectives of CESSRST 2016-2021 are:

**Goal: Conduct NOAA mission-aligned collaborative research**

**Objectives:**
- Increase NOAA Collaboration and Engagement with NESDIS and other Line Offices
- Increase and create NERTO opportunities for all CESSRST graduate students
- Increase the number of publication relevant and aligned to NOAA EPP funding and mission science

**Goal: Recruit, train and graduate increased number of students in NOAA related STEM fields**

**Objectives:**
- Create and implement Center-Wide Recruitment Plan
- Create and institutionalize Center-wide Core-Competency (CWCC) Framework
- Create and implement Center-Wide Social Science Framework
- Create and implement Professional Advancement and Career Engagement (PACE)
- Create summer Bridge Program to increase number of applications for NOAA UG scholarship opportunities

**Goal: Increase/attain institutional capacity to sustain education and research**

**Objectives:**
- Increase/leverage University and generate extramural resources to sustain CSC capacity to conduct research and education
- Create new Academic Programs and Curriculum in line with NOAA mission science
- Communicate CSC accomplishments and success stories
- Create best practices that are scalable and transferable
- Participate in CSC Recipient Network – across all NOAA Cooperative Science Centers.
# CESSRST Key Personnel Team

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<tr>
<th>Key Personnel</th>
<th>Name</th>
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<tr>
<td>Center Director</td>
<td>Reza Khanbilvardi, PhD P.E.</td>
<td><a href="mailto:khanbilvardi@ccny.cuny.edu">khanbilvardi@ccny.cuny.edu</a> 212.650.8009 T107 Steinman Hall, The City College of CUNY, 140th St and Convent Ave., New York, NY 10031</td>
</tr>
<tr>
<td>Center Assistant Director</td>
<td>Shakila Merchant, PhD</td>
<td><a href="mailto:smerchant@ccny.cuny.edu">smerchant@ccny.cuny.edu</a> 212.650.8379</td>
</tr>
<tr>
<td>Distinguished Research Scientist</td>
<td>Dr. Fred Moshary (Acting DRS)</td>
<td><a href="mailto:moshary@ccny.cuny.edu">moshary@ccny.cuny.edu</a> 212.650.7251</td>
</tr>
<tr>
<td>Communications and Outreach Manager</td>
<td>Olga Joseph (past) Sarah Garcia (Past) Ellis Simon (current)</td>
<td><a href="mailto:esimon1@ccny.cuny.edu">esimon1@ccny.cuny.edu</a> 212.650.5468354</td>
</tr>
<tr>
<td>Education Expert</td>
<td>Elizabeth Day Miller, PhD (past)</td>
<td><a href="mailto:edaymiller@ccny.cuny.edu">edaymiller@ccny.cuny.edu</a></td>
</tr>
<tr>
<td></td>
<td>Nancy Degnan, PhD (past)</td>
<td><a href="mailto:degnan.nancy@gmail.com">degnan.nancy@gmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Laurie Cook, PhD (current)</td>
<td><a href="mailto:lcook@ccny.cuny.edu">lcook@ccny.cuny.edu</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>212.650.8121</td>
</tr>
<tr>
<td>Data and Information Manager</td>
<td>Paul Alabi</td>
<td><a href="mailto:kalabi@ccny.cuny.edu">kalabi@ccny.cuny.edu</a> 212.650.5025</td>
</tr>
<tr>
<td>External Evaluator</td>
<td>Janice Easton, PhD (past) Mark Howse, PhD (current)</td>
<td><a href="mailto:jeaston@ufl.edu">jeaston@ufl.edu</a> <a href="mailto:mark.howse@stellarachievement.org">mark.howse@stellarachievement.org</a></td>
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## A Snap-Shot of the Implementation Plan

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<tr>
<th>Program Title and ID</th>
<th>NOAA Cooperative Science Center for Earth Systems Science and Remote Sensing Technologies (NOAA-CESSRST) Grant Number - NA16SEC4810008 Award Period – September 1, 2016 to August 31, 2021 Award Amount - $15M for 5 years</th>
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<tbody>
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<td>Overarching Program Priority:</td>
<td>Increase numbers of CSC graduates from traditionally underrepresented minority communities eligible to join the STEM workforce at NOAA and other NOAA mission-relevant occupations.</td>
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| Goal(s): | ● Conduct NOAA mission aligned collaborative research  
● Recruit, train and graduate increased number of URM students in NOAA related STEM fields  
● Increase/attain institutional capacity to sustain education and research |
| Objectives (SMART): | Increase *CSC capacity to conduct research* and *increase number of students* particularly from URM group trained and graduated in NOAA sciences by conducting *collaborative research* in NOAA mission aligned sciences |
| Performance Measures: | EPP/MSI Performance Metrics:  
● Increase the number students particularly from underrepresented minority community trained and graduated in NOAA Sciences  
● Increase NOAA Collaboration and conduct research to help advance NOAA mission sciences |
- Generate Leveraged funding
- Inter-CSC collaboration
- Postdoctoral opportunities for recent CESSRST graduates

### Background / References:

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<tbody>
<tr>
<td>1</td>
<td>Special Award Condition (SAC) (see appendix I)</td>
</tr>
<tr>
<td>2</td>
<td>CSC Handbook</td>
</tr>
<tr>
<td>3</td>
<td>CESSRST Faculty and Students Handbook (Resource Center webpage)</td>
</tr>
<tr>
<td>7</td>
<td>NOAA Education Strategic Plan - <a href="https://bit.ly/1OZXQe0">https://bit.ly/1OZXQe0</a></td>
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### Activity(s):

- Create Center-Wide framework/sub-plans:
  1. Science/Collaborative Research;
  2. Social Science;
  3. Recruitment;
  4. Student Development – Professional Advancement and Career Engagement (Core-Competency)
  5. Postdoctoral Development Plan
  6. Center-wide Evaluation Plan
  6. 5 Year Milestone Chart
- Create internal committee and sub-committee for clear communication and collaborative engagement center-wide
- Create CESSRST NOAA Science and Education Advisory Board

### Timeline:

- Six monthly performance and financial progress reports – **September 30 and March 31 each year.**
- Annual Student Progress Report
- Annual NERTO opportunities for Graduate students

### Resources Required:

- Budget
- College resources (career center, institutional research office, office of sponsored program, human resources/staff, faculty commitment)

### Lead Person/Organization:

**Dr. Reza Khanbilvardi**, Center Director, NOAA CESSRST Center, NY
khanbilvardi@ccny.cuny.edu || 212.650.8009

### Anticipated (main) Outcomes:

- **Increased number of students** recruited, supported, trained and graduated in NOAA sciences
- Help create a competent and diverse **STEM workforce** in NOAA mission STEM fields
- Increased **CSC capacity** to conduct education and research

### Progress Notes:

Center Wide Milestone Chart to track the **progress and benchmarks** on quarterly basis to help conduct an **internal monitoring and evaluation**

### Alignment To:

- NOAA Mission Science
- NOAA Social Science
- NOAA Education and
- NOAA Workforce and Inclusion Initiative
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<tr>
<th>Agency/Institution</th>
<th>Offices/Groups</th>
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| The City University of New York | City College of New York (Lead Institution)  
Lehman College  
Brooklyn College  
New York City College of Technology |
| CESSRST Partner Institution | Hampton University, VA  
San Diego State University, CA  
University of Maryland, Baltimore County, MD  
University of Puerto Rico, Mayaguez, PR  
University of Texas, El Paso |
| NOAA Lines/Offices | NESDIS (Primary Line Office) (STAR, OSPO, OSGS, NCEI, TPIO)  
NWS (OHD, RFC, NCEP, EMC)  
OAR (GFDL, PMEL, ESRL, ARL)  
NOS (NCCOS) |
| Community College Cohort | Bronx Community College, CUNY  
LaGuardia Community Colleges, CUNY  
Hostos Community College, CUNY  
Queensborough Community College, CUNY  
Borough of Manhattan Community College, CUNY  
San Diego City College and Southwestern, CA  
Thomas Nelson Community College, VA  
El Paso Community College, TX  
Community College of Baltimore County, MD |
| Other Academic Affiliates | Columbia University, NY (CU)  
New York University, NY (NYU)  
University of California, Irvine (UCI)  
San Jose State University, CA (SJSU)  
University of California, San Diego (UCSD)  
Scripps Oceanographic Institution (SIO) |
| NOAA Cooperative Institutes | Cooperative Institute for Satellite Earth System Studies (CISESS),  
Cooperative Institute for Meteorological Satellite Studies (CIMSS),  
Cooperative Institute for Research in Environmental Sciences (CIRES),  
The Cooperative Institute for Research in the Atmosphere (CIRA) |
| Industrial Partners | Northrop Grumman, Raytheon, Lockheed Martin,  
Boeing, ERT Inc., IMSG Inc., SSAI Inc., STC Inc. AER |
CUNY and its partner institutions recently got a 5-year (September 1, 2016 to August 31, 2021) institutional award through national competition to create a Cooperative Science Center for Earth System Science and Remote Sensing Technologies that will educate, train, and graduate a diverse and highly skilled future workforce in the disciplines that support and align with NOAA’s strategic missions. These graduates will acquire competent skill sets to join the workforce at NOAA and other agencies, private sectors with significant and successful experience in critical NOAA disciplines achieved through participation in state-of-the-art research aligned with NOAA’s Mission and Strategic Priorities. The new center’s activities will be delineated, monitored and evaluated under three major program elements and the action plan as described below:

1. Education and Training
2. Science – Collaborative Research
3. Management (Program and Budget)

1. **Education and Training**

NOAA Reviewers requested greater specificity concerning: (1) The rising sophomore summer research experiential training; (2) Center cohort community building and strengthening; (3)
Manner by which student cohorts are engaged in meaningful NOAA mission-relevant STEM scientific research in the primary focus areas; (4) Cohort development; and, (5) Cohort engagement (mechanisms for success). Additionally, NOAA Reviewers requested specifics on: How students are to be (6) recruited for the NOAA Experiential Training. Points 1-5 are addressed in this revised IP section on education and training. Point 6, the information on recruitment for NOAA Experiential Training is presented under the section entitled, Recruitment, Retention and Success.

A. Overview

CESSRST will support NOAA’s objective to prepare a diverse workforce in NOAA mission areas. CESSRST will do so by designing, developing, implementing and assessing a unique and holistic education and training framework to support NOAA’s education goals in the STEM and social science disciplines.

CESSRST educational activities and programs take place throughout a student’s tenure as a CESSRST Fellow. These activities and programs are focused on students’ academic, professional and social success to ensure that students remain at CESSRST institutions, complete their education and pursue NOAA mission related STEM and social science careers. Technical and or academic competencies in (1) Remote Sensing; (2) Socio-economics Drivers and Impacts of Earth System and Environmental Science; (3) Environmental Modeling and Algorithm Development; and (4) Data Analysis and Visualization will drive the core academic curriculum for students across all disciplinary majors and campuses and are well aligned with NOAA’s workforce needs. We will ensure that we meet our CESSRST prerogatives and goals through a dynamic and integrated education and training structure, the CESSRST Educational Framework.

CESSRST Educational Framework includes two main pillars that support URM students in pursuit of STEM majors, graduate studies, and careers aligned with the NOAA mission. These are: 1.) The Summer Bridge Program, which is designed primarily for rising sophomores; particularly targeting students who would like to bridge from community colleges to senior colleges/campuses of CESSRST and, 2.) the Professional Advancement and Career Engagement, or PACE, for all CESSRST Fellows. Further details on the Summer Bridge Program and PACE, are intended to address points 1 and 2 in the NOAA review of the IP, which are, respectively, to more adequately address the rising sophomore summer research; and, to provide details on how CESSRST builds, fosters and strengthens the cohort-based community, inclusive of the Individual Student Development Plan. Then, points 3, 4 and 5 are addressed as well.

B. The Rising Sophomore Summer Research Experiential Training, or the Summer Bridge Program

The Summer Bridge Program for Undergraduates: (i) offers rising sophomores summer research experiences in 3 thematic areas aligned with NOAA’s science, social science and education and training objectives; and, (ii) trains and supports sophomores to apply for the CESSRST Fellowship as well as for the NOAA Hollings Fellowship and the NOAA Undergraduate Fellowships, for their junior and senior years. Recruitment for the student body will occur at each of the six CESSRST campuses, advertised as an 8- week intensive research experience open to students in the sciences, social sciences and engineering. The Program extends from mid-June to mid-August. Each partner institution at CESSRST is committed to advertise the summer bridge opportunities to their local community college – via information sessions, seminars and email networks; campus career
centers or classroom advertisements by the CESSRST affiliated faculty members. The summer bridge opportunities will also be advertised on the CESSRST website and CESSRST twitter account for wider publicity. The plan is to recruit about 15 students each summer to be engaged in NOAA science training and learn about NOAA opportunities.

Research opportunities will be in “earth systems sciences and engineering” using observations from NOAA satellites and Ground-based Measurements with the goal of understanding and predicting changes in our earth’s environment.” Prospective sophomores must have a GPA of 3.0. Students will receive a summer research internship stipend of $4,000.

During the Summer Bridge Program, students will receive training in Remote Sensing, GIS and Matlab Technical Skills and Content, Professional Development, and Social Science. As part of the effort to reinforce education through research, these skills are intentionally utilized in the research project methodology. Faculty and researchers present their research projects during the first week of the Summer Bridge Program, so that the undergraduates can make more informed choices about what summer research projects they prefer. Students will be asked to rank-order their preferences, up to their top three research projects. Notably, the social science components of these projects include applications in public health, sustainability and risk analysis, as examples. Table 1 below shows the Core Competency Curriculum Map. A full schedule of the Summer Bridge Program is found as Appendix II, the Research Topic List, 2017 is found as Appendix III and the Core Competency Calendar is found as Appendix IV.

Webinars and presentations by CESSRST faculty and scientists are part of the summer experience as are field-site visits and other experiential learning and social networking events. The students are exposed to various information sessions on the topics related to CESSRST mission and vision;
fellowship opportunities, NOAA Hollings Fellowship and the NOAA Undergraduate Fellowships. Students will be given a pre and post survey to assess the value of the program and adopt best practices and approaches for subsequent years. Students will also be able to meet with the CESSRST Education Expert and engage in focus group meetings with the CESSRST External Evaluator.

As noted, recruitment for the Summer Bridge Program takes place at all CESSRST institutions during the late fall and spring semesters, with final selection and notification occurring in late April. Students who are admitted to the Program also receive information about the dates of orientation, the full schedule and the Core Competency Curriculum, so that they are fully prepared for the Program. Students who attend from other CESSRST institutions join-in via distance learning technology and conduct their research experience at their home institutions. The CESSRST instructors/faculty and staff are especially aware of the students who participate by distance and encourage full engagement in the hands-on teaching and learning.

Overall, the Summer Bridge Program is intended to: i) Prepare undergraduate students in NOAA required skills and dispositions; ii) provide the experiential learning opportunities through summer internships; and, iii) share the information and how to successfully apply for the NOAA sponsored fellowships. Each of these components is evaluated by the CESSRST External Evaluator to inform the internal management mechanisms that are designed to fully assist undergraduates in obtaining (1) foundational training in STEM fields related to NOAA sciences, (2) funding, and (3) completing their STEM focused degree and (4) graduating with a STEM degree.

Along with other cohort recruitment activities, described in this IP’s section entitled, Recruitment, Retention and Success, the Summer Bridge Program becomes an essential pathway for rising sophomores to complete their STEM degrees, and in achieving CESSRST goals in support of NOAA’s mission and vision for education and training of URM students.

C. CESSRST Cohort Construction Process

The implementation plan drives the Cohort construction process. The plan itself has been developed according to CESSRST goals and to achieve the CSC outcomes and output. These include NOAA mission science relevance and early NOAA engagement, and Center’s goal of increasing diversity across NOAA mission relevant sciences. The plan also takes into consideration CESSRST’s overall and student budgets, and eligibility and financial support guidelines for CESSRST fellows. The plan includes projects and tasks with respective deliverable. There is an associated table of milestones. Taking into consideration the implementation plan, the research coordination committee guides CESSRST recruitment committee on student recruitment needs in terms of student interests and skills in alignment with CESSRST projects and tasks. The recruitment committee recruits interested applicants across CESSRST institutions in a variety of venues such as national professional and student conferences, student job and internship fairs, etc. The recruitment information is input to a database that includes prospective student information such as major and level, GPA, research interests, etc.

The CESSRST researchers/research teams use the recruitment database to follow up with prospective applicant and consolations with their NOAA research collaborator. They then nominate candidates to the research coordinator in for their team using a nomination form which
includes information on student nominee as well as the task/project/and theme where the student will be engaged and potential NOAA mentor.

CESSRST research coordination committee will prioritize the nomination in view of the implementation plan and make recommendations to the CESSRST administration.

CESSRST administration awards fellowship and constructs the student cohort for each year. The final award decision is made based on CESSRST goals, and timetable of CESSRST outputs and outcomes. All students must satisfy the eligibility requirements:

1. US Citizenship
2. Students is a degree candidate in NOAA Related STEM or social science disciplines.
3. The Student has a GPA of 3 or higher.
4. Student has agreed to satisfy CESSRST Core Competency requirements.
5. Student has agreed to satisfy CESSRST NOAA Experiential Research and Training and Opportunity (NERTO) internship requirements.
6. PhD and Master students commit to not hold jobs or employment while they are a CESSRST fellow.

The selection takes into account the budgetary restrictions, the areas of research priority, evidence of early NOAA engagement by the nominating mentor, and the Center’s goal of recruiting the diverse cohort and increasing the number of underrepresented students in NOAA mission sciences. The chart below describes the Cohort selection process.

**D. Center Cohort Community Building and Strengthening: The CESSRST Professional Advancement and Career Engagement, or PACE;**

Education activities and programming will also include important activities to build and maintain skills, content knowledge, research capabilities, and community once students are admitted as members of the CESSRST cohort(s). The Center-wide CESSRST Professional Advancement and Career Engagement, or PACE will ensure that each student supported by CESSRST will be competent and ready for workforce transition at the time of graduation.

PACE is designed to: (a) provide a road map for students’ academic, professional and social development which is named the Individual Student Development Plan, or ISDP; (b) increase the technical skill development by achieving core competencies in critical academic areas; (c) increase professional skills development by actively participating in CESSRST sponsored professional development seminars; and, (d) provide student with experiential learning opportunities and
internships (SSIO and NERTO). PACE comprises these 4 elements specifically to help build individual student research capabilities and exposure as well as to build and create overall cohort cohesion and community.

E. Manner by which student cohorts are engaged in meaningful NOAA mission-relevant STEM scientific research in the primary focus areas.

While even more detail on scientific research is presented on pages 36, CESSRST’s Individual Student Development Plan, which is a part of PACE, demonstrates the intentionality of integration of education with scientific research primary focus areas, as requested by IP NOAA Reviewers. This section also describes the CESSRST personnel who are responsible for student success, also as requested by the IP NOAA Reviewers.

Once admitted into the CESSRST Program by November 30 each academic year, all students, across all levels, are required to complete their Individual Student Development Plan, or ISDP, within 30 days of their acceptance as a CESSRST Fellow. CESSRST has conceived of its support to all students from undergraduate to graduate as a continuum. The rationale for the ISDP is that the plan concretizes the “roadmap” of students’ education and training by requiring them to describe, update, and report specifics. Thus, for the CESSRST students, the ISDP is a living, organic tool that supports them as they interact with:

i) Faculty and NOAA mentors; ii) the CESSRST Education Expert and CESSRST Student Affairs Coordinator; and, iii) other CESSRST administrators and personnel.

Students are asked to review their ISDP on a bi-semester basis with their Faculty Mentor, the CESSRST Education Expert, and where and when appropriate, with their NOAA Mentor. Additionally, students and staff are in contact, at least once a month, if not more, over the summer. These “check-in” communication mechanisms include email, phone, face-to-face or skype contact. In this way, any challenges faced by a student (or a cohort) can be identified for early intervention and problem-solving. The ISDP serves as a personal and “professional” performance management tool for students, for cohorts as a collective, and for CESSRST as a Center.

From another important perspective, the ISDP becomes a lens into the overall effectiveness of CESSRST scientific research and educational administrative components, when coupled with periodic formal and informal assessment conducted by the CESSRST Program External Evaluator. The experience of the individual students, as captured and reported through the ISDP, is a gauge for measuring overall quality improvement, in continuous pursuit of programmatic excellence. On one hand, the ISDP supports students in completing their education and in graduating in the STEM fields; and, on the other, the ISDP provides the CESSRST education and research staff with the information and assessment to help students achieve their intended education and research outcomes.

The ISDP is housed on an interactive, secure platform and is prompted by a student’s first “formal” exposure to the CESSRST program through the fellowship application process. Each prospective student is asked to complete the simple, on-line application that collects pertinent information such as name, institution, GPA, major and reasons for applying for the CESSRST Fellowship, as examples.
Once admitted to the program, this ‘front-page’ application form becomes the basis for a much broader set of prompts including courses, internships, Faculty and NOAA Mentors and research-work placements, plans for completion, as examples. Notably, ISDP’s also are intentional about the identification of research themes aligned with CESSRST mission and values in meeting workforce needs in the natural and social sciences, on one hand; and, on the other, asking the students to think about how their work actually dovetails with the economic, environmental and social imperatives of our nation and the earth. This type of prompting through an ISDP will likely result in anchoring, over the longer term, the imperatives for being and remaining in rigorous NOAA STEM related education and training; and, will also give the Mentors and the Education Expert key information to continue to support students become the professionals and leaders of the 21st century.

The ISDP serves as a repository for two other important functions. “Student success” stories as evidenced by published peer and non-peer reviewed articles, presentations at conferences, webinars, or other platforms for education and outreach, are centrally located; and, the ISDP prompts all students to complete their Responsible Conduct of Research Certification found at: https://about.citiprogram.org/en/series/responsible-conduct-of-research-rcr/. The Certification must be emailed to the CESSRST Data Manager for purposes of tracking completion of the RCR. CESSRST personnel including campus PIs, Faculty Mentors, NOAA Mentors, the CESSRST Director and Assistant Director and the CESSRST Education Expert can access the repository. Thus, each CESSRST student’s perspective on responsible research is reinforced at the education and research-community level.

By creating a complete and fully integrated description of the education, training and research journey through the ISDP, individual and cohort community is built and strengthened.

Finally, CESSRST anticipates that the ISDP will become foundational to building and maintaining a robust, active and up-to-date alumni database. This is particularly important in our view, as a mechanism to provide ongoing support of NOAA related activities as well as those of CESSRST, particularly as Fellows enter the academia, government or the private sector.

F. Cohort Development; and Cohort Engagement for Success

CESSRST students will also participate in year-round professional development including career and academic seminar series addressing topics in the NOAA STEM and social sciences. Likewise, students will be supported in maintaining their academic success and gain job-relevant experiences and skills through experiential learning activities in university research laboratories, and NOAA laboratories and facilities.

The CESSRST Mentoring Structure comprising both a NOAA Mentor and an institutionally based Faculty Mentor provide further support for the CESSRST individual student as well as overall vitality of each cohort. Specifically, the Faculty Mentor will collaborate with the student’s NOAA Mentor to ensure that individual student research project is imbued with the NOAA mission-relevance. Because each individual student receives this level of professional and academic attention through the mentoring process, overall quality assurances can occur. At a management and organizational level, the CESSRST Research Coordination Committee and the Science Oversight Committee interfaces with the Education Committee around salient research issues and the effective integration of education, training and research.
CESSRST has created two positions to provide overall and individual advising and support. One is required in the FFO and one has been developed through CESSRST.

Under the guidance and direction of the CESSRST Education Expert, a Student Affairs Coordinator is responsible for advising students on issues having to do with their curriculum, course of study, challenges they may face, with regard to their academic performance and maintaining the GPA level required by CESSRST. The Education Expert works with the Student Affairs Coordinator to ensure that a series of individual student and cohort-wide face-to-face and virtual “conversations” and discussions occur. These are intended as mechanisms to build trust and cohesion within and among individuals and cohorts over the duration of the 5-year period. Likewise, these mechanisms are intended to gain insight and feedback on the specific and general experience of the CESSRST Fellows. In this way, the progress of each student and each cohort can be monitored and guided. When intervention is called for, it will be at the stage where timely problem solving can occur and the integrity of the student experience can be maintained and reinforced.

The CESSRST Education Expert also ensures that organizational structures are adequate to support the work at a student affairs level, overall, as well as across the partner institutions. Additionally, the Education Expert engages with the data management and communications team to gather critical information needed to maintain the goals of supporting students to attain the content and work skills emblematic of NOAA mission. The important quantitative and qualitative data and information by student and by cohort is gathered to help define best practices, on one hand, and interrupt any practices that have unintended impacts (again this is at an organizational, management level as well as at the individual student level).

Finally, the Education Expert heads up committees and works with subcommittees to address any challenges or obstacles. Education coordination efforts may also extend beyond education committees to recruitment, retention, core competency as well as scientific and social science committees.

Externally, the CESSRST Evaluator collects data for assessment that is known only to the evaluator. This raw data comes from the Evaluator’s own focus group feedback sessions, individual student interviews, surveys and questionnaires, to name a few. As a second mechanism of continuous quality improvement, the Evaluator will inform the Education Expert, the CESSRST Assistant Director and CESSRST PIs about any organizational or programmatic issue or issues that could potentially impact on student performance and student research capabilities and success. Thus, the outside review becomes another “portal” of data and analysis for the key performance indicators in education and training of the CESSRST supported students.

The overall intention, clearly, is to ensure that the organizational structure links into the mentoring, support and guidance work undertaken by the CESSRST personnel on behalf of the students, and as highly functioning mechanisms to ensure student success. The IP approach to effective coordination is to identify seminal touchpoints and feedback necessary to ensure programmatic integrity leading to CESSRST best practices.

For purposes of tying in CESSRST implementation to outcomes and internal assessment and monitoring required and tied back to the FFO, the Education Expert also will inform, make presentations to and meet with PIs, heads of committee and subcommittees (including the
Committee on Recruitment, Retention and Support), the CESSRST Assistant Director and the CESSRST external evaluator. This occurs, at least, for the CESSRST Summer Annual Meeting, twice every semester during the academic year and as needed should unanticipated situations, needing troubleshooting and problem-solving arise.

At the end of a student’s CESSRST education and research experience, CESSRST personnel will facilitate job placement to help connect students with NOAA related job opportunities. The External Evaluator will conduct exit interviews and CESSRST graduates will be contacted for at least 36 months after they complete their CESSRST Fellowship.

Thus, monitoring and evaluation of project outcomes will be conducted for each student outcome throughout the tenure of the project. Analysis will be conducted by cohort and across cohorts, as well. Placement of students in the workforce and post-graduate tracking will be included as part of the overall Evaluation of CESSRST-related outcomes. The continuous monitoring of education and research activities will inform program improvements. Longitudinal studies will provide longer-term evaluation of the program and help identify the program’s strengths and areas for improvement. These studies will also determine CESSRST’s ability to meet the diverse workforce requirements of NOAA and the nation. This information will feed back to CESSRST’s recruitment and retention activities through appropriate modifications to the CESSRST program.

The next section on recruitment, retention and success addresses two final points made by the NOAA reviewers that of - how students are recruited so that there is a continuous pool of students to apply as well as a timeline of the cohort experience.

Lastly, the Reviewers requested feedback on the following question: What are specific CESSRST funded student activities, products and accountabilities to the Center. We have interpreted this through our elaborated sections on PACE, the ISDP, and cohort development. Should we have misinterpreted this question, we will gladly clarify with the NOAA Reviewers and provide additional narratives/explanation as needed.

2. RECRUITMENT, RETENTION AND SUCCESS

In order to achieve the program priorities and education outcomes of increasing the number of students trained and graduated in NOAA mission related STEM disciplines and reducing the attainment gap, CESSRST team has designed a robust and center-wide student recruitment, retention and success plan. This plan aims to (1) recruit and graduate a highly diverse pool of students who are focused on building a career in NOAA-related STEM disciplines of Earth System Sciences and Remote Sensing Technologies; (2) address the nation’s STEM priorities to increase higher education access for students particularly from historically underrepresented and economically disadvantaged communities, and, (3) respond to NOAA’s Education Goal #4: for a diverse and highly skilled future workforce that pursues careers in NOAA’s mission related fields. Identifying recruitment needs, conducting outreach and program dissemination, supporting prospective students’ applications to CESSRST institutions, and assessing the success of these activities will accomplish this.

**Recruitment Strategies:** CESSRST has established a committee structure for managing and implementing all aspects of CESSRST education and scientific activities. The Recruitment Sub-Committee of the Education and Outreach Committee is tasked with:
a. Developing targeted outreach and recruitment tools and materials (electronic, print, social media) describing the benefits of participating in CESSRST (funding, academic, professional development, research, and internships).

b. Creating a center-wide outreach and recruitment plan to identify events and pathways to promote CESSRST opportunities for students at all stages of their education trajectory. Each partnering institution will participate in events and opportunities at the local, regional, and national levels in order to access students interested in their post-secondary degrees (undergraduate and graduate degrees). The center-wide outreach and recruitment plan will include a yearly budget and event calendar. Possible recruitment events, opportunities, and pathways include, but are not limited to:
   i. CESSRST affiliated faculty members promoting opportunities with their classes and individual students.
   ii. Advising/career centers at each campus, community colleges, and high schools promoting CESSRST with interested students. These activities will result in creation of a recruitment network/pipeline between partner institutions and local secondary and postsecondary institutions to increase awareness of NOAA Sciences CSC.
   iii. Representatives from CESSRST institutions actively participating in activities that serve as an effective in-house recruitment vehicle. Some of the campus activities may include:
       • Annual CESSRST Day (high school students);
       • Campus-wide College fairs; and
       • College and University Career fairs (undergraduate and graduate students).
   iv. Representatives from CESSRST institutions engaging in K-12 networking in their local communities to create a high school pipeline into undergraduate degree programs.
   v. Representatives from CESSRST institutions continuing to leverage high school programs in NOAA sciences (i.e. HIRES) as potential recruitment avenues for recruiting freshmen cohorts.
   vi. Participation of representatives from CESSRST institutions in national professional conferences and meetings (i.e. AMS, AGU, BEYA, HBCU, LAESA-SHPE, SACNAS, and HACU) to target underrepresented minority populations to pursue post-secondary studies at CESSRST partner institutions.

c. Prospective students interested in specific CESSRST research will be recruited and placed in ongoing research projects and collaborative projects.

d. Meeting with and reporting to the Education and Outreach Committee at least every semester, aligned with NOAA reporting timeline (spring and summer).

e. Coordinating with the CESSRST Evaluator to assess recruitment and retention progress.

**Deliverables:**

- Development and dissemination of informational materials (brochures, web pages, social media) and calendar of events for public awareness of CESSRST recruitment activities.
- Identify national, regional and local recruitment opportunities (each partner institution needs a list) for in-person and virtual recruitment aligned with the four CESSRST research theme areas.
- Identify advising/career centers at feeder institutions (HS, UG, and CC).
- CESSRST University partners will conduct a semi-annual in-person and/or virtual seminar series by CESSRST faculty and/or NOAA collaborators to promote CESSRST and NOAA scholarship opportunities, research internships, and graduate programs.
● Develop annual budget.
● Assess of recruitment strategies outputs and outcomes.

Below chart depicts the current and future recruitment activities

2. Admission into the CESSRST Program: In order for students to be eligible for a CESSRST fellowship, they must be enrolled (undergraduate or graduate degree) at one of the CESSRST partner institutions. Support and guidance will be provided to all interested students to complete their admission process. To be part of the CESSRST program:
   a. Each student must apply through the center-wide application process available on the CESSRST website (http://noaacrest.org/apply/noaa-crest-application).
   b. Each application will be reviewed based on these selection criteria:
      i. US citizenship,
      ii. At least a 3.0 GPA and
      iii. Prospective student interest in pursuing a degree in one of the four thematic areas of CESSRST research (Coastal Resilience, Weather Hazards, Water Prediction, and Ecosystem Services).
      iv. Applicant information (application) is disseminated to the partner institution the applicant indicates they are interested in attending.
   c. Successful applicants will be notified of their acceptance into the CESSRST program.
   d. All accepted students must sign a Letter of Understanding (LoU) along with their CESSRST advisor to abide by the program requirements to advance their professional training in NOAA related STEM careers.

Deliverables:
● Develop CESSRST application for all levels (UG, MS, Ph.D.).
● Applications reviewed for CESSRST eligibility.
● Applicant information (application) is disseminated to institutions of interest to applicants.
● Successful applicants notified of acceptance into the CESSRST program.
● Assess admission into CESSRST outputs and outcomes.

CESSRST Administrators along with the Recruitment Sub-Committee will document and enumerate recruitment activities and outputs in accordance with the proposed Milestone Chart (below). For each event, CESSRST will monitor attendance and collect attendee demographic data. The Recruitment Sub-Committee will oversee and ensure that the Center-wide Outreach and Recruitment Plan incorporates best practices, creates an event calendar that is periodically updated, enumerates the number of media materials distributed and ensures that activities conducted are geared toward recruitment efforts. The number of students that participate in recruitment activities (i.e., career fairs) and the number of students expressing interest in CESSRST and NOAA related
sciences will be recorded. Event information will be compared with information from CESSRST applications to correlate recruitment strategies with actual numbers of applicants. Recruitment and Outreach Sub-Committee will compile the data and report to CESSRST bi-annually in order to monitor achievement of recruitment efforts. This data will be compiled and reported by CESSRST to NOAA bi-annually in order to assess the accomplishments of stated outcomes.

### Recruitment and Admission Strategies

<table>
<thead>
<tr>
<th>Milestones</th>
<th>Monitoring / Evaluation</th>
</tr>
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<tbody>
<tr>
<td><strong>CESSRST Center-wide Recruitment Plan</strong></td>
<td>• Number of print/virtual materials developed and disseminated (Y1-Y5)</td>
</tr>
<tr>
<td>• Develop and disseminate CESSRST recruiting materials</td>
<td>• Enumerate materials and interested students at career fairs and events (Y1-Y5)</td>
</tr>
<tr>
<td>• Calendar of events for awareness of recruitment activities</td>
<td>• Monitor recruitment and retention efforts Center-wide (ongoing)</td>
</tr>
<tr>
<td>• Identify national, regional and local recruitment opportunities for in-person and virtual recruitment aligned with CESSRST research areas</td>
<td>• Incorporate questions regarding awareness of CESSRST and NOAA on application materials (Mar-Apr, 2017)</td>
</tr>
<tr>
<td>• CESSRST Outreach Events, including participation in freshmen orientation and in community college STEM activities (linked to community college education and career advising)</td>
<td>• Survey students in high-school pipeline programs (i.e. NOAA-CESSRST DAY, April and CUNY HIRES; Jul-Aug, Y1-Y5)</td>
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<tr>
<td>• National Conferences</td>
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<td>• Community College education and career advisors</td>
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<tr>
<td>• K12 engagement/pipeline program (summer internships, field trips and after school programs)</td>
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<tr>
<td>• E.g., CESSRST Day and CUNY HIRES</td>
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<tr>
<td>• Develop annual recruitment budget</td>
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<tr>
<td><strong>Admission into the CESSRST Program</strong></td>
<td>• Track # applicants, % accepted/applied (Y1-Y5)</td>
</tr>
<tr>
<td>• Develop application online portal for all levels (UG, MS PhDs) with access for CESSRST partners and Recruitment Sub-Committee</td>
<td>• Incorporate questions regarding awareness of CESSRST and NOAA on application materials (Mar-Apr, 2017)</td>
</tr>
<tr>
<td>• Review applications, placement in the appropriate campus/lab/research group and notify the successful applicants</td>
<td>• Ensure applicants meet specified selection criteria (ongoing)</td>
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**Retention and Success:** Every effort will be made to ensure students accepted into CESSRST will remain in CESSRST and be successful as students. The following support mechanisms will be implemented across CESSRST to ensure student retention and success:

a. Upon acceptance to CESSRST, all CESSRST supported undergraduate will participate in an eight-week Summer Bridge Program in Earth System Science and Remote Sensing Technologies prior to their first year of joining CESSRST. The Summer Bridge Program will be designed and administered by the CESSRST Faculty, Scientists and invited NOAA mentors and collaborators. The program will provide student technical training in Level I core competency and professional development areas (i.e. personal portfolio development, search/selection of graduate and postdoctoral programs, strategies for successful proposal and fellowship applications, effective mentor/mentee relationships). Rising undergraduate
sophomore participants will be required to apply to NOAA undergraduate scholarships, and other NOAA mission aligned related experiential training and/or scholarships and fellowships. The Summer Bridge Program is intended to help prepare new students for their academic and research experiences in the fall. (Please see section under Education and Training, page 14)

b. During their first semester with CESSRST, students will participate in a new student orientation webinar session (to introduce strategies for how to most effectively fulfill their graduation requirements and learn how to build relationships with their supervisors and colleagues).

c. Opportunities for students to participate in a CESSRST-adopted, academic year, retention and success program (such as SAFE, PRODUCE, LSAMP, or B.E.S.T) will be available to all students who may benefit from additional support services.

**Deliverables:**
- Students in the Summer Bridge program participate in the ongoing research projects at their home institution.
- New student orientation sessions offered in the Fall and Spring.
- Participation in retention and success programs extended to all CESSRST students.
- Assess CESSRST retention and success outputs and outcomes.

<table>
<thead>
<tr>
<th>Retention and Success Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Milestones</strong></td>
</tr>
<tr>
<td>• Enroll CESSRST students at all institutions in retention and success programs (i.e. Summer Bridge, New Students Orientation)</td>
</tr>
<tr>
<td>• New Student Orientation Webinar</td>
</tr>
<tr>
<td>• NOAA Scholarships</td>
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<tr>
<td>• Optional success programs</td>
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</tbody>
</table>

### 3. **Professional Advancement and Career Engagement (PACE)**

The center-wide CESSRST Professional Advancement and Career Engagement (PACE) Plan is designed to engage CESSRST affiliated Faculty, Scientists, Staff, and students (UG, MS and Ph.D. levels) to conduct research and to create a diverse and highly skilled future workforce in the disciplines that support and align with NOAA’s strategic missions. In order to build a talented and competent workforce and address the job-skill gaps that persist among graduating students, their college and graduate school experience must encompass more than just course work, research, presentations, and publications. The goal of PACE is to ensure that each student supported by CESSRST will be core competent and ready for workforce transition at the time of his/her graduation. Additionally, PACE is designed to: (1) provide a road map for students’ academic,
professional, and social development (ISDP); (2) increase technical skill development by achieving core competencies in critical areas; (3) increase professional skills development by actively participating in CESSRST sponsored professional development offerings and (4) provide students with experiential learning opportunities and internships (SSIO and NERTO).

A. Individualized Student Development Plan (ISDP)

All students entering the CESSRST CSC will design their Individual Student Development Plan (ISDP) within 30 days of acceptance into CESSRST. The ISDP is an electronic portal, to be hosted by the new CESSRST MIS system, designed to serve as a road map to guide, plan and document progress toward achieving student learning and career goals. This plan will identify the specific training, education, and development activities (formal and informal) needed to acquire the competencies identified by CESSRST. Students will develop the ISDP with guidance from their research supervisor and the Education Expert. The ISDP is designed to:

a. Identify and assess future developmental needs in required competency areas;
b. Provide structured learning experiences aligned with NOAA’s workforce needs;
c. Establish an agreed-upon set of learning objectives and developmental activities that comprise a formal career development program.

**Deliverables:**
- Initial population of ISDP by student
- Initial review of ISDP by the Faculty/advisor and NOAA co-mentors (for Graduate Students)
- Initial review of ISDP by the Education Expert and the Student Affairs Coordinator
- Revisit and revise ISDP with Faculty/advisor each semester
- Revisit and revise ISDP with Education Expert each semester
- Discuss progress and identify areas for improvement with advisor and Education Expert
- Create concrete actions to remedy need for improvement with advisor and Education Expert
- Assess CESSRST ISDP outputs and outcomes.

### Individual Student Development Plan (ISDP)

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Monitoring / Evaluation</th>
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</thead>
<tbody>
<tr>
<td>● Develop ISDP framework</td>
<td>● ISPD Beta tested by current students, faculty and Education Coordinator (Apr-May, 2017)</td>
</tr>
<tr>
<td>● Students complete ISPD within first 90 days of acceptance</td>
<td>● Self-assessment rubric/questionnaires embedded in ISPD gather baseline core competency data in academic and professional skills and abilities (Apr-May, 2017)</td>
</tr>
<tr>
<td>● Students fill out their ISDP with support from CESSRST advisor and NOAA mentor</td>
<td>● Education coordinator reviews self-assessments and works individually with students (ongoing)</td>
</tr>
<tr>
<td>● Education Coordinator reviews ISPD with students to assess core academic and professional needs</td>
<td>● Students assess their achievement towards the technical and professional core competencies (Y1-Y5, each semester)</td>
</tr>
<tr>
<td>● Students meet with Education Coordinator each semester to track performance and identify strengths and areas of needed improvement</td>
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</tr>
</tbody>
</table>
B. Technical Skills Development

A key element of the Center’s Professional Advancement and Career Engagement (PACE) are common core technical competencies across the Center and within the Research Themes, referred to as Level-I (Basic) and Level-II (Advanced). This Technical competency complements the Professional Skills Development component of PACE (Section 3). All CESSRST students will receive formal technical training to achieve competency in the following core areas: (1) remote sensing; (2) socioeconomic and biophysical controls of earth and environmental change; (3) computer modeling and algorithm development; (4) experimental design, data analysis and visualization. These competency areas will drive “Level-I Core Competency” for participating students at all levels (Undergraduate and Graduate) across all disciplinary majors and campuses. All CESSRST students will be required to satisfy the Level-I Core Competency requirement. Graduate students will also be required to satisfy Level-II Core Competency that consists of advanced common proficiency in specific topical areas supported by the individual Research Themes (I-IV).

The Core Competency Coordination sub-committee of the Education and Outreach Committee is tasked with:

a. Designing the center wide core-competency curriculum in line with the CESSRST 2021 proposal, NOAA, and NOAA contractor workforce needs. The core competency curriculum will include the following common technical topics: Geospatial Data Analysis, GIS, Remote Sensing and Satellite Data Interpretations, and Computational Coding and Programming. Additionally, the core competency curriculum will be further developed in coordination with the Science Research Coordination Sub-Committee to achieve proficiency in Research Theme driven topics (i.e. hydrology, weather modeling, coastal processes, observations, etc.).

i. Core competency curriculum will be designed through collaboration with the Core Competency and the Science Research Coordination Sub-Committees and receiving input from NOAA scientists/collaborators to determine workforce related knowledge, skill levels, and ability needs.

ii. The ways a student can achieve each specific core competency and descriptions of these offerings will be available on-line for all CESSRST students and mentors.

b. Identifying two levels of competency for implementation center-wide:

i. Level I (Basic) core competency at the graduate or undergraduate level: All CESSRST-supported undergraduate and graduate level students will be required to achieve basic competency in all four of these areas (1) remote sensing; (2) socioeconomic and biophysical controls of earth and environmental change; (3) computer modeling and algorithm development; and (4) experimental design, data analysis and visualization).

ii. Level II (Advanced) core competency at the graduate level: All CESSRST-supported Masters and Ph.D. level students will be required to achieve Level-I and Level-II core competency. Level-II consists of in-depth common knowledge within the Research Theme (I, II, or III) of each student’s research project. Scientists associated with each
Research Theme will define these competency requirements. Additionally, feedback from NOAA scientists and contractors, and availability of instructional resources across all campuses and/or professional organizations (i.e. mini-courses, workshops, courses, instructional modules) will be taken into consideration when establishing the core competencies at Level-II. Where and when needed, new courses and instructional modules will be developed to fill identified gaps.

c. Level-I Core Competency will be accomplished through in-person, on-line, and/or virtual center-wide workshops or mini-courses for students. This approach will ensure all students, regardless of the institution, acquire the Level-I core competencies. A problem-based learning approach will be used to accomplish competency in the four areas.

d. Level-II Core Competency will be provided through multi-campus collaboration and by participation from NOAA scientists and contractors to insure all graduate students within Research Themes achieve the established Level-II core competency in support of the individual Research Theme. Traditional mechanisms such as graduate courses and non-traditional such as short courses, field trips, workshops, or internships are examples of mechanisms to be used to meet Level-II core competency.

e. Ensuring implementation and compliance with the core-competency curriculum is coordinated with the Education Coordinator.

f. Develop and implement a comprehensive process to monitor student acquisition of required elements for competency at Levels I and II as students and also after joining the workforce.

g. Meeting with and reporting to Education and Outreach committee every semester.

**Deliverables:**
- Develop and conduct a Core Competency Identification survey for NOAA and NOAA collaborators, and CESSRST Core Competency and Science Research Coordination sub-committee members to be used to identify specific content of core competencies.
- Identify and delineate basic and advanced core competency skill sets and outcomes from the survey and additional Center input.
- Design CESSRST Level-I and Level II core competency curricula.
- Identify effective mechanisms that the core competency curriculum can be satisfied (on-line, in-class, seminars, workshops, etc.).
- Formulate and implement a comprehensive monitoring plan to measure levels of proficiencies at each Core competency level. This may include, but not limited to, courses grades (i.e. B or better), and surveys from faculty, NOAA co-mentors, and employers.
- Implement core competency curriculum (on-line, in-person, off-campus).
- Monitor student participation and compliance in achieving core competencies each semester using the Individual Student Development Plan (ISDP).
- Report on student progress toward attaining core competencies (between Core Competency Coordination sub-committee and Education and Outreach Committee).
- Assess CESSRST technical skills development outputs and outcomes.
### Technical and Research Skill Development (CESSRST Competency Framework)

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Monitoring/Evaluation</th>
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<tbody>
<tr>
<td>● Core Competency Sub-Committee designs CESSRST Level-I core competency requirements and curricula</td>
<td>● CESSRST Administrators monitor development of Core Competency Framework (Mar-May, 2017)</td>
</tr>
<tr>
<td>● Research Themed Sub-Committee designs CESSRST Level II core competency requirements and curricula for graduate students</td>
<td>● Competency Sub-Committees list and define expectations for achievement of Level I core competencies (Feb-Apr, 2017)</td>
</tr>
<tr>
<td>● CESSRST network (select NOAA scientists, agency collaborators, etc.) review/edit competencies</td>
<td>● Core-Competency Sub-Committee work with Research Themed Sub-Committees to expedite the development of Level II competency framework (Mar-May, 2017)</td>
</tr>
<tr>
<td>● Final CESSRST Level I and Level II core competencies developed and associated modes of delivery are identified</td>
<td>● CESSRST faculty, NOAA scientists, agency collaborators review core competencies (Apr, 2017)</td>
</tr>
<tr>
<td></td>
<td>● Final draft of core competencies complete (May, 2017)</td>
</tr>
<tr>
<td></td>
<td>● Establish criteria to assess achievement toward competency goals (Mar-Apr, 2017)</td>
</tr>
<tr>
<td></td>
<td>● Rubrics/questionnaires for self-assessment toward achieving core competencies embedded in ISDP (Apr-May 2017)</td>
</tr>
<tr>
<td></td>
<td>● CESSRST faculty advisors and Education Coordinator monitor student participation and compliance in achieving core competencies (Y1-Y5, ongoing)</td>
</tr>
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</table>

### C. Professional Skills Development:

In addition to advancing their technical skills, CESSRST students will develop their professional and social skills as they continue along their path to becoming scientists/engineers in NOAA STEM fields. Professional and social skills are those that increase students’ confidence in their ability to conduct research and to facilitate interpersonal interactions such as the ability to work in groups and establish collegial relationships. Over the course of an academic year, students will participate in structured monthly workshops targeted at improving and developing these skills. Activities aimed at enhancing the professional and social competencies of CESSRST students include following modules:

- Professional Vitae Writing
- Professional Leadership, Mentoring, and Networking
- Professional Etiquette
- Career Development
- Professional Presentations
- Technical Writing
- Ethics (RCR) Ethics (work and professionalism)

These modules will help the students know the essential information needed for their vita. The students will also learn about scientific organizations relevant to NOAA, the importance of networking and assuming leading roles in these organizations, while understanding the expectations of professional etiquette. Students will be given two information/orientation webinars.
(spring and fall each year) to help understand the relationship with NOAA and importance of the funding opportunity provided through Educational Partnership Program (EPP).

The student will also learn about various career opportunities and expectations for growth in the environmental engineering and sciences, including academia, the government, and private sectors. They will also learn the essentials of giving an effective oral and poster presentations. The student will know the 5 key components of a good science abstract and learn the essentials of writing a peer-reviewed journal article and the basics on how to perform a comprehensive literature review. Finally, the students will be required to undertake the RCR training and earn the CITI Certificate

a. **Project-based and Peer Mentoring:** Mentoring is an integral part of CESSRST. Faculty and scientists’ mentor Post-docs who mentor Ph.D. students who mentor master’s degree students who mentor undergraduate students. These mentoring activities take two primary forms: project-based mentoring and peer mentoring.

i. **Peer mentoring:** CESSRST students (including the NOAA GRTSP and NOAA Undergraduate Scholarship Alumni) will continue to engage in peer mentoring activities at CESSRST through ongoing community-based STEM outreach programs. The CESSRST students will mentor younger students through the many community-based events and programs in their geographic area. These opportunities help CESSRST students gain mentoring and communication skills while providing CESSRST science-based outreach to others in their community.

ii. **Project-based mentoring:** The typical scenario of mentoring from scientist to undergraduate is often employed with little support to the mentors along the way. As part of Professional Skills Development, pedagogical and mentoring strategy seminars/workshops will be included offered in addition to the annual workshop schedule. These offerings, modeled after the successful University of Hawaii C-MORE PDTP, will target those who mentor others, providing knowledge and skills known to work when mentoring others.

**Deliverables:**

- Develop and implement Professional Skills Identification survey for NOAA and NOAA collaborators, CESSRST faculty, scientists, and students to use identify key needed professional skills.
- Design and implement CESSRST Professional Skills Development curriculum.
- Development and communicate expected levels of student participation in CESSRST Professional Skills Development curriculum.
- Develop calendar of offerings designed to satisfy Professional Skills Development requirements (on-line, in-person, off-campus).
- Monitor student participation and compliance in achieving Professional Skills Development requirements each semester.
- Report on student, faculty and post-doc participation in and progress toward Professional Skills Development (between Core Competency Coordination sub-committee and Education and Outreach Committee).
- Assess CESSRST professional skills development outputs and outcomes.
Professional Skills Development

<table>
<thead>
<tr>
<th>Milestones</th>
<th>Monitoring/Evaluation</th>
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</thead>
<tbody>
<tr>
<td>● Education Coordinator develops Professional competencies and identifies associated modes of delivery</td>
<td>● CESSRST Administrators monitor development of Professional Development (PD) Competency Framework (Feb-Mar, 2017)</td>
</tr>
<tr>
<td>● Broader CESSRST network (NOAA scientists, agency collaborates, etc.) review/edit competencies</td>
<td>● CESSRST faculty, NOAA scientists, agency collaborators review PD competencies (Mar, 2017)</td>
</tr>
<tr>
<td>● Education Coordination develops CESSRST Professional Skills Development Program</td>
<td>● Final draft of PD competencies complete (Apr, 2017)</td>
</tr>
<tr>
<td>● CESSRST Professional Skills Development Program implemented</td>
<td>● Criteria to assess student achievement towards competencies developed (Mar-Apr, 2017)</td>
</tr>
<tr>
<td></td>
<td>● Students summarize PD experiences in their ISDP</td>
</tr>
<tr>
<td></td>
<td>● Rubrics/questionnaires for self-assessment toward achieving PD competencies embedded in ISDP (July, 2017)</td>
</tr>
<tr>
<td></td>
<td>● Education Expert monitors student participation and compliance in achieving professional skills development requirements (Y1-Y5, ongoing)</td>
</tr>
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</table>

D. Experiential Learning (Internships):

Opportunities for students to actually experience and participate in the scientific endeavor/process are invaluable. An internship can expose students to careers or fields of interest to help determine if they have a genuine interest in that particular field. Internships are an excellent way to begin building important connections that are critical for developing and maintaining a strong professional network for the future. CESSRST, in cooperation with NOAA facilities and researchers, will offer students, at all levels (undergraduate, masters, and doctorate), meaningful internship opportunities.

a. Undergraduate: NOAA training and research experience opportunities for Freshmen and Sophomore students will focus on:
   i. Providing summer opportunities in NOAA mission-relevant research and training experience to postsecondary students at CESSRST institutions who have completed their freshman year;
   ii. Preparing pre-selected freshman and sophomore students from across CESSRST institutions for NOAA undergraduate scholarship applications and similar opportunities; and
   iii. Increasing the total number of competitive scholarship applications in NOAA mission fields submitted by MSI post-secondary students from traditionally underrepresented communities.

b. Graduate: CESSRST will place each graduate student in an internship program at a NOAA lab or facility to align with the students’ NOAA science related interests and training. Each Graduate student funded by CESSRST will have a designated NOAA advisor/mentor. This will help students explore NOAA opportunities and ensure each student is directly engaged in the NOAA sciences and gains experiential learning opportunities in residence at NOAA facilities. The role of the NOAA mentor, collaborating with the proposed academic center advisor/mentor, is to ensure the NOAA
mission-relevance of each student’s project. The NOAA mentor will also provide and/or support guidance to enhance the development of skills and competencies for the NOAA-mission future workforce. Students will be exposed to experiential learning opportunities available at Government laboratories, with Federal Contractors, and/or with Private Industries that align with NOAA mission related sciences (e.g., US Army Corp, FEMA, USDA, NASA, USGS, USEPA, IMSG, and SSAI). Fellows will be required to participate in a minimum of one summer in an experiential learning placement. These opportunities will:

i. Expose students to more than one research environment,
ii. Broaden students’ professional perspectives,
iii. Develop professional networking early in their careers, and
iv. Facilitate job placement upon graduation.

Some examples of possible experiential learning opportunities include:
- NOAA Experiential Research and Training Opportunities (NERTO),
- Students Scholarship Internship Opportunities (SSIO),
- NESDIS/STAR/CoRP Early Career Exchange Program
- Students Professional Academic Readiness and Knowledge in Satellites (SPARKS) will be applied to JPSS, GOES-R and future next generation Satellite missions.
- Collaborations with government agencies and NGOs and industry partners.

As students accomplish each of the above components of the CESSRST Program, they will record and store their individual accomplishment information in their ISDP plan.

**Deliverables:**

- **Undergraduate**
  - Identify summer research opportunities for students completing Freshman and Sophomore years.
  - Identify students completing Freshman and Sophomore years who are eligible for summer research opportunities.
  - Establish application process for undergraduate summer research opportunities.
  - Notify students selected for summer research opportunities.
  - Implement summer research opportunities.
  - Pre-selected freshman and sophomore students from across CESSRST institutions are prepared to apply for NOAA undergraduate scholarships and similar opportunities.
  - Freshman and sophomore students apply for NOAA undergraduate scholarships and similar opportunities.
  - Assess experiential learning outputs and outcomes for CESSRST undergraduates.

- **Graduate**
  - Identify potential internship hosts among NOAA labs and facilities.
  - Identify masters and Ph.D. students eligible for a graduate level internship.
  - Match eligible students with appropriate NOAA hosts.
  - Implement summer research opportunities.
  - Assess experiential learning outputs and outcomes for CESSRST graduate students.
<table>
<thead>
<tr>
<th>Milestones</th>
<th>Monitoring/Evaluation</th>
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<tbody>
<tr>
<td><strong>Undergraduate</strong></td>
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</tr>
<tr>
<td>• Identify summer research opportunities for students completing Freshman and Sophomore years, inclusive of “Rising Sophomore” group for the Summer Bridge Programming</td>
<td></td>
</tr>
<tr>
<td>• Eligible students apply and are selected for summer research opportunities – Summer Bridge</td>
<td></td>
</tr>
<tr>
<td>• Implement summer research opportunities (aligns with CESSRST sciences)</td>
<td></td>
</tr>
<tr>
<td>• Pre-selected Freshman and Sophomore students are prepared to apply for NOAA undergraduate scholarships and similar opportunities</td>
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<tr>
<td><strong>Graduate</strong></td>
<td></td>
</tr>
<tr>
<td>• Identify potential internships (SSIO/NERTO) hosts among NOAA labs and facilities</td>
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<tr>
<td>• Match eligible students with appropriate NOAA Science Mentor</td>
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<tr>
<td>• Implement summer research opportunities</td>
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<tr>
<td><strong>Monitoring/Evaluation</strong></td>
<td></td>
</tr>
<tr>
<td>• CESSRST Administrators identify internship opportunities that align with research themes (Y1-Y5, ongoing)</td>
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</tr>
<tr>
<td>• Match students with internships based on student interests (Y1-Y5)</td>
<td></td>
</tr>
<tr>
<td>• Pre-post survey developed for SURE students to evaluate their summer research experiences and further interest in NOAA sciences (Jun-Aug, Y1-Y5)</td>
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<tr>
<td>• Interviews with SURE students and mentors (Aug-Sep, Y1-Y5)</td>
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<tr>
<td>• Track # scholarship applications (ongoing)</td>
<td></td>
</tr>
<tr>
<td>• CESSRST Administrators identify internship opportunities that align with research themes (ongoing)</td>
<td></td>
</tr>
<tr>
<td>• Work with NOAA labs and facilities to match student to science mentors</td>
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</tr>
<tr>
<td>• Coordination of GRT activities monitored by Education Coordinator (Y1-Y5, ongoing)</td>
<td></td>
</tr>
<tr>
<td>• Pre-post survey developed for GRT students to evaluate their summer research experiences and interest in NOAA sciences (Jun-Aug, Y1-Y5)</td>
<td></td>
</tr>
<tr>
<td>• Interviews with GRT students and survey NOAA science mentors (Aug-Sep, Y1-Y5)</td>
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</table>
Together with Core Competency and Professional Advancement and Engagement (section 3), Research is an integral part of training the next generation of Scientists, Engineers and Social Scientists in NOAA mission sciences, and primary way that the Center engages students with NOAA missions and scientists and engineers. CESSRST research provides experiential learning opportunities for undergraduate students and is a key component of graduate training leading to Masters and PhD degrees.

CESSRST research is in three interconnected focus areas, or Themes, that address high priority long-term goals for NOAA, from “Resilient Coastal Communities and Economies” to “Weather-Ready Nation” to “Integrated Water Prediction” to “Climate Adaptation and Mitigation”. With a strong focus and expertise on remote sensing observations, advanced observing systems and big data analysis, CESSRST will also respond to the NOAA agency wide need for improved “Observing, Modeling and Engaging” capabilities. Key objective across all CESSRST research themes is to inspire CESSRST students to study the Earth as an integrated system across traditional boundaries and foster an interdisciplinary, holistic understanding of the major environmental challenges faced by the society, enriched with experiential learning opportunities in environmental satellite related research. Across all themes, CESSRST collaborative research is in direct alignment with NOAA’s Vision of Environmental Intelligence and supports NOAA’s leading role in addressing societal problems through integration of remote sensing technologies with multidisciplinary research in environmental systems, socioeconomic drivers, and solutions. A good number of resources and facilities supports collaborative research activities in the center. Most of these facilities were created and developed prior to 2016 Award cycle. A list of resources and facilities (across all partners for each theme and tasks) from prior new EPP CSC award from other leveraged resources in CESSRST were identified and summarized in Appendix VI.

**Theme I: Coastal Resilience**

**Key CESSRST Investigators:** Maria Tzortziou (Coordinator, CCNY), Roy Armstrong (UPRM), Alexander Gilerson (CCNY), Jennifer Cherrier (BC), Kyle McDonald (CCNY), Craig Tweedie (UTEP)

**A. NOAA Relevance and Societal Impacts**

Improving coastal resilience depends on coastal intelligence and developing a deeper understanding of the potential impacts of coastal processes and hazards on coastal communities, businesses, natural resources, ecosystems and the services they provide. Theme I addresses this high research priority for NOAA through a combination of coastal observations, development of new remotes sensing tools, and assessment of the environmental and socioeconomic effectiveness of developed approaches for mitigating the impacts of coastal stressors on nearshore habitats and coastal communities. Under Theme I, CESSRST will contribute to NOAA’s efforts to develop integrated coastal ocean observing systems and networks with advanced measurement capabilities. Detailed observations across coastal regions, from tropical coastal waters to urban temperate environments to the coastal Arctic, will result in datasets that will provide powerful tools for calibration and validation support for algorithms and products across satellite sensors, missions, and platforms (e.g., Suomi-NPP, Landsat, Sentinel, JPSS-1, GOES R series, PACE). Supporting NOAA’s leading role in coastal ecosystem management towards sustainability and mitigation of
negative impacts on human health, coastal environments, and economies, CESSRST will apply in-situ and satellite observations to develop remote sensing tools for monitoring coastal water quality indicators, assessing resilience of tropical coral reef ecosystems, capturing harmful algal bloom impacts, and quantifying Arctic coastal erosion. The resulting datasets will be used to develop improved parametrizations for weather and ocean forecasting models and hazard mitigation. Integration of Theme I research with detailed observations of atmospheric hazards and processes (Theme II) will provide comprehensive characterization of atmospheric dynamics in coastal environments, improving atmospheric correction of coastal ocean color satellite imagery, and examining atmospheric-ocean interactions. Integration with measurements and models of water resources and terrestrial processes (Theme III) will capture interactions across the terrestrial-aquatic interface. Theme I supports NOAA’s research priority to improve “Coastal Intelligence Capabilities”: provide timely, actionable information that can be used by governments, businesses, and citizens to make decisions that support healthy ecosystems, strong economies, and resilient communities along our coasts.

B. Tasks and Outcomes

Task 1. CUNY-CREST Ocean Observatories in Critical Coastal Regions

Understanding the complexity of coastal ecosystems from space and improving our ability to manage our coastal natural resources requires advanced observational infrastructure for (i) development and validation of new coastal satellite algorithms and products, (ii) data assimilation into operational models and (iii) application of ocean observations to improvement of decision-support tools. Driven by these research priorities, CESSRST will provide NOAA with comprehensive observations in critical coastal regions characterized by varying levels of anthropogenic disturbance and vulnerability to environmental pressures. The CUNY-CREST Long Island Sound Coastal Ocean Observatory (LISCO) will provide continuous measurements of ocean radiometric quantities and bio-optical properties in one of the most heavily urbanized coasts of the US, the New York coastal region. Multi- and hyper- spectral radiometric observations will be combined with polarization sensing capabilities, coupled with regular in-situ observations from research vessels. Continuous observations using NOAA in-situ sensors, AERONET and Pandora ground-based networks, and integration with atmospheric measurements performed under Theme II, will result in characterization of atmospheric variability across this highly urbanized coastline, allowing for assessment of atmospheric pollution impacts on coastal ocean color retrievals. In addition to coastal urbanization, environmental pressures and weather extremes strongly impact coastal communities, economies and ecosystems. The need for scientific information on the integrated impacts of climate change and weather extremes on coastal environments has been recognized as an urgent priority to support long-term planning. The CUNY-CREST Coastal Ocean Observatory in Puerto Rico will provide measurements of ocean radiometric quantities, bio-optical properties and atmospheric composition, in a tropical coastal area that is highly vulnerable to weather extremes, episodic rainfall events and flush floods. One of the main objectives of the CUNY-CREST Coastal Ocean Observing Systems program is integrating field observations and advanced remote sensing tools (for JPSS and other systems) to assess impacts of episodic weather events, such as extreme precipitation, on tropical coastal regions, including the Puerto Rican coastal zone and the U.S. Coral Reef Task Force priority area of the Guánica Watershed and associated coral reefs. This is strongly relevant to NWS and NESDIS objectives to advance understanding of coastal ecosystem vulnerability to torrential rains.
and flash-floods. Linking to Theme III activities, new models will be developed for an NWS operational forecast system for Puerto Rico that will improve flash flood guidance for tropical coastal waters. Results will be valuable for characterizing evacuation zones in terms of exposure and sensitivity, and informing emergency responders and strategic planners in the development of mitigation, response, and recovery strategies for flash-floods and episodic rain events. The end users of the VIIRS ocean color regional cal/val initiative in Puerto Rico will be state (Puerto Rico Department of Natural Resources) and federal agencies (EPA, NOAA NOS and NMFS) in charge of resource management in the US Caribbean. The long-term research of CUNY-CREST’s Coastal Ocean Observing Systems is aimed at investigating both oceanic and atmospheric conditions to address some of the major challenges in coastal ocean remote sensing, including complex atmospheric correction, high spatial heterogeneity and strong temporal variability associated with both human and environmental pressures.

Task Coordinator: Alexander Gilerson (CCNY)

Outcome: Integration of satellite remote sensing data and field observations to characterize ocean and atmospheric properties and dynamics across CUNY-CREST ocean observatories, recommend enhanced atmospheric correction approaches for satellite ocean color algorithms developed for existing and future satellite ocean color sensors, and assess impacts of human activities and extreme events on coastal habitats (e.g., coral reefs) and coastal resources.

Task 2. Quantifying coastal erosion in the Arctic, and assessing impacts on vulnerable coastal ecosystems and communities.

The Arctic Ocean has the largest coastline of any ocean on Earth and a coastal zone that has been recognized as one of the most climate-change vulnerable ecosystems on Earth. These coastlines are rapidly disappearing, posing threats to coastal communities, infrastructure, economies, and transforming coastal habitats and biological systems through export of nutrients, carbon, sediments, and pollutants into the coastal zone. These effects are expected to amplify in the future as temperatures increase and sea levels rise. As part of Project 2 Task 4, CESSRST will develop and validate new methods and satellite algorithms to delineate coastlines in the Arctic environment and assess effects of changing Arctic conditions across the ocean-land interface.

Task Coordinator: Craig Tweedie (UTEP)
NOAA Collaborators: Nicole Kinsman (Alaska Regional Advisor NOAA/NOS/National Geodetic Survey).

Outcome: Development of new methods for delineating the position of the Arctic coastline and nearshore environment from high spatial resolution satellite imagery to improve the spatiotemporal resolution of coastal erosion assessments, especially near vulnerable arctic communities, and assessing impacts of coastal erosion and riverine input on nearshore water quality.

Task 3. Development of Coastal Water Quality Indicators
Improving space-based monitoring of carbon, nutrient and pollutant fluxes and dynamics in urban coastal ecosystems is critical for quantifying influences of coastal hazards on coastal communities, economies, and ecosystems. To protect our natural resources, state and federal agencies have been working on improving methods for monitoring the biological, chemical, physical and recreational condition of coastal waters. Such information is needed by decision makers for improved management, environmental protection, and restoration. As part of Task 2, CESSRST will develop and validate new algorithms and products for monitoring bio-optical indicators relevant to environmental and coastal quality (e.g., CDOM, phytoplankton pigments, Kd(PAR), TSS).

**Task Coordinators:** Maria Tzortziou (CCNY)

**NOAA Collaborators:** Christopher Brown (NESDIS), Menghua Wang (NESDIS), Rick Stumpf (NOS-NCCOS).

**Outcome:** Development and evaluation of satellite algorithms for monitoring chlorophyll, dissolved organic carbon, particulate organic matter, and sediment dynamics in optically complex coastal waters, both for existing satellite sensors (e.g., VIIRS, MODIS, OLCI, Landsat) and future sensors (e.g., PACE).

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**Task 4. Development of in-situ and satellite-based environmental datasets for assessing resilience to disturbance in tropical coral reefs**

This project will investigate the spatial and temporal variability of marine conditions of coral reefs at the sub-regional scale and the role of the symbiotic zooxanthellae in coral’s ability to resist bleaching. Efforts to monitor coral reef health currently rely on monitoring environmental conditions collected from observational buoys and satellites, and are therefore missing the in situ observations needed to help eliminate assumptions and improve accuracy. This project will provide a foundation for advancing NOAA NESDIS priority goals by developing, and deploying in situ loggers that will record temperature, salinity, light, and pH observations at the coral reef surface. These observations will then be used to help validate NOAA’s Coral Reef Watch’s 5-km SST-based products, including their Daily 5-km Satellite Coral Bleaching Thermal Stress Alert Area Product. Satellite data products will be used to monitor physical, biological and biogeochemical parameters affecting coral reef health. This research will also investigate the linkage between the zooxanthellae and the coral’s resistance and resilience to bleaching.

**Task Coordinator:** Kyle McDonald (CCNY, CUNY)

**NOAA Collaborators:** Karsten Shein, Mark Eakin (NOAA/NESDIS/Coral Reef Watch/STAR), Jim Hendee (NOAA AOML).

**Outcome:** Application of satellite and ground-based observations to increase the quantity, type, and coverage of in situ environmental data in coral reef ecosystems, and develop species distribution models to help improve the survival rates of coral nursery outplantings and objectively determine sites for coral nurseries.

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**Task 5. Improved monitoring of HABs and their impacts in coastal eutrophic systems**

Coastal HAB events have been estimated to result in economic impacts in the United States of at least $82 million each year, due to impacts on public health, tourism, and the seafood industry. Increased nutrient loadings, alterations in primary production community dynamics, introduced species, hydrological modifications, and climate change can all affect the occurrence, frequency and
severity of HABs. Directly responding to NOAA NESDIS, NOS and NCCOS goals, CESSRST will: (i) develop and transition new remote-sensing tools for improved monitoring of HABs, and their impacts in NY coastal waters and other coastal eutrophic systems that are highly prone to (harmful and non-harmful) algal blooms (e.g., *Karenia brevis* in Gulf of Mexico); and (ii) evaluate the environmental and socioeconomic efficacy of a cost-effective modular hybrid green infrastructure (MH-GI) system we developed, for mitigating pollutant loading as it relates to offsetting HAB growth and toxin production in coastal waters. Linking to CESSRST’s social science goals, we will carry out an economic assessment of this ecosystem-based management approach for mitigating harmful algal blooms (i.e. economic benefits and ecosystem service gains of using this approach). Efforts will be coordinated with other NOAA programs focusing on HABs including the NOAA Great Lakes Harmful Algal Blooms and Hypoxia program, a collaborative effort between scientists at NOAA’s Great Lakes Environmental Research Laboratory and the Cooperative Institute for Limnology and Ecosystems Research (CILER).

**Task Coordinators:** Jennifer Cherrier (Brooklyn College, BC)  
**NOAA Collaborators:** Steve Morton (NOS-CCEHBR), Rick Stumpf (NOS-NCCOS)  
**Outcome:** Evaluation of the MH-GI system for mitigating pollutant loading as it relates to offsetting HAB growth and toxin production, and application of satellite data to assess the effectiveness of the MH-GI system for mitigation efforts.

**C. Student Training Requirements**
The educational materials and activities developed under Theme I will address key processes in coastal environments, coastal resiliency, and sustainability. Students involved in Theme I research and educational activities will receive interdisciplinary training in the fields of physical, biological and optical oceanography, engineering, biogeochemistry, coastal ecology, coastal urbanization, and, through integration with social sciences, urban sustainability, coastal hazards and risk assessment, and ecological economics. They will have the opportunity to develop skills and knowledge in a wide variety of research and analytical techniques, including hands on training on deployment and operation of a wide range of in-situ sensors for optical, physicochemical, biological, biogeochemical measurements in the field; development and evaluation of remote sensing bio-optical algorithms; as well as development and application of modeling tools for environmental and socio-economic assessments. Involvement of CESSRST students in Theme I research will provide them with a highly valuable systems approach research training that will be critical for preparing these students for the future needs of the NOAA workforce.

**THEME II: ATMOSPHERIC HAZARDS**

**Key CESSRST Investigators:** John Anderson *(Coordinator)*, James Booth, Jorge González, Johnny Luo, Prathap Ramamurthy, Barry Gross, Fred Moshary, Mark Arend, Yonghua Wu (CCNY), Hamidreza Norouzi (CUNY), Patrick McCormick, Jia Su, John Anderson (HU), Ruben Delgado, Belay Demoz (UMBC), Heidy Sierra Gil (UPRM), Miguel Velez-Reyes (UTEP)

**A. NOAA Relevance and Societal Impacts**
Severe weather and air quality events have major ecological, human-health, and socio-economic impacts. Anthropogenic and natural emissions drive air quality and climate change, which in turn
drive severity and frequency of future weather events. GHGs, ozone, and aerosols play an important role in global climate change, but the impact of aerosols on climate remains the largest uncertainty in climate forecasts. Under Theme II we will use innovative technology and integrative observations to study atmospheric processes and trace constituents, validate satellite products, and improve model predictions. Theme II contributes to NOAA’s long-term goal of a “Weather Ready Nation” and is well aligned with NOAA’s vision of healthy and resilient ecosystems, communities, and economies. With emphasis on observing system optimization, research under Theme II will result in novel sensor technologies and applications, and improvement of data products leading to refinement of forecast models and decision support tools.

B. Tasks and Outcomes

Task 1. Severe Storm Prediction

Predicting hazardous weather and explaining the physics that drives the events continues to be a key task at NOAA. Research will address these hazards through: (1) high-temporal resolution convective storm analysis related to GOES-East, and (2) analysis and modeling of convective initiation in Puerto Rico. For the GOES-East convective storm analysis, we will work with GFDL. For the coastal convection initiation project in Puerto Rico, we will work with ESRL and with NESDIS.

Task Coordinator: James Booth (CCNY)

NOAA Collaborators: Yi Ming (NOAA/GFDL), Tom Smith (NOAA/NESDIS/STAR), Daniel Melendez (NOAA/NWS), Arun Kumar (NOAA/CPC)

Outcome: Improved understanding of atmospheric processes to improve NWS and GFDL research associated with hazardous weather events. This work will include analysis of ground-based and satellite observations and numerical models. It will focus on phenomena across a range of spatial scales, from the synoptic-scales (i.e., atmospheric blocking and extratropical cyclones) to the mesoscale (i.e., coastal convection and precipitation). This work is designed to characterize the processes for the sake of improving numerical models and improving our physical understanding, and hence our ability to forecast the weather hazards.

Task 2. Heat Stress and Urban Modeling

Urban areas are characterized by complex land-atmosphere interactions that overwhelmingly redistribute incoming energy to sensible heat flux which amplifies the thermal state and exacerbates the impact of heatwaves. This leads to significant health and economic consequences: Heat index, a combination of near surface relative humidity and air temperature, is commonly used to account for heat severity and to issue health advisories. Diurnal cycles of land surface temperature at 2 km resolution afforded by GOES-East will be further downscaled by statistical techniques that combines ground stations, high resolution land-cover, modeling and blending with high-resolution satellite products from LandSat/ASTER. Turbulent parameterization can then be applied to compute high resolution air temperature that can be compared to other data sources using the CUNY-CREST NYCMetNet, which includes the NOAA/NCEP MADIS surface station data sets, ground based remote sensing measurements, in situ flux measurements and the NY-urban HydroMet testbed data. The high-resolution air temperatures will be combined with modeled surface moisture fields and surface stations data to derive surface air humidity, from which heat indices will be calculated. Similarly, persistent thermal IR imagery from GOES-East will enable
us to retrieve a spatial thermal storage product for developed and natural environments by analysis of the diurnal observation of temperature transients. This will be demonstrated for the New York Metro area. These high-resolution products when coupled with soil moisture will allow closure of the energy balance in urban areas, which will be validated with a network of flux towers and soil moisture measurements that are under development.

The products and analysis above will drive urbanized Weather Research and Forecast Model (uWRF). We will further develop uWRF to increase resolution to sub-kilometer range and to include thermal storage of cities and improved aerosol ingestion/microphysics. The refined model will produce weather forecasts for health, transportation, and energy sectors. It will also aid emergency management agencies at City and State level.

Task Coordinator: Jorge E. González (CCNY)

NOAA Collaborators: Bob Yu (NOAA/NESDIS/STAR), Stanley G. Benjamin, Andrey Grachev (NOAA/ESRL).

Outcomes:
1) Heat-index nowcast products for urban environments will be developed: The index will consist of two major inputs; surface air temperatures and surface humidity. The surface air temperature product will be developed using a combination of statistical correlations between network ground observations and GOES-East skin temperature product. The surface humidity product will consist of adapting early stage products from MODIS to GOES-East. The heterogeneity of the two input and final product will be corrected using local ground observations. Furthermore, we will use the GOES-East skin temperature product to quantify thermal storage of urban environments such as NY City. The thermal storage will be characterized by their thermal response numbers product and validated with observed surface energy balance for NY City using flux tower measurements and soil moisture observations for above and underground sensible and latent heat flux.

2) Improved urbanized numerical weather forecasting product with representation for urban land-surface processes: The key improvements in uWRF will consist on: a) sub-kilometer parameterization, configuration and validation for NYC as first test case, and b) in correcting for thermal storage using the above products (in 2). Sub-kilometer parameterization will consist in model validation with surface and Planetary boundary layer (PBL) observations for selected cases and seasonal comparisons, and in potential improvements in the PBL parameterization compatible with current urban parameterizations. The thermal storage parameterization will be incorporated by data ingestion of TRN and in model development to account for energy exchanges in BEP/BEM from surface to the underground urban infrastructure. The ultimate goal is to have sub-kilometer operational products for NYC as first case and transferable to other complex cities.

Task 3: Satellite Validation and Analysis

The CUNY-CREST Direct Broadcast Satellite (DBS) antenna network has sites at CCNY (NYC), HU (Hampton, VA), and UPRM (Mayaguez, PR) to receive real time satellite data from Suomi-NPP/JPSS-1, Terra/Aqua, and other polar orbiting satellite as well as a geostationary antenna system at CCNY for receiving real time data from GOES/GOES-East. This will make atmospheric and air quality research products available in a timely manner for forecasts by many state and
government agencies. Research work will include (1) effective surface parameterization for improved high resolution satellite aerosol optical depth (AOD) over land for both VIIRS and GOES-East, (2) improvement of PM2.5 pollution estimates from AOD, and (3) trace gas validation and analysis efforts will include lidar measurements and the Suomi NPP Ozone Mapping Profile Suite (OMPS) Limb Profiler where ozone comparisons will be carried out with Aura MLS and SAGE III-ISS products. Work will include infusing OMPS LP ozone products into the NOAA-Unique CrIS-ATMS Processing System (NUCAPS) to create an improved operational product.

Task Coordinator: Barry Gross (CCNY)

NOAA Collaborators: Larry Flynn, Shobha Kondragunta (NOAA/NESDIS/STAR), Mike Dutter (NOAA/NWS-AKQ)

Outcome: Satellite Research Products: Low latency NOAA NESDIS STAR and CESSRST research products developed and generated directly from CUNY-CREST satellite receiving stations at CUNY, HU, and UPRM, for distribution to various research tools and stakeholders. Work will also include validation and improvement of atmospheric aerosol and trace gas products from GOES-East, SNPP/JPSS, and other satellite instruments, and application to Air Quality.

Task 4: The CUNY-CREST Earth System Observing Network (CESON) and Applications

The CUNY-CREST Earth System Observing Network (CESON) is the result of extensive enhancement to the CUNY-CREST Lidar Network (CLN) with sites at CCNY, UMBC and HU with extensive remote and in-situ observation capabilities. CESSRST will utilize this extensive remote and in-situ observation capabilities to support satellite validation activities, field campaigns, and forecast model verification and refinement. Research work will include: (1) the impact of the PBL dynamics on surface air pollution; and (2) studies to glean information on continental/inter-continental dust and smoke transport episodes and their impacts on local air quality. Ceson’s observations and products will be used for validation and refinement of forecast models such as OAR/NCEP WRF-CMAQ, CIMMS RAQMS, ESRL’s WRF-CHEM and others. Accurate determination of the height of the PBL is needed for model validation and assimilation. The PBL algorithms will also be used to detect the PBL and cloud base height from aerosol profiles collected from the NOAA owned and operated national ASOS ceilometer network. A database of PBL heights for validation/assimilation for forecasting models will then be produced. Furthermore, NOAA uses wind lidar in campaigns (e.g. INFlux) in support of studies and modeling for weather and air quality. Algorithms for data analysis of PBL height and wind products will be developed in collaboration with NOAA ESRL. In addition, deployable aerosol, wind, and trace gas lidars, microwave radiometers, and sounding system will enable CESSRST to participate in NOAA and other national air quality and environmental campaigns (e.g. AEROSE, FIREX, INFLUX, OWLETS, and LISTOS etc.).

Task Coordinator: Ruben Delgado (UMBC)

NOAA Collaborators: Pius Lee (NOAA/ARL), Jeff McQueen (NOAA/NWS), Alan Brewer (NOAA/ESRL), Dennis Atkinson (NOAA/NWS-OST), Mike Hicks (NOAA/NWS-OOS)

CI Collaborations: Mike Hardesty (CIRES), Christoph Senff (CIRES), Aditya Choukulkar (CIRES)

CSC Collaborations: Ricardo Sakai (NCAS)

Outcome: Compilation of PBL heights, dynamics and smoke/dust transport to the East Coast for
weather and air quality model validation, and impacts on surface air pollution and health. These will include PBL and cloud-base height algorithm development for use from profiles collected from the NOAA owned and operated ASOS ceilometers and CESON lidars. Work will also include participation in NOAA and related field campaigns using CESON ground-based in-situ and remote sensing instrumentation.

C. Student Training Components

Depending on the student’s specific project, the student training component can include: Downloading and analysis of satellite data; Statistical data analysis; Blending data with multiple spatial and temporal resolutions; Remote sensing instrumentations design and engineering; Field measurements and campaigns; Development or refinement of data products, algorithms, or models. Graduate students working on project 2 will participate in NERTO’s at NOAA NESDIS, NWS, ESRL, and OAR labs, depending on their contribution.

**THEME III: WATER PREDICTION AND ECOSYSTEM SERVICES**

**Key CESSRST Investigators:** Naresh Devineni and Tarendra Lakhankar (Coordinators), Nir Krakauer, Indrani Pal, Cheila Cullen, Peter Romanov (CCNY), Walter Oechel, Donatella Zona, Aram Kalhori, Trent Biggs, Fernando De Sales, Arielle Levine (SDSU) Jonathan Munoz, Rafael Rodriguez (UPRM)

**A. NOAA Relevance and Societal Relevance**

The most significant factor in human vulnerability to climate is the impact of climate on water resources and ecosystems. The ability to make precise predictions about this detrimental risk is challenging, especially when human populations, land use change, and other factors are also affecting water futures. Theme III focuses on developing a unified water prediction system and ecosystem services using remote sensing of earth systems. This work aligns with the NOAA’s “Water Prediction” research priority. Unified water prediction and modeling methodologies will be created to aid the development of operational products and services. The Theme includes climate-informed water and ecosystems modeling, socio-economic impacts and vulnerability assessments. The work also supports NOAA’s mission to provide improved protection of life and property from natural hazards, and for a better understanding of the total environment.

**B. Tasks and Outcomes**

**Task 1. Drought Risk Assessment and Ecosystem Outcomes**

Drought has cascading impacts on the environment, economy and society. Water deficits resulting from natural variability in rainfall coupled with increased demands have severe implications for the adequacy of water storage. As the future becomes more uncertain, water managers need a better understanding of the trends and better estimates of potential shortfalls in supply due to droughts of varying severity and duration. Assessment of risk for various sectoral operations could be much better informed if appropriate stress indices were developed for drought conditions relative to current and projected demands and their quantiles predicted ahead with period real-time update using satellite remote sensing data. In this task, we will develop drought indices that consider variability in climate and changing demands to accurately represent the duration and severity of droughts.
drought at monthly to annual timescales. We will validate this newly developed drought index with SMOS and SMAP soil moisture data. Soil moisture anomalies will be combined with NDVI to provide current assessments of vegetation health. Finally, we will assess the long-term trends in droughts and explore the potential for drought predictability at lead times of 0-6 months using multi-model seasonal ensemble forecasts and climate predictors to potentially inform decision making at the sector level for near-term adaptation and risk hedging. Assessment of extreme drought that leads to forest fires will be analyzed out using remote sensing data.

**Task Coordinator:** Nir Krakauer (CCNY)

**NOAA Collaborators:** Xiwu Zhan (NESDIS/STAR), Cameron Speir (NOAA Southwest Fisheries Center), Roger Pulwarty (PSD/ESRL)

**Outcomes:** Estimating trends in natural hazards and hydrologic droughts, along with a complete database of demand-based drought index data and real-time probabilistic forecast methods for drought quantiles.

**Task 2. Flood Risk Assessment and Data Products**

Extreme storm events and resulting floods cause many adverse socio-economic effects and have become a growing issue for state and local municipalities. While there exists many data sources and tools for analyzing the occurrence and components of extreme storm events, there are currently no robust integrations capable of better understanding the spatial distribution of floods. In addition to looking at single location intensities, it is also important to explore multiple spatially distributed extreme events that cover a particular duration and return period of interest. In this task, we will explore the estimation of the space-time distribution of extreme storm events and resulting flood events using multiple sources of data (in-situ observations, radar products, and satellite remote sensing data). Activities under this task will include development of high-resolution urban flood guidance and hazard warnings (uFFG) system by incorporating hydro-meteorological data from the NY-uHMT (New York Urban Hydrometeorology Test Bed). This will help identify and isolate areas where land development has altered the runoff characteristics of the New York City Area. Results from these activities will not only be useful in planning for storm emergencies but will also allow for improved designs of infrastructure. We will examine experimental HF Radar-derived wave data and compare with current observational data sets, to evaluate the potential of the HF-Radar data to improve wave forecasts at the WFO. Together, this research forms a key step towards improving regional resiliency against the wide range of impacts incurred by extreme storm event related flooding.

**Task Coordinator:** Naresh Devineni (CCNY)

**NOAA Collaborators:** Bob Rabin (NSSL), Xiwu Zhan (NESDIS/STAR), Jack Harlan (IOOS), Dennis Atkinson, Ernesto Rodriguez (NWS)

**Outcomes:** A high-resolution blended precipitation product using our latest New York City urban Hydro-Meteorological Testbed (NY-uHMT) and remote sensing data for flood prediction and urban coastal vulnerability assessment.

**Task 3. Assessment and Application of National Water Model using Remote Sensing Data Products**
The growing water crisis threatens our nation’s health, safety, economy, and environment. An assessment of the water cycle including monitoring of snow/ice accumulation and melting is crucial to sustaining agriculture and municipal water demands. The remote sensing-based snow data products being developed and validated under this project will address critical challenges in water cycle observations. We will utilize the previously developed Global Multi-Sensor Automated Snow and Ice Mapping System, modify it and apply to historical satellite data to generate a long-term dataset of daily global maps of snow and ice extent. The primary intent is to develop new and improved snow and ice cover climatology and a corresponding daily dataset covering the period from 1998 to 2016 for use in climate modeling and in particular within the joint NOAA and NASA Global Precipitation Mission (GPM) project. This task also complements the derived high-resolution snow extent maps with snow depth and snow water equivalent (SWE) data. Information on the snow depth and SWE will be derived from observations of SSM/I, SSMIS and AMSR2 sensors.

Further, an integration of satellite observations into hydrological models is crucial for the future development of the National Weather Service (NWS) operational streamflow and flood forecast system. The National Water Model (NWM) is a hydrologic model that simulates current and forecast streamflow over the entire continental United States (CONUS). This task aims at improved understanding of physical processes represented in NWM and future model development. Under this task, we will investigate the use of the Weather and Research Forecasting Hydrological modeling system (WRF-Hydro), which is the core of the NWM operated by the NOAA’s National Water Center (NWC), in simulating streamflow and major flood events caused by heavy rainfall and snowmelt. Moreover, we will integrate observations into models for a future/proposed NWS operational forecast system for Puerto Rico to improve flash flood guidance for Puerto Rico. This research would include assessing the efficacy and impacts of atmospheric forcings used to drive the NWM for both wet and dry extreme conditions and in monitoring and prediction to inform drought and flood risk management.

**Task Coordinator:** Tarendra Lakhankar (CCNY)

**NOAA Collaborators:** Kelly Mahoney and Rob Cifelli (PSD/ESRL) Ralph Ferraro (NESDIS/STAR) Ernesto Rodriguez (NWS)

**Outcomes:** Development of a new snow and ice climatology product, assessment of remote sensing based forcings, and their integration into the National Water Model. Exploration of the utility of the National Water Model for flash flood predictions.

**Task 4. Monitoring land-atmosphere-ocean fluxes**

NOAA has extensive air monitoring stations around the world. These stations measure a number of gases, including CO2 and CH4. One goal of NOAA is to use seasonal and interannual variation in atmospheric CO2 and CH4 concentrations to estimate surface fluxes (ocean and land) of these gases. CESSRST will augment these NOAA capabilities with flux measurements from a network of 12 eddy covariance tower sites from Barrow, Alaska to Southern California, covering Arctic, chaparral and coastal sage scrub, coastal marine and desert systems. The tower measurements can be compared to inversion modeling of atmospheric concentrations and winds (e.g. WRF STILT) to give increased confidence in the validity of estimates of surface fluxes calculated from eddy covariance measurement and from inversions of atmospheric measurements. This will
complement ecosystem-level evapotranspiration and phenology to analyze the impacts of climate change and climate variability on CO2 flux and evapotranspiration in semi-arid ecosystems in the chaparral of Southern California. Under this Task, we will be proving data on the patterns and controls on CO2 and CH4 fluxes, evapotranspiration, and energy balance from Arctic, semi-arid, coastal temperature ocean, and coastal South Pacific Ocean ecosystems, to understand and interpret the atmospheric concentration data from Barrow and American Samoa to improve earth system model.

**Task Coordinator:** Walter Oechel (SDSU)

**NOAA Collaborators:** Lauren Jarlenski and Mareike Sudek (NOS) Alex Tardy (NWS), Russ Schnell, Bryan Thomas and Jim Butler (ESRL/GMD)

**Outcomes:** Monitoring environmental and flux data from SDSU’s eddy covariance flux towers and mapping regional ET of the recent decades (2000 - 2018) for implementation of SEBAL and METRIC models in the Western United States.

**Task 5. Use of UAS platforms for environmental intelligence and satellite product validation**

The use of unmanned systems (aerial and water surface) is gaining traction within NOAA, as it provides opportunities for more localized and higher resolution observations. These systems can then be used to complement satellite observations, and for calibration/validation of satellite sensors in combination with ancillary sensors. The UAS based sensor development will provide with high-resolution data that could be used to support JPSS cal/val efforts. In addition, the mobility and fast deployment of these type of sensors can support emergency management efforts (EPA, FEMA, local emergency management offices) and monitoring of protected areas (PR-Department of Natural Resources) Vulnerability assessment has stake holders in NWS, and federal and local emergency management offices. Radar product development will support NWS, and federal and local emergency management offices operations.

**Task Coordinator:** Rafael Rodriguez (UPRM)

**NOAA Collaborators:** Gary Wick (NOAA/ESRL)

**Outcomes:** Application and development of multiband sensor technologies for monitoring environmental conditions in Land, Atmosphere and Coastal regions using UAVs.

**C. Student Training Requirements**

These projects will be co-designed with the NOAA collaborators. This bi-directional interaction with NOAA scientists will enable effective transition of research to operations. Data analysis, computer programming and geo-spatial analysis using GIS and remote sensing will be part of all the projects. All students will be trained through scenario-based problem-solving environments. Students will be organized into cooperative learning groups for strengthening the ideas of teamwork. Wherever possible, the investigators will invite the NOAA collaborators to deliver guest training sessions, so the students can learn and benefit from the discussion on the outcomes and experiences from the real world.
**Coordinator: Valerie Were**

Social science is essential to helping the National Oceanic and Atmospheric Administration (NOAA) achieve its mission. NOAA’s Office of Education asked the four Cooperative Science Centers that it supports to use social science more explicitly in their activities. Accordingly, social science will be integrated into the Center’s research, education, and training.

**A Focus on Applied Social Science**

Integrating social science into the Center’s activities is challenging because social science is a collection of disciplines rather than a single subject. Should we focus economics, which is important for understanding monetary value? What about non-monetary value, which are just as important because monetary value does not always express something’s full value. What role do geography and anthropology play in understanding the world and how people interact with the environment? Rather than choose among social science disciplines and talk about theoretical underpinnings of a just those selected disciplines, the Center will take an applied approach to social science. An applied approach is more useful because the Center’s students and researchers will gain an understanding of the social science disciplines science that are most relevant to their research context.

Ultimately, there are three learning objectives for the Center’s students and scientist regarding social science. First, everyone will learn what social science is and is not. Secondly, students and scientists will learn how NOAA uses social science. Finally, everyone will gain a context-relevant understanding of how social science enhances his or her research.

**The Social Science Framework**

Social science at the Center is guided by a framework that takes into account NOAA’s social science goals and the expertise at the Center (See figure below). Goal 2 in the agency’s Social Science Vision and Strategy states that NOAA’s products and services strengthen societal decision-making. This goal inspires the Center’s overarching goal to apply remote sensing technologies to link earth system sciences to societal well-being and decision making. This overarching goal drives the three core elements of the social science framework namely, the social science focus areas, the Center’s science, and the societal impacts the Center wants to achieve. Collaboration among the Center, NOAA and other stakeholders, and student engagement and core competency training also link to the three core pieces of the social science framework.
Social Science in the Center’s Education and Training

The students are enrolled in rigorous natural science degree programs but they are also expected to graduate with a level of competence in social science. The goal for social science integration in the Center’s student education and training is to increase the level of understanding for how social science can enhance their research. The goal is not to turn the students into social scientists, as that requires years of education training just like the curricula in which they are already enrolled. Given the emphasis on increasing appreciation rather than creating social scientists out of natural scientists, we define competency as the having sufficient knowledge to understanding how social science can enhance their research.

A basic understanding of social science is required of the Undergraduate, Masters, and Doctoral students. To meet this charge, the Center requires several items from each student. The table below explains each item and the relevance to meeting competency.

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<tr>
<th>NOAA Social Science Basics Mini Course</th>
<th>Student Story Map</th>
<th>Social Science Research Question (as appropriate)</th>
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![Diagram of COASTAL RESILIENCE and APPLICATION OF REMOTE SENSING TECHNOLOGIES TO LINK EARTH SYSTEM SCIENCES TO SOCIETAL WELL-BEING AND DECISION MAKING](image-url)
NOAA released webinar to introduce the agency's staff that is largely composed of natural scientists, to the basics of social science.

The Center will use this video to introduce students to social science. Using the video has the added benefit of putting social science in the context of how NOAA uses social science.

Each student produces a Story Map during his or her time with the Center. The goals are to: Communicate science to a non-technical audience, and Think about the decision-making implications.

Some students already combine social science with natural science and engineering. All students required to link their research to decision making in their thesis or dissertation.

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<th>Social Science in the Center’s Research</th>
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<td>The Center is committed to growing the number of faculty with social science expertise as that will make integration easier across the Center. The goal is to establish an individual responsible for coordinating social science at each of the consortium’s campuses. The figure below shows how the Center envisions social science coordination across the consortium. The Social Science Lead will work with faculty on each campus who have a better connection to research occurring locally.</td>
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Guided by the social science framework, each campus coordinator is responsible for working with the local faculty to integrate social science. This includes working with ongoing research as well as developing new projects. Campus coordinators also help with recruiting students interested in the social sciences as they apply to the Center’s research themes; Coastal Resilience, Atmospheric Hazards, and Water Prediction and Ecosystem Services.

**Other Activities that Support Social Science Integration**

Other key activities support social science integration at the Center. There is a Social Science Subcommittee at the Center. Over the course of the year, there will also be social science seminars. More on each of these elements follows.
Social Science Sub-Committee

The Social science Sub-committee meets at least once every semester and communicates with Internal Scientific Oversight and Research Coordination Sub-Committees as needed. Its membership consists of the primarily of the Social Science Coordinators and representatives from each campus, however, there are a few other individuals invited to sit on the sub-committee as collaborators.

Purpose and Charge:

1. Coordinate with Research and Education Committees to identity center-wide Social Science Collaborative Projects in line with the NOAA Social Science collaborators
2. Help identify/mentor CESSRST supported students with social science research questions for each cohort student (graduate-level)
3. Create Center-wide Social Science Report
4. Ensure Social Science deliverables and milestones are met per implementation plan
5. Report to the Scientific and Education Committees
6. Maintain and Update Social Science Highlights and Products
7. Meets and Coordinate with the Research and Education Committees

Social Science Seminar Series

Seminars provide the opportunity for the Center’s students to learn how social scientists apply their knowledge to help solve natural science questions. The goal is to have at least three seminars per semester that highlight social science application in each of the research themes. Speakers will come from within the Center, from NOAA, and beyond.

CESSRST Postdoctoral Plan

The postdoctoral plan for CSC postdocs is to produce well-rounded and technically competent leaders in the fields of Earth Systems Science and Remote Sensing Technologies in-line with NOAA mission sciences ready to enter the workforce into Federal job or work as NOAA contractors.

Three to four Postdoc will be recruited, trained and supported by CESSRST during the next five years (2016-2021), and the postdoc fellowship will be for 2-year period. Fresh graduate (applicant should apply within 2 years of their doctoral degree attainment) will submit their postdoctoral plan following the NOAA EPP/MSI guidelines. Each selected postdoc will create an individualized postdoctoral plan that addresses below mentioned targeted activities cohesive with the workforce and professional development strategies:

- **Core-competency plan** – to include (a) mastery of all technical and soft-skillsets; (b) write peer-reviewed papers and grants/proposals; (c) help create and/or participate in cross-thematic CESSRST activities and (d) mentoring training
- **Collaborative Postdoc Research Plan**: create a project that aligns with NOAA mission and goals and work with NOAA scientists. Work with NOAA CSC Technical Monitor to develop a unique and exciting career opportunity for scientific or administrative services experience in support of NOAA’s mission. Attend all CESSRST Science Meetings/Workshops and at the
end of the first year to discuss their research and to explore connections across various NOAA mission science disciplines and CESSRST

- **Mentoring Plan:** Facilitate on-going research projects, and mentor graduate and undergraduate students. They will also be encouraging to create learning modules and teach core-curriculum

- **Experiential Learning:** collocate at the NOAA lab(s)/facilities for a minimum period of 3 months (up to 1 year as needed) to network and engage in NOAA collaborations and explore, create potential workforce opportunities in coordination with NOAA collaborators/mentors.

**CSC Postdoctoral Fellowship Eligibility Requirements:**

- U.S. Citizenship;
- Recent doctoral graduate – within two (2) years of graduation;
- Doctoral degree field must support NOAA’s mission; and
- Period of eligibility for fellow in CSC Postdoctoral Fellowship Program is 24 months within a 26-month period.

**Process for Early NOAA Engagement and NOAA Mission Science Alignment**

1. All CESSRST Research Themes have identified their relevance to the four NOAA long term Goals and related objectives. Further, the projects are in areas identified as NOAA research priorities in the NOAA Strategic Research Guidance Memorandum (integrate Earth system processes and predictions, environmental observations, integrated water prediction, artic, and decisions science/risk assessment/risk communications. In the weather/atmosphere theme, projects have been realigned to the priorities of the H.R. 353 (the Weather Bill).

2. The Projects in the implementation plan were developed in consultation with or collaboratively with NOAA Scientists, and have all identified NOAA Collaborations.

3. The CESSRST Technical Monitors (Vanessa Griffin and Harry Cikanek) have reviewed the CESSRST themes, projects and tasks and provided feedback, which lead to realignment of certain Projects and Tasks. Going forward, the technical monitors will continue to review CESSRST research and provide guidance to the Center to keep the research aligned to NOAA priorities, and help CESSRST scientists expand their NOAA collaborations and identify new NOAA collaborators.

4. Graduate student (PhD and Masters) research tasks are developed with their NOAA mentors who serve on their committees and host the students during the NERTO at NOAA facilities

5. CESSRST has an annual meeting with NOAA NESDIS scientists where collaborative research in Themes, Projects, and Tasks are discussed in an open forum and new research directions are jointly explored with NOAA NESDIS scientists.

6. CESSRST also plans to arrange similar on-site meetings with scientists NOAA Labs (GFDL, PMEL, ESRL, ARL, etc.), and the National Weather Service to discuss collaborative research projects and explore research directions of priority with NOAA
7. CESSRST Research Coordination Committee and the Science Oversight Committee review ongoing projects and tasks at least twice per year to insure that research is in line with NOAA priorities and demonstrate NOAA engagement.

**The process by which the outputs/outcomes will be attained.**

The Scientific research outcomes for CESSRST include: 1) Increased NOAA mission relevant research capacity at MSIs and 2) CSC-supported faculty, staff and students' research directly aligned with NOAA's mission and strategic priorities.

A number of approaches will be used to ensure the outputs/outcomes are attained:

1. First, the CESSRST Research Committee will regularly review all projects for interdisciplinary objectives, productivity, and relevance to NOAA's strategic priorities.
2. Records will be collected every 6 months and reported to NOAA.
3. NOAA missioned alignment science and education training will also be ensured through Regular meetings with the Technical Monitor and NOAA Program Office, annual CESSRST External Advisor Board (C-EAB) meetings, and annual CSC Directors’ meetings and regular conference calls (minimum once every semester).
4. Students are expected to present results from theirs studies at national conferences, and expected author/co-author manuscripts for peer-reviewed journal articles. These expectations will be made clear during the student's involvement in the project, and the students will be trained both on how to communicate and present their work at conferences as well as how to write impactful research papers for publication.

**DATA MANAGEMENT AND SHARING PLAN**

**SCIENCE DATA SHARING AND MANAGEMENT PLAN**

The proposed work will involve different types of data that range from large scale, multi dimension and high-resolution datasets such as VIIRS and MODIS, to small-medium scale observations. CESSRST has several unique infrastructures that provides acquisition, processing and storage of various types of datasets. This grant will also involve collaboration between groups within and outside the Center. This will lead to multiple datasets being created across each of the Center’s research areas as defined in the science and research plan. Those thematic areas include Coastal resilience, Atmospheric hazards, Water prediction, Ecology and surface processes. The Center's data management and sharing plan governs data produced directly from research funded partially or directly by this proposal. These datasets are generated from research groups within the CESSRST Center. While each group has its own datasets, all must conform/adhere to the standards issued by the CESSRST Center. The Data Management and sharing plan outlines how the Center organizes, manages and shares its data. This data management plan is also expected to evolve over the period of this grant.

Each CESSRST funded project (excluding leverage funded science projects) will be required to file a Data Management and Sharing Plan with the Center Management. We have developed a Filemaker Based Management Information System (MIS) to track students and their outcomes (academic tracking, postgraduate, outreach and summer activities). The MIS also keeps track of
CESSRST funded projects, peer-reviewed journal publications, and awards. This will not only provide tracking of current and longitudinal award products, outputs and impacts, but also monitor each project’s compliance with the CESSRST Data Management and Sharing Plan.

The Data Management and Sharing Plan provides guidance to the CESSRST researchers how to store and disseminate their data products, e.g., how to make their product data available to the public and to support their refereed publications. CESSRST research scientists and students will have access to resources and infrastructure such as high performance computing facilities and storage system within the center to help/facilitate data management and sharing of products developed as part of this grant. The dissemination of data starts with a point of contact (Principal Investigator). All datasets created during the course of this grant will have a PI/lead researcher whose name, institutional affiliation and contact information is collected as part of the metadata information. The PI will oversee the management, archiving, preservation, sharing and security of assigned datasets.

To properly address the NOAA data requirements, our data management plan is divided into the following two parts: (i) Students data management and longitudinal tracking, and (ii) sharing and publication of the CESSRST research product datasets. To ensure that the data management plans are rigorously executed, a CESSRST Data Management Committee will be created and will provide training, computing skills, and standard enforcement.

**STUDENTS DATA MANAGEMENT AND LONGITUDINAL TRACKING**

Student (Administrative) data is a compilation of student metrics; their academic portfolio, various milestones, events, recruitment and outreach data. It also includes reports, student ISDPs and roadmaps, performance reports and metrics. *FileMaker DB system will be used with a custom online system developed by ClientBucket Services.*

(Backend) FileMaker will be the central and permanent storage of all administrative data and provide a platform for complex queries needed for reporting and other administrative needs. FileMaker will act as the main repository for all Center admin data including Outreach, Education and Some Research Data (**Figure 1**). It will provide an interface for data entry and modification. FileMaker is limited to only Center Management and Administrators via a proprietary system.

(Front End) Client Bucket online services (**Figure 1**) and platform will be the general Frontend access (via website) for collecting data and reports from students, faculty and other sources. Client Bucket will also act as a temporary store and simple query API. FileMaker will be updated in real-time from data received via Client Bucket services. The Client Bucket portal will allow students, faculty and staff to manage their profiles and individual data such as iSDP, research portfolio, success stories and academic metrics automatically across all partner institution which provides a level of quality control. Some Data within this system will also be provided for publishing on the Center Website.
The main data repository that manages all CESSRST-related data, including administration, metrics, iSDP, profiles, portfolios, publications, and research metadata. It is based on FileMaker as the central system with Client Bucket as the collection tool. Both work seamlessly to enable easy use across students, partners and administrators.

Tasks:
- Enhance, improve and expand MIS FileMaker as central management system.
- Create and execute Client Bucket Services as the online frontend for the center wide data collection system.

RESEARCH DATA SHARING PLAN AND THE CESSRST PRODUCT DATA DELIVERY METHODS

Data Collection, Stewardship, Storage, and Sharing

The main tool for publishing and sharing research product data will be a new website named “Products.” All partners will also have sub-sites that links directly to this main CESSRST website. Data generated from research will be available on data portals and servers and accessed via this website. This main website will be diverted to sub-websites and servers.

Tasks
a) Create an enhanced center-wide website for general information with a “PRODUCTS” button, which includes a catalog of the CESSRST data products (led by Data Management sub-committee). The new website will be deployed by summer 2017.
b) Enhance/Create partner institution websites (using matching templates): Each partner institution’s website will be deployed by the end of 2017.
c) Create a template for press release of each significant CESSRST data product: The template will be made available to CESSRST campus PIs and their deputies by summer 2018.
d) Improve and enhance data portals (ftp, web) for data retrievals, including openDap services and other APIs that allow seamless integration with main CESSRST center website: These functions will be made available to CESSRST researchers by the December 2017.

e) Establish a product release committee to safeguard the quality and standard of the CESSRST products that meet all the NOAA requirements and metrics specified in the “Data and Publication Sharing Directive” (led by Sam Shen): Committee will be established by October 2017. The committee will require each product to have simple data reading and visualization codes included in the data readme file.

f) Develop new software packages, smart phone apps, and convenient computer codes for data reading and visualization for the CESSRST datasets (led by Sam Shen): This is a continuing effort. The existing packages developed by CESSRST scientists including 4-dimensional visual delivery of big climate data (4DVD Technology http://climate.mrsharky.com/) by Sam Shen’s group to be formally released in July 2017, and customized daily snow cover visualization for any region (http://www.itsonlyamodel.us/daily-snow.html) over the Northern Hemisphere based on the remote sensing products from NOAA Interactive Multisensor Snow and Ice Mapping System (IMS). The 4DVD technology is already capable to visually the NOAA Global Temp data and the 20th Century Reanalysis data.

g) Train CESSRST researchers to properly prepare product datasets for public release: CESSRST will make online training on products standards and data stewardship. Each CESSRST annual meeting will include at least one presentation on the product standards and preparation for data release.

Data Archiving, Preservation, Storage and Delivery

Storage of CESSRST product data will be provided with CESSRST cluster. This will continually be scaled up to accommodate the data volume growth and data delivery needs. The cluster, together with NCAR supercomputing and Amazon AWS cloud computing, will also perform research computation and data analysis for satellite/remote sensing.

Tasks

1) Develop and manage a CESSRST cluster-computing framework at CUNY with 100TB hard disk space for data storage and mid-range computation: Dell PowerEdge R930 Rack Server will be deployed by the end of 2017 at CUNY. This cluster will play roles of both data repository/distribution and high performance computing. For example, we will install 4DVD on the server in Spring 2018 to delivery some CESSRST datasets, such as the precipitation datasets developed by Sam Shen’s group.

2) Explore data repository and publication resources with NOAA NCEI for selected products that reflect improvements to the current NOAA datasets, such as improved gridded precipitation data for the United States: CESSRST has established a collaboration relationship with NOAA CICS-NC and NCEI. We have contacted some CICS-NCEI scientists, such as Ge Peng, for the NCEI publication of the selected CESSRST products. The complete CESSRST-NCEI data repository procedures will be established by the end of 2018.

3) Explore data repository and publication with commercial data services and journal data services, such as Dryad - http://datadryad.org: Many commercial data repository services are now available, and recommended by NOAA, to store and publish datasets. By July 2018, we will establish a CESSRST procedure to use these resources.
4) Allocate resources to establish a procedure to assign DOI to each CESSRST product dataset that is formally released via the CESSRST center website: DOIs can be easily requested now, such as www.datacite.org. CESSRST will remind its researchers every 6 months on the availability of this resource and ensure that the CESSRST data will follow NOAA EDMC rules and be properly cited.

5) Provide training about various kinds of data formats: CESSRST products will be output in many formats, such as .nc, .shp, .csv, .bin, or .asc. CESSRST will train its students to read and analyze these datasets, and show them how to write data reading and visualization codes, so that the CESSRST products can be turned into educational resources in classrooms.

6) GOES-R Launch, Acquisition and Archiving at CESSRST (satellite receiving station add-ons): The datasets from these satellite remote sensing will be a continuous effort. CESSRST will ensure that the data will be made available to the public before its corresponding papers are formally published. The same rules are applied to all the CESSRST publications and their datasets. CESSRST management will enforce this rule rigorously.

7) Improve data user interface and machine-readable API for efficient data delivery: Hadoop distributed file service system and the corresponding database technology will be used to deliver datasets efficiently. The 4DVD technology is an example. We will apply these new big data technologies through NCEI and NOAA’s big data partner Amazon. Sam Shen’s group has experience using Amazon AWS cloud computing system and will lead the big data task for CESSRST.

**CESSRST MANAGEMENT**

While managing a large and detail-oriented Cooperative Science Center brings with it some inherent challenges, however, CESSRST brings to this proposal a highly experienced and competent management team. This competency is based on a proven record of accomplishment of 15 years and experience in advancing NOAA’s goal to produce a highly skilled and diverse workforce while simultaneously advancing NOAA Sciences in Remote Sensing Science and Technology. The City College of the City University of New York will serve as the lead institution for the proposed consortium (HU, UPRM, SDSU, UTEP, and UMBC). CESSRST) will also bring several other CUNY colleges and other partner institutions to the consortium to engage in bridging community college to senior college activities, as mentioned in the Education and Outreach section.
In order to create a collaborative participation and clear communications within the intrinsic multifaceted program like CESSRST, the following committees and sub-committee have been created and charged:

**SUB-COMMITTEE AND BOARDS – ROLES AND CHARTER**

**CESSRST Key Personnel Team**
- Center Director – Reza Khanbilvardi
- Center Assistant Director – Shakila Merchant
- Distinguished Research Science – Fred Moshary (acting)
- Data and Information Manager – Paul Alabi
- Communications and Outreach Manager – Sarah Garcia (past), Ellis Simon (current)
- Education Expert – Elizabeth Day-Miller (past); Anne Nancy Degnan (past), Laurie Cook (Current)
- Evaluator – Janice Easton (past) Mark Howse (current)

**Campus PIs**
- Pat McCormick, Hampton U
- Ruben Delgado, UMBC
- Rafael Solis, UPRM
- Miguel Velez-Reyes, UTEP
- Walter Oechel, SDSU

**Campus Deputy PIs:**
- John Anderson, Hampton U
- Belay Demoz, UMBC
- Jonathan Munoz, UPRM
- Craig Tweedie, UTEP
- Sam Shen, SDSU

**CESSRST Internal Executive Committee**

**Purpose and Charge:**
- Responsible for overall management and decision-making of the center activities pertaining to deliverables to NOAA
- Help execute the CESSRST’ program priorities and objectives
- Ensure all Special Award Conditions are met – center wide – 50% budget on student training; timely submission of reports (science and education); execution of the Student Development Plan
- Help execute center-wide recruitment, core-competency and social science framework.
- Attend all executive Committee meeting and actively engage in deliberations

**Members:**
- Reza Khanbilvardi, Chair
- Shakila Merchant, CCNY
- Pat McCormick, Hampton U
- Ruben Delgado, UMBC
- Rafael Solis, UPRM
- Miguel Velez-Reyes, UTEP
- Walter Oechel, SDSU

The Executive Committee meets atleast once every month via – BlueJeans Video Conference call and meets in person during the CSC director's annual meeting and CESSRST Annual Symposium

**CESSRST Internal Science Oversight Committee**

**Purpose and Charge:**
1. Oversee the research activities
2. Expand CESSRST research
3. Oversee and execute the Implementation and Science Plan
4. Identify and re-align/phase-out of the existing projects
5. Review and approve new proposed research activities including new ideas for inter-thematic, inter-CESSRST and Inter-CSC projects.
6. Report to the CESSRST External Advisory Board and the CESSRST Internal Executive Committee (minimum twice per year or as needed)

**Members:**
- CESSRST Distinguished Research Scientist – Fred Moshary (Acting Chair)
- Assistant Director for Integrated Research Development Maria Tzortziou (Co-Chair)
- Science Lead Coordinator - Fred Moshary
- Center Director - Reza Khanbilvardi
- CUNY CESSRST Associate Director for Science Kyle McDonald
- CESSRST Partner Institution Representative Pat McCormick
- CESSRST Partner Institution Representative Belay Demoz
- CESSRST Partner Institution Representative Roy Armstrong
- CESSRST Partner Institution Representative Sam Shen

*The committee will meet 2 times per year*
Research Coordination Sub-Committee

**Purpose and Charge:**

7. Compile CESSRST Science Report per thematic areas
8. Ensure research deliverables and milestones are met per implementation plan
9. Report to the Scientific Oversight Committee
10. Maintain and Update Research Highlights and Products
11. Meets and Coordinate with the Education Committee

**Members:**

- Fred Moshary (Chair)
- Maria Tzortziou (Theme I – Coastal Resilience)
- John Anderson (Theme II – Atmospheric Hazards)
- Naresh Devineni and Tarendra Lakhankar (Theme III – Water prediction and Ecosystem Services)

*The research coordination sub-committee will meet four times per year or as needed.*

Social Science Coordination Sub-Committee

**Purpose and Charge:**

1. Coordinate with Research Committee to identify center-wide Social Science Collaborative Projects
2. Create Center-wide Social Science Report
3. Ensure Social Science deliverables and milestones are met per implementation plan
4. Report to the Scientific and Education Committee
5. Maintain and Update Social Science Highlights and Products
6. Meets and Coordinate with the Research and Education Committee

**Members:**

- Valerie Were (Chair)
- Shakila Merchant (Ex-Officio Co-Chair)
- Kevin Foster (CCNY - Faculty)
- Ivonne Santiago (UTEP – Faculty)
- Tania Lopez (UPRM – Faculty)
- Christine Mallinson (UMBC – Faculty)
- Arielle Levine (SDSU – Faculty)

*The social science sub-committee meets once every semester and communicate with Internal Scientific Oversight and Research Coordination Sub-Committee as needed.*
**CESSRST Scientific Data/Product Management Committee**

**Purpose and Charge:**
1. Ensure Data Management and Sharing Plan is executed in accordance to the FFO and SAC
2. Develop and manage a CESSRST cluster-computing framework at CUNY
3. Work closely with the Research Coordination committee to explore CESSRST data repository and publication resources with NOAA NCEI for selected products
4. Meet every semester or six monthly to prepare CESSRST six monthly performance report.
5. Report to the Scientific Oversight Committee
6. Maintain and Update Research Highlights and Products on the website and CESSRST Database management system
7. Coordinate/lead data collection, retrieving, analysis, archiving, and management workshop for CESSRST, NOAA and other stakeholders as needed.

**Members:**
1. Dr. Sam Shen, SDSU, Chair
2. Paul Alabi, CUNY, Co-Chair
3. Dr. Alex Gilerson, CUNY, Theme I Representative
4. Dr. Pratap Ramamurthy, CUNY. Theme II Representative
5. Dr. Peter Romanov, CUNY, Theme III Representative
6. Dr. Russell S. Vose, Chief, Climate Science Branch, Advisor, NOAA/NCEI

The committee will meet 2 times a year or as frequently as needed.

**Education and Outreach Committee**

**Purpose and Charge:**
1. Ensure integration of CESSRST research into education and professional training
2. EO deliverables and milestones are met per implementation plan
3. Maintain and Update EO Highlights and Products
4. Meet and Coordinate with the Research Committee
5. Work with the Evaluators and update the Program Performance outcomes
6. Work with the EO sub-committee (such as Core-Competency; Recruitment; Communications and Reporting)

**Members:**
- Laurie Cook (Chair)
- Shakila Merchant (Ex-Officio/Co-Chair)
- Cesar Ortiz, Students Affairs Coordinator
- Jorge Gonzalez (Core Competency rep)
- Miguel Velez-Reyes (UTEP Campus rep)
- Jonathan Munoz (UPRM Campus rep)
- Neal Phillip (BCC Community College lead)
- Yasser Hassebo (LaGCC Community College co-lead)
- Reginald Blake (NY City college of Tech lead)
- Aram Kalhori (SDSU Campus Lead)

The EO Committee meets once every semester and communicate with Internal Scientific Oversight and Research Coordination Sub-Committee as needed.
Core Competency Coordination Sub-committee

Purpose and Charge:
1. To design and implement the center wide core-competency curriculum in line with the CESSRST 2021 proposal
2. Work with the Education Specialist to ensure the implementation and compliance of the Core Competency
3. The sub-committee will meet and report to EO committee every Semester

Members:
- Jorge Gonzalez (Chair)
- John Anderson (HU/Co-Chair)
- Ruben Delgado (UMBC)
- Craig Tweedie (UTEP)
- Jonathan Munoz (UPRM)
- Donatella Zona (SDSU)
- Reza Khanbilvardi and Shakila Merchant (Ex-Officio/Management Rep)

The Core-Competency sub-committee meets once every semester and report to EO committee biannually.

Recruitment Sub-Committee

Purpose and Charge:
1. Meet with the Research Coordination Committee to assess the Recruitment NEEDS
2. Create a Center-wide Recruitment Plan and yearly budget and the event calendar
3. Create a center-wide outreach plan with linkage to the recruitment plan (e.g. connect with CBOs)
4. Design/create recruitment materials (electronic and print)
5. Ensure that all CESSRST affiliated faculty members reach out to their classes beginning of the semester
6. Create a recruitment network within CESSRST and campus’s advising/career centers
7. Coordinate with CESSRST Evaluator to assess the recruitment plan

Members:
- Ruben Delgado and Cesar Ortiz (UMBC and CCNY Co-Chairs)
- John Anderson (HU)
- Miguel Velez-Reyes (UTEP)
- Jonathan Munoz (UPRM)
- Sam Shen (SDSU)
- Ellis Simon, CUNY
- Shakila Merchant (Ex-Officio/Management Rep)

The recruitment sub-committee meets every semester and report to EO committee biannually.
**COMMUNICATIONS MATRIX**

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Deliverables</th>
<th>Frequency</th>
<th>Medium</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>Press Release</td>
<td>As needed</td>
<td>Website</td>
<td>Media Coverage</td>
</tr>
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<td></td>
<td>Newsletter</td>
<td>Bi Month</td>
<td>Website</td>
<td>Shared Knowledge</td>
</tr>
<tr>
<td></td>
<td>Seminar Series</td>
<td>Two per term, per campus</td>
<td>Campus</td>
<td>Shared Knowledge</td>
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<tr>
<td></td>
<td>Career Fairs</td>
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<td>Recruitment</td>
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<td></td>
<td>Recruitment Fairs</td>
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<td>Flyers</td>
<td>Recruitment</td>
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<tr>
<td></td>
<td>Success Stories</td>
<td>As needed</td>
<td>Website</td>
<td>Recruitment</td>
</tr>
<tr>
<td></td>
<td>CESSRST Events</td>
<td>As needed</td>
<td>On Campus</td>
<td>Recruitment</td>
</tr>
</tbody>
</table>

**COMMUNICATIONS CHANNELS**

**Internal Comm**
- Emails
- Meetings
- Newsletters
- Phone Calls
- Reports
- Shared Drive
- Google Drive
- ASANA

**External Comm**
- CREST Website
- Partner Websites
- Social Media
- Flyers
- Events
- Press Releases
- Conferences
- School Visits
- Advertisements
- Published Research
CESSRST External Advisory Board

- **CESSRST’ External Advisory Board (C-EAB) and its charter will be established before Spring 2017.**
- The Board will be responsible to advise the CESSRST Consortium members on long- and short-term strategies for research, education and the application of science to resource management and environmental assessment and prediction in line with NOAA’s Strategic Plans (Science, Social Science, Education and Diversity and Inclusion).
- **C-EAB will meet annually and provide necessary input to ensure that CESSRST science programs are of the highest quality and provide optimal support to that address high priority long-term goals for NOAA, from “Resilient Coastal Communities and Economies” to “Weather-Ready Nation” to “Integrated Water Prediction” to “Climate Adaptation and Mitigation”.
- The advisory board will assist CESSRST members in maintaining a complete and accurate understanding of scientific issues critical to the agency's missions.
- The board will also help increase workforce opportunities (e.g. postdoctoral opportunities, NOAA contractors’ jobs; and other potential internship opportunities within and related to NOAA mission STEM fields).
- **C-EAB will be led by the Board chair and composed of about 8 to 10 committee members ranging from NOAA Managers, Eminent Scientists, Engineers, Potential Employers representing Private Sectors; and Educators.**

**Deliberate Plans for Collaborations with Other CSCs, NOAA, and External Entities**

Following best practices will be implemented to enhance collaborations external to CESSRST (with other CSCs, NOAA and other organizations):

1. Will create a joint CSC recruitment calendar of events
2. Organize CSC best practice seminars and brown bags –minimum one every semester
3. OAR-NWS-NOS-NESDIS Brown bag series to increase research and training opportunities for students
4. CSC Directors regular meetings to deliberate plans for site visits to various NOAA line office and labs for joint CSC collaborations.
5. Regular meeting with Technical Monitor and NOAA Program Office to ensure NOAA missioned alignment science and education training.
6. Annual CESSRST External Advisor Board (C-EAB) meeting
7. Annual CSC Directors’ meetings and regular conference call (minimum once every semester)
8. Create Internship Opportunities for students at local, state and private sectors, and other NOAA CI labs – such as CIRA, CICS, and CIMSS.

**Monitoring**

CESSRST Administrators, Research Coordinator, and the External Evaluator will monitor the data needed to assess CESSRST Program Impacts. Specifically, data related to determining the quality and quantity of research collaborations between NOAA scientists and CESSRST faculty, staff and
students in NOAA mission sciences and strategic priorities include peer reviewed publications, presentations and data products, student authorship (1st or 2nd) on peer reviewed publications, presentations and data products, sustained inter-institutional collaborations in NOAA mission aligned priorities, and citations of CESSRST publications. ISDP will be used to monitor the academic, research, and professional accomplishments of CESSRST students. In a formative sense, the ISDP serves as a road map for students’ academic tenure at CESSRST.

**EVALUATION:**

The impact of CESSRST efforts in this funding opportunity will be realized through the placement of students in the workforce and post-graduate tracking. Longitudinal tracking of CESSRST students during and after their academic tenure will be included as part of the overall evaluation of CESSRST related outcomes. The continuous monitoring of education and research activities through the ISDP will inform program improvements. Longitudinal studies will provide longer-term evaluation of the program and help identify the program’s strengths and areas for improvement. The evaluation efforts will showcase CESSRST’s ability to meet the diverse STEM workforce needs through its institutional commitment to students.

The chart below highlights the key milestones, corresponding monitoring, and evaluation activities.

<table>
<thead>
<tr>
<th>CESSRST Collaborative Research/Science</th>
<th>Monitoring/Evaluation</th>
</tr>
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<tbody>
<tr>
<td><strong>Milestone</strong></td>
<td><strong>CESSRST Collaborative Research/Science</strong></td>
</tr>
<tr>
<td>➢ Research Themed Sub-Committee works with Core Competency Sub-committee to develop CESSRST Level II core competency requirements and curricula</td>
<td>➢ Research Themed Sub-Committee monitors the completion of projects, tasks, and deliverables for each theme (Y1-Y5, ongoing)</td>
</tr>
<tr>
<td>➢ CESSRST faculty list and define expectations for achievement of competencies</td>
<td>➢ # students trained in NOAA sciences</td>
</tr>
<tr>
<td>➢ Broader CESSRST network (NOAA scientists, agency collaborators, etc.) review/edit competencies</td>
<td>➢ # publications</td>
</tr>
<tr>
<td>➢ CESSRST Level-II core competencies developed and associated modes of delivery identified</td>
<td>➢ # presentations</td>
</tr>
<tr>
<td>➢ Social Science Sub-Committee works with Research and Education Sub-Committees to identify activities and courses to integrate social science component of projects</td>
<td>➢ data products, R2X (R2O, R2A, R2D)</td>
</tr>
<tr>
<td>➢ CESSRST Admins monitor development of Level II Research Competency Framework (Mar - Apr, 2017)</td>
<td>➢ Survey of NOAA Scientists on CESSRST collaboration (see CESSRST Management) (Y2 and Y4)</td>
</tr>
<tr>
<td>➢ CESSRST Admins monitor integration of Social Science component of each Research Theme (Apr-May, 2017)</td>
<td>➢ CESSRST External Advisory Board evaluates the quality of the research</td>
</tr>
<tr>
<td>➢ Criteria to assess student achievement towards competencies developed</td>
<td>➢ Research Faculty/Advisors monitors student participation and compliance in achieving competencies (Y1-Y5, ongoing)</td>
</tr>
<tr>
<td>➢ Social Science Sub-Committee monitors the completion of projects, tasks, and deliverables for each theme (Y1-Y5, ongoing)</td>
<td>➢ Education Coordinator integrates social science in the PD offerings (Y1-Y5)</td>
</tr>
</tbody>
</table>

**NOAA Research Science Themes**

- **Theme I: Coastal Resilience**
  - Social Science Connection
  - Student Training Component
- **Theme II: Atmospheric Hazards**
  - Social Science Connection
  - Student Training Component
- **Theme III: Water Prediction and Ecosystem Services**
  - Social Science Connection
  - Student Training Component
NOAA ENGAGEMENT IN EVOLVING BEST PRACTICES FOR POTENTIAL CAREERS AT NOAA OR OTHER NOAA MISSION-ALIGNED CAREER OPPORTUNITIES

CESSRST will engage NOAA Program Office and NOAA Collaborators to:

1. Expand Students Professional and Academic Readiness with Knowledge in Satellites (SPARKS) to other NOAA Contractors (IMSG, RTI, ERT, Nobilis, GST and SSAI) and Private Sectors to increase internship and workforce training opportunities in core competency areas such as – Data Assimilation, Cal/Val; Radiative Transfer Algorithms – Fast Models, Scientific Stewardship, Remote Sensing (Land, Atmosphere, Vegetation, Droughts, Fires)
2. Create NOAA Scholarship Opportunities for CSC Students – GRTSP, Nancy Foster, Knauss Fellowship
3. Create NERTO opportunities for all CSC graduate students:
   a. SSIO – Students Scholarship Internship Opportunities (at NOAA Facilities, NESDIS-NCWCP, OAR/ARL, NWS/OHD/RO, OAR/ERSL/GFDL/PMEL
   b. OKEANOS – OER Exploration (Oceanic)
   c. AEROSE Expedition (Atmospheric)
4. Postdoctoral training for CSC funded post-doctoral students in different NOA facilities.

CESSRST INSTITUTIONAL AND SUSTAINABILITY PLAN

The CESSRST Strategic Plan aligns with CCNY’s Strategic Plan “Vantage Point 2022,” developed in 2015. CESSRST goals and objectives directly align with CCNY’s Strategic Plan in areas such as:

1. “Increase access to high impact experiences, such as internships, service learning” (directly correspond to CESSRST designed activities part of SSIO, NERTO, Internships in NOAA facilities),
2. “Expand student career development and post-graduate job opportunities” (CESSRST new initiatives such as JPSSSPARKS – an Education Proving Ground),
3. “Advance cutting-edge exploration, creativity, scholarship, entrepreneurship, and innovation” (cutting-edge CESSRST Science plan in Earth System Sciences and Remote Sensing Technology,
4. “Foster collaboration that links research, and creativity across all schools and divisions” (CESSRST education and science activities bring together Gove School of Engineering, Division of Sciences, Collin Powell School of Policy, and School of Education across CCNY),
5. “Institute a college-wide mentorship program that nurtures research, scholarship, and creativity” (CESSRST unique mentorship strategy of bringing CESSRST Scientists and NOAA Scientists together in providing mentorship to CESSRST students),
6. “Establish new interdisciplinary programs at the undergraduate and graduate levels” (CESSRST new proposal to create a new doctoral program in Interdisciplinary field of Earth System Sciences and Environmental Engineering, and a New Master Degree in Data Sciences),
7. “Support interdisciplinary research and creativity” (aligns with CESSRST Collaborative Research Plan),
8. “Enhance education and training on equity, inclusion, and diversity” (aligns with CESSRST new recruitment activities, training initiatives, internship opportunities, workforce development, and all fundamental elements in new CESSRST activities)

In addition to the above, the CESSRST Sustainability Plan will also focus on following key elements:

1. New Academic Initiatives (new degree programs, NOAA science related curriculum, core curricula) that will benefit the students at all the academic institutions
2. Create NOAA Science Citizenry on CESSRST campuses in NY, CA, VA, PR, MD and TX.
3. Sustainable Education and Outreach best practices to be adopted by the CESSRST consortia
4. Articulation with the Community Colleges to increase transfer of AS degree students to senior colleges - particularly from underrepresented minority communities, First Generation College and female students.
5. Provide access to CESSRST Research Infrastructural state-of-the-art facilities to students, academic and local, state and federal stakeholders.
6. Create a unified and accessible data-sharing portal for wide dissemination with academic, research and other stakeholders.
7. With the help of C-EAB, and CESSRST Science Oversight Committee, opportunities for new research and education grants and proposals, submission will be planned thru the five years and beyond.

The chart below highlights the key milestones, corresponding monitoring, and evaluation activities related to data and program management. A Gantt chart will be developed as part of our management plan and will illustrate all project activities, their schedule and how they relate to each other.

<table>
<thead>
<tr>
<th>Center Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Milestones</strong></td>
</tr>
<tr>
<td>Administrative Data Management (Student/Education Outcomes)</td>
</tr>
<tr>
<td>Management Information System</td>
</tr>
<tr>
<td>• Design and build the Students Database Management System (MIS) and client interface</td>
</tr>
<tr>
<td>• Beta test to improve or enhance MIS/ISDP usability</td>
</tr>
<tr>
<td>Data Products Management (Research/Science Outcomes)</td>
</tr>
<tr>
<td>Data Collection, Stewardship, and General management</td>
</tr>
<tr>
<td>• Improve and expand MIS FileMaker as Center Management System (CMS)</td>
</tr>
<tr>
<td>• Create and execute ClientBucket as the online/web based front-end for Center-Wide data collection system</td>
</tr>
<tr>
<td>Data Publishing and Sharing (Web services and portals)</td>
</tr>
<tr>
<td>• Create Center-wide website for general information</td>
</tr>
<tr>
<td>• Create partner institution websites (using matching</td>
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</table>
### Program Outputs and Outcomes

The success of CESSRST will be measured through a broad range of educational and professional outputs and outcomes. In the figure below, blue cells highlight the institutional commitment of CESSRST in achieving its goal of training a diverse and highly skilled workforce that pursue careers in disciplines that support NOAA’s mission. The orange cells emphasize data collection efforts used to provide evidence of a successful program.
The program outputs and outcomes will be monitored and evaluated per the milestone chart. We will distinguish between monitoring and evaluation plans and utilize program monitoring to ensure our program inputs are being achieved. Program monitoring will be conducted through the data management system developed (i.e. Student development plans, recruitment calendars, education specialist tracking of PD opportunities). Short and intermediate outcomes assessed through project level pre-post surveys. Long-term CESSRST outcomes and impacts assessed through alumni surveys toward the end of the program or end of each student cohort graduation.

**Table: Expected Outcomes and Deliverables**

<table>
<thead>
<tr>
<th>Program Activity</th>
<th>Action/Outputs</th>
<th>Deliverables/Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EDUCATION</strong></td>
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<tr>
<td>Recruitment, Engagement and Outreach</td>
<td>• Center-Wide Recruitment and Outreach Events, including participation in freshmen orientation activities on each campus where appropriate</td>
<td>• Increase # of students learn about NOAA sciences and mission and CESSRST</td>
</tr>
<tr>
<td></td>
<td>• Specific targeting and capacity building at the Community College level affiliated with each Partner</td>
<td>• Increase # of students, recruited, enrolled and trained in NOAA related Sciences annually.</td>
</tr>
<tr>
<td></td>
<td>• Broad and effective use of social media, Email, Blogging, Facebook, Twitter, Webinars, You Tube and other platforms to increase applications</td>
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<td></td>
<td>• Other</td>
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</tr>
<tr>
<td></td>
<td>• K12 engagement/pipeline program, where applicable</td>
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<tr>
<td></td>
<td>• NOAA CESSRST Day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Career Fairs and National Recruitment Events</td>
<td></td>
</tr>
</tbody>
</table>
| Undergraduate Research Training | • Recruit rising freshmen and sophomores into the Summer Bridge Program from first two Outreach efforts listed under Recruitment Engagement and Outreach  
• NOAA science relevant research training  
• Oral and Written Communication Skills  
• (writing resumes, applications for scholarship and graduate schools) | • Increase # of URM students who:  
• Pursue higher education,  
• Apply for scholarships in NOAA fields,  
• Transfer from AS to BS degrees.  
• Decreased attainment gaps in NOAA fields. |
| Summer Bridge Program CESSRST Undergraduate Research Experience | • NOAA science relevant research training  
• Develop courses that addresses the core competencies  
• Oral and Written Communication Skills  
• Professional Development Workshops  
• Mentoring Workshops  
• Internship/Experiential Opportunities (SSIO, NERTO, other) | • Increase # of students:  
• Trained, and Graduated annually  
• Pursuing higher education in NOAA fields  
• Apply STEM to policy and management decision-making  
• Increase quantitative and analytical skills, statistical analysis, computer modeling, and algorithm development.  
• Increase competence applying STEM to decision making, policy and management  
• Increase the opportunities to secure jobs in NOAA related STEM fields |
| Graduate Research Training | • Create Inter-disciplinary curriculum, courses and degree program in NOAA STEM disciplines | • Understanding of NOAA science social science and stewardship  
• Increase # of students and degrees awarded that reflect the changing demographics of the nation |
| Curriculum, Courses and Degree Programs | • Student Development Plan  
• Professional Development Workshops  
• Training/Seminar Series | • Functional competencies (Technical, Academic and Professional) to support the NOAA mission and workforce |
| Professional Advancement and Career Engagement (PACE) | • Collaborations with NOAA scientists and other collaborators  
• Regular science meetings, workshops, science seminars  
• Regular meetings with the Technical Monitor | • Increase NOAA Mission relevant science  
• Increase student education and training in NOAA science  
• Help advance CESSRST sciences to support NOAA’s operational missions. |
| NOAA Science Mission | • Increase NOAA Scientist Collaboration and Mentoring  
• NOAA seminars, workshops, colloquium and symposia | • Increased mentoring of students by NOAA scientists  
• Increase research and training capacity |
| NOAA Mentoring and Partnership | • Initiate and increase collaborative proposal preparation and student training | • Increase and sustain inter-institutional (inter-CSC and intra-CESSRST) collaborations in NOAA mission aligned priorities  
• Increase leveraged funding and sustainability |
| Collaborative Research | • Actionable Strategic and Implementation Plan by CESSRST members  
• Internal Executive Committee meetings  
• Seminars, Webinars, and Workshops  
• Interviews, Focus Group, Surveys, etc.  
• Formative and Summative Assessment | • Successfully create and sustain center-wide programmatic and administrative components to support students’ success and collaborative research  
• Evolve frameworks for understanding “what works” from results-based accountability to continuous quality improvement to evidence-based outcomes. |
| MANAGEMENT | • Consortium Collaborative Assessment |
The CCNY Office of Research Administration Director, Grants Administrator at Research Foundation of City University of New York (RFCUNY) will maintain the finances and budget – including the subcontractors. However, an internal budget bookkeeping will be maintained in the CESSRST Management office at CCNY which will be monitored for budget spending for each milestones accomplishments such as (1) CESSRST students’ cohort (stipends, tuitions, travel, research and NERTO) purchase requisitions (equipment, supplies) faculty and student travel (conferences, workshops) subcontract invoices (all campuses) by the administrative support staff under the supervision of the Assistant Director. All the budget requests, payments are reviewed routinely and approved by the Center Director. The Financial Tracker sheet will be maintained by CESSRST new management system (MIS) by CESSRST Data Manager and Budget Specialist. Center Director and Assistant Director will review this on a regular interval. The quarterly report will be shared with NOAA Program Office and six-monthly financial report will be submitted by the RFCUNY to NOAA via Grants Online.

**PROJECTED CESSRST IMPLEMENTATION PLAN MILESTONE CHART: 2016-2021**

<table>
<thead>
<tr>
<th>CESSRST Education and Training</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
<th>Y4</th>
<th>Y5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recruitment, Retention and Success</strong></td>
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<tr>
<td><strong>Recruitment Strategy</strong></td>
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<tr>
<td>Develop and disseminate CESSRST Informational materials (brochures, webpages, social media) and calendar of events for public awareness of CESSRST recruitment activities</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Identify nation, regional and local recruitment opportunities for in-person and virtual recruitment aligned with the four CESSRST research thematic areas</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Develop annual recruitment budget</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Assess CESSRST recruitment output and outcomes</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Admission into the CESSRST Program</strong></td>
<td></td>
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</tr>
<tr>
<td>Develop common application online portal for all levels (UG, MS PhDs) with access to all CESSRST partners and recruitment sub-committee</td>
<td>x</td>
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</tr>
<tr>
<td>Review application at each institution, placement in the appropriate campus/lab/research group and notify the successful applicants</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Assess admission into the CESSRST output and outcomes</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Retention and Success</strong></td>
<td></td>
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</tr>
<tr>
<td>Engage CESSRST students at all institutions in retention and success programs (i.e. Summer Bridge, New Students Orientation and Retention programs)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Assess CESSRST retention and success outputs and outcomes</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
## Individual Student Development Plan (ISDP)

<table>
<thead>
<tr>
<th>Task</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Students (Cohorts I through V) develop and create ISDPs</td>
<td>x</td>
</tr>
<tr>
<td>Faculty, CESSRST advisor, NOAA mentor and Education Coordinator review all the ISDP with the students</td>
<td>x</td>
</tr>
<tr>
<td>Students discuss progress, identify areas for improvement, and create plan to remedy needed improvement with advisor, mentor, and Education Coordinator</td>
<td>x</td>
</tr>
<tr>
<td>Assess CESSRST ISDP outputs and outcomes</td>
<td>x</td>
</tr>
</tbody>
</table>

## Technical Skills Development (Core-Competency)

<table>
<thead>
<tr>
<th>Task</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design CESSRST Level-I and Level-II core competency requirements and curricula</td>
<td>x</td>
</tr>
<tr>
<td>Implement CESSRST Level-I and Level-II core competency curricula</td>
<td>x</td>
</tr>
<tr>
<td>Monitor student participation and compliance in achieving core competencies</td>
<td>x</td>
</tr>
<tr>
<td>Assess CESSRST technical skills development outputs and outcomes</td>
<td>x</td>
</tr>
</tbody>
</table>

## Professional Skills Development (Soft Skills)

<table>
<thead>
<tr>
<th>Task</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design CESSRST Professional Skills Development curriculum</td>
<td>x</td>
</tr>
<tr>
<td>Implement CESSRST Professional Skills Development curriculum</td>
<td>x</td>
</tr>
<tr>
<td>Monitor student participation and compliance in achieving professional skills development requirements</td>
<td>x</td>
</tr>
<tr>
<td>Assess CESSRST Professional skills development outputs and outcomes</td>
<td>x</td>
</tr>
</tbody>
</table>

## Experiential Learning (Internships) Undergraduate

<table>
<thead>
<tr>
<th>Task</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify summer research opportunities for students completing Freshman and Sophomore years</td>
<td>x</td>
</tr>
<tr>
<td>Eligible students apply and are selected for Summer Undergraduate Research Experience (SURE) opportunities</td>
<td>x</td>
</tr>
<tr>
<td>Implement summer research opportunities (aligns with CESSRST sciences)</td>
<td>x</td>
</tr>
<tr>
<td>Pre-selected Freshman and Sophomore students are prepared to apply for NOAA undergraduate scholarships and similar opportunities</td>
<td>x</td>
</tr>
<tr>
<td>Assess Experiential Learning outputs and outcomes for CESSRST UG students</td>
<td>x</td>
</tr>
</tbody>
</table>

## Experiential Learning (Internships) Graduate

<table>
<thead>
<tr>
<th>Task</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify potential internships (SSIO/NERTO) hosts among NOAA labs and facilities</td>
<td>x</td>
</tr>
<tr>
<td>Match eligible students with appropriate NOAA mentoring hosts</td>
<td>x</td>
</tr>
<tr>
<td>Implement summer research opportunities</td>
<td>x</td>
</tr>
<tr>
<td>Assess Experiential Learning outputs and outcomes for CESSRST Graduate students</td>
<td>x</td>
</tr>
<tr>
<td><strong>Theme I: Coastal Resilience</strong></td>
<td><strong>Y1</strong></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Task 1. CUNY-CREST Ocean Observatories in Critical Coastal Regions</td>
<td>x</td>
</tr>
<tr>
<td>Task 2. Quantifying coastal erosion in the Arctic and assessing impacts on vulnerable coastal ecosystems and communities.</td>
<td>x</td>
</tr>
<tr>
<td>Task 3. Development of Coastal Water Quality Indicators</td>
<td>x</td>
</tr>
<tr>
<td>Task 4. Development of in-situ and satellite-based environmental datasets for assessing resilience to disturbance in tropical coral reefs</td>
<td>x</td>
</tr>
<tr>
<td>Task 5. Improved monitoring of HABs and their impacts in coastal eutrophic systems</td>
<td>x</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Theme II: Atmospheric Hazards</strong></th>
<th><strong>Y1</strong></th>
<th><strong>Y2</strong></th>
<th><strong>Y3</strong></th>
<th><strong>Y4</strong></th>
<th><strong>Y5</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1: Severe Storm Prediction</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Task 2: Heat Stress and Urban Modeling</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Task 3: Satellite Validation and Analysis</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Task 4: The CUNY-CREST Earth System Observing Network (CESON) and Applications</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<table>
<thead>
<tr>
<th><strong>Theme III: Water Prediction and Ecosystem Services</strong></th>
<th><strong>Y1</strong></th>
<th><strong>Y2</strong></th>
<th><strong>Y3</strong></th>
<th><strong>Y4</strong></th>
<th><strong>Y5</strong></th>
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</thead>
<tbody>
<tr>
<td>Task 1: Drought Risk Assessment and Ecosystem Outcomes</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<tr>
<td>Task 2: Flood Risk Assessment and Data Products</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Task 3: Assessment and Application of National Water Model Using Remote Sensing Data Products</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<tr>
<td>Task 4: Monitoring Land-Atmosphere-Ocean Fluxes</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<tr>
<td>Task 5: Use of UAS Platforms for Environmental Intelligence and Satellite Product Validation</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<table>
<thead>
<tr>
<th><strong>CESSRST Social Science</strong></th>
<th><strong>Y1</strong></th>
<th><strong>Y2</strong></th>
<th><strong>Y3</strong></th>
<th><strong>Y4</strong></th>
<th><strong>Y5</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory and Selection of Social Science Courses – for students to take as electives where appropriate to enhance their training</td>
<td>x</td>
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<tr>
<td>Develop and begin implementing Social Science (SS) Competency</td>
<td>x</td>
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<tr>
<td>Story Map creation as a learning module of SS Competency</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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</tr>
<tr>
<td>Preliminary discussion with CESSRST research scientists about social science integration in the science projects</td>
<td>x</td>
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<tr>
<td>Develop the Social Science Seminar Series</td>
<td>x</td>
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<tr>
<td>Continue Social Science Seminars</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Continue implementing Social Science Competency</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Assess the status of social science integration into the Center’s Research</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
### Impact Report on Social Science Integration into CESSRST Education, Training, and Research

#### CESSRST Data Sharing and Management Plan

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<thead>
<tr>
<th>Administrative Data Management (Student/Education Outcomes)</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
<th>Y4</th>
<th>Y5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students Database Management System (new MIS)</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey the users and identify the needs</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Architecture, Design and build the new MIS (ClientBucket)</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta Testing the new MIS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Building the Faculty, Student, Research and Management Databases</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Mining and Analysis (Monitoring and Evaluation of output and outcomes)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

#### Data Products Management (Research/Science Outcomes)

<table>
<thead>
<tr>
<th>Data Collection, Stewardship, and General management</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
<th>Y4</th>
<th>Y5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhance, Improve and expand MIS FileMaker as Center Management System (CMS)</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create and Execute Client Bucket as the online/web based Front-end for Center-Wide data collection system</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Data Publishing and Sharing (Web services and portals)

| Create an enhanced center wide system for general information | x  |    |    |    |    |
| Enhance/Create partner institution websites (using matching templates) | x  | x  |    |    |    |
| Improve and Enhance data portals (ftp, web) for data retrievals. (includes openDap services and other API that allow seamless integration with man website) | x  | x  | x  |    |    |

#### Data Archiving, Preservation and Storage (CESSRST cluster nodes)

| Create and manage a CESSRST cluster for data storage and mid-range computation | x  | x  | x  |    |    |
| GOES-R Launch, Acquisition and Archiving at CESSRST (satellite receiving station add-ons) | x  | x  | x  |    |    |
| Large scale computation (CUNY High Performance Computing facility) | x  |    |    |    |    |
| Expand and improve CESSRST cluster with API for websites for data transfers as data volume increases | x  | x  | x  | x  | x  |
| Development of Software packages, Mobile Applications Computer Codes for data reading and visualization for the CESSRST datasets |    |    |    | x  | x  |

#### CESSRST Program Management

<table>
<thead>
<tr>
<th>CESSRST Center-wide Post Doc Plan</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
<th>Y4</th>
<th>Y5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Compliance training by researchers, students and staff</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Internal Executive Committee meeting (Partner Institutions)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Formulate a new CESSRST External Advisory Board (C-EAB) and a charter</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Advisor Board and Technical Meeting</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Annual Center Directors meeting and engagement in CCC network</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Regular CSC directors call</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Monthly budget management/update meeting with RFCUNY, CESSRST budget staff to ensure regular drawdown and timely financial progress reporting to NOAA</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Annual Partner Institution Site Monitoring Visit</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Quarterly committees (education and science) and sub-committee updates to the management</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Collaborate with NOAA Program Office and Scientists (thematic) to plan, create and implement graduate NERTO opportunities</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Engage in External Stakeholder meetings</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Annual CESSRST Symposium</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Biennial EPP/MSI forum</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>CESSRST Evaluation</strong></td>
<td>Y1</td>
<td>Y2</td>
<td>Y3</td>
<td>Y4</td>
<td>Y5</td>
</tr>
<tr>
<td>IRB Approval (CUNY)</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designing the evaluation instruments - survey tools</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Monitoring to assess the program outputs (education, science and management)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Program Evaluation to assess the final program outcomes</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Final Evaluation and Assessment Report</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
Student Recruitment projection
Summary At-a-Glance
(Based on the proposed Science 2021 Plan and Deliverables to NOAA)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Summer-Bridge)*</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>20</td>
<td>9</td>
<td>17</td>
<td>6</td>
<td>28</td>
</tr>
<tr>
<td>Masters</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>PhD</td>
<td>8 (new)</td>
<td>12 (new)</td>
<td>11 (8 from Yr1 + 2 new)**</td>
<td>14 (12 from Yr. 2 + 2 new)**</td>
<td>3 (continuing and/or new)*</td>
</tr>
<tr>
<td>Total Number of Students to be Trained across All CESSRST***</td>
<td>48</td>
<td>37</td>
<td>46</td>
<td>40</td>
<td>55</td>
</tr>
</tbody>
</table>

Footnote:
* Summer Bridge Program for Rising Sophomores at $4,000 for each student from the professional development budget
** Numbers (in Years 3, 4, and 5) of new and continuing Ph.D. could change depending on potential leveraged funds
*** Theme-wise breakdown of potential student recruitment chart is given in the Appendix V.

Support Level New Students (All for 2 years)

- **PhD**: $92,000.00 = ($36,000x2 years + $10,000 for NERTO + $10,000 Research Support)
- **Masters**: $60,000.00 = ($25,000x2 + $5,000 for NERTO + $5,000 Research Support)
- **Undergrad**: $24,000.00 = ($12,000x2)

<table>
<thead>
<tr>
<th>Student Professional Development Fund</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$51,500</td>
<td>$70,000</td>
<td>$50,000</td>
<td>$58,000</td>
<td>$62,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assuming Level of CESSRST Fund</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$2,975,000</td>
<td>$3,100,000</td>
<td>$3,100,000</td>
<td>$3,100,000</td>
<td>$3,100,000</td>
</tr>
</tbody>
</table>
LIST OF ACRONYMS

AER – Atmosphere and Environmental Research
AEROS – AERosols and Ocean Science Expeditions
AGU – American Geophysical Union
AMS – American Meteorological Society
ARL – Air Resources Laboratory
BEYA – Black Engineers Year Award
CCC - CSC Cooperative Committee
CICS – Cooperative Institute for Climate Studies
CIMSS – Cooperative Institute for Meteorological Satellite Studies
CIRES – Cooperative Institute for Research in Environmental Sciences
CIRA – Cooperative Institute for Research in Atmosphere
CSC – Cooperative Science Center
CWCC – Center-Wide Core Competency
EMC – Environmental Monitoring Center
EPA – Environmental Protection Agency
ERT Inc. – Earth Research Technologies Inc.
ESRL – Earth System Research Laboratory
GFDL – Geophysical Fluid Dynamics Laboratory
GIS – Geographic Information System
GOES-R – Geostationary Operational Environmental Satellite-R Series
HABs – Harmful Algal Blooms
HACU - Hispanic Association for Colleges and Universities
HBCU – Historically Black College and Universities
IMSG Inc. – IM Systems Group, Inc.
ISDP – Individualized Student Development Plan
JPSS – Joint Polar Satellite System
LAESA-SHPE - Latin American Engineering Student Association- Society for Hispanic Professional Engineers
LISCO – Long Island Sound Coastal Observatory
LSAMP - Louis Stokes Alliances for Minority Participation
SSIO – Students Scholarship Internship Opportunities
STAR – Center for Satellite Applications and Research
NCCOS – National Centers for Coastal Ocean Science
NCEI – National Centers for Environmental Information
NCEP – National Centers for Environmental Prediction
NCEP – MADIS - Meteorological Assimilation Data Ingest System
NCWCP – National Center for Weather and Climate Prediction
NERTO – NOAA Educational Research and Training Opportunities
NOAA-CCEHBR- National Oceanic and Atmospheric Administration- Center for Coastal Environmental Health and Bio-molecular Research
NOAA-CESSRST – National Oceanic and Atmospheric Administration-Cooperative Science Center for Earth System Sciences and RE mote Sensing Technologies (NOAA-CESSRST)
NMFS – National Marine Fisheries Services
NOS – National Ocean Services
NWS – National Weather Services
NYC MetNet – New York City meteorological Network
OAR – Office of Atmospheric and Research
OKEANOS - NOAA Ship Okeanos Explorer
OER – Office of Exploration and Research
OHD – Office of Hydrologic Development
OLCI – Ocean Land Color Imager
OSPO – Office of Satellite and Product Operations
OSGS – Office of Satellite Ground Services
PACE – Professional Advancement and Career Engagement
PACE – Plankton, Aerosol, Cloud Ecosystem
PMEL – Pacific Marine Ecosystems Laboratory
PRODUCE – Producing Readiness Of Diversity University Cohorts in Education
RFC – Regional Forecasting Centers
SAC – Special Award Conditions
SACNAS - Society for Advancement of Chicanos and Native Americans in Science
SDSU – San Diego State University
SPARKS - Students Professional and Academic Readiness with Knowledge in Satellites
TPIO – Technology, Planning and Integration for Observation
UAS – Unmanned Aircraft Systems
UAV – Unmanned Aerial Vehicle
UMBC - University of Maryland, Baltimore County
UPRM - University of Puerto Rico, Mayaguez
UTEP – University of Texas, El Paso
Supplemental Information
APPENDIX I: SPECIAL AWARD CONDITIONS

Description: Performance Progress Reports
Amendment – CD-450
Type – Programmatic
Due Date: (Biannual – March and September each year)

Description: Project Progress Reports are due on a semi-annual basis, no later than 30 days following the end of each six (6) month period from the start date of the original award. The last semi-annual Project Progress Report, which may cover less than a six-month period, will be due no later than 90 days after the award expiration. The content requirements for semi-annual performance progress reports are standard and in accordance with Program Office guidance provided in the EPP/MSI CSC Policy and Procedures Handbook. The grantee shall include sub-award activities in semi-annual Performance Progress Reports (PPR) that are submitted to NOAA through Grants Online (https://grantsonline.rdc.noaa.gov/flows/home/Login/LoginController.jsp).

EPP MSI CSC Evaluation Plan for Center
Description: Evaluation
Amendment – CD-450
Type – Programmatic
Due Date: 2/19/2017

Post Award Recipient Center Evaluation Plan Submission: A comprehensive Evaluation Plan for the Center award is to be submitted to NOAA, through Grants Online, no later than six (6) months from the award start date. Post Award Recipient Center Evaluation Plan: Each recipient will develop an evaluation plan that assesses program progress and measures the impact of activities related to intended education and training, research and outcomes of the CSC. Therefore, each recipient is required to hire a third-party, external evaluator who understands the scope and mission of the CSC. The evaluator(s) should be an expert in postsecondary education to assess education and training outcomes using protocols consistent with the U.S. Department of Education and the National Science Foundation guidelines, http://www.nsf.gov/pubs/2013/nsf13126/nsf13126.pdf.

Description: Review Criteria of Post Award Recipient Center Evaluation Plan.

The Award Recipients Center Evaluation Plan will be reviewed by NOAA using the criteria below:
1. External evaluator demonstrates expertise necessary to successfully conduct the proposed CSC evaluation;
2. The extent to which methods for conducting formative and summative evaluations are rigorous and appropriate for the CSC;
3. The extent to which the formative and summative evaluation methods will provide high-quality data and performance feedback and permit periodic assessment towards meeting intended performance outcomes; and,
4. The extent to which the evaluation plan includes sufficient resources to carry out the evaluation.
External Evaluator:

Award funds, not to exceed $50,000.00, may be used for external evaluator prior to NOAA review, approval and acceptance of the full Center-wide Evaluation Plan. No additional award funds may be made without NOAA (EPP/MSI and Grants Office) approval. Evaluators are expected to adhere to the Guiding Principles for Evaluators (http://www.eval.org/p/cm/ld/fid=51) and proposed CSC evaluations should be consistent with standards established by the Joint Committee on Standards for Educational Evaluation (http://www.jcsee.org/).

EPP MSI CSC Center Implementation Plan is Required

Description: Center Implementation Plan:
Amendment – CD-450
Type – Programmatic
Due Date: 10/22/2016

A comprehensive Center Implementation Plan for the Center award is to be submitted to NOAA, through Grants Online, no later than sixty (60) days from the award start date. The content of the Center Implementation Plan addresses award documents (i.e. application and response to clarifying items) must include:

1. Timelines with important milestones aligned with deliberate outcomes, i.e. education and training metrics, retention measures, products etc.
2. Education and training strategies that demonstrate robust linkage with Center scientific research and future NOAA-mission careers;
3. Strategy for Center-wide student core competency attainment in social sciences aligned with NOAA mission;
4. Detail measures for Longitudinal Tracking of beneficiaries;
5. Details for 2 EPP/MSI supported fellows in the Postdoctoral Program including engagement with NOAA at a NOAA facility. Each CSC is required to provide funding for two postdoctoral positions. The Center Postdoctoral Fellows must be appointed within the first nine months of the award start date.
6. Training for students, faculty and award administrators in mentorship and menteeship skill sets;
7. Training related to ethical conduct of research;
8. All CSC management key positions must be filled 9 months of the award;
9. Key positions may not be vacant for more than 6 months throughout the duration of the award;
10. Advisory Board(s) details, including, selection, term-limits, replacement process and function, plan for engagement, and expectations for Board members and the CSC;
11. Clear demonstration and articulation of institutional and sustainability plans;
12. Details for integration of education and training with the research component;
13. Details for the recruitment, retention strategies for students supported in proposed Center;
14. Details for how the partnering institutions will be involved in the administrative structure and function of the CSC;
15. Details for how the CSC will meet the EPP/MSI Program-level outputs and outcomes;
16. Details with timelines for transparent communication within the CSC and external to the CSC;
17. Deliberate plans for collaborations with other CSCs, NOAA, and external entities;
18. Details for engaging NOAA in best practices for developing graduates who will be fully equipped for the candidate pool that NOAA may consider for potential careers at NOAA or refer for other NOAA mission-aligned career opportunities.

EPP MSI CSC Programmatic Special Award Conditions
Amendment – CD-450
Type – Programmatic
Due Date: 10/22/2016

1. The NOAA Educational Partnership Program (EPP) with Minority Serving Institutions (MSI) Cooperative Science Center (CSC) award is designed to create collaborative partnerships with other academic institutions, including MSIs. Partnerships are also required between the designated Center, OEd EPP/MSI, and NOAA's Line Offices as listed, www.noaa.gov.

2. Each CSC award must conduct both education and research. The Center education and research shall directly align with NOAA’s mission, strategic plans, objectives and outcomes to recruit, train and graduate post-secondary students, particularly from underrepresented communities, to become eligible to successfully compete and enter the NOAA mission workforce career paths at NOAA and related enterprises.

3. The overall Program-level metrics for the EPP/MSI CSC awards as a Federal STEM Education Agency-mission Future Workforce are:
   a. Annually, number of EPP-funded post-secondary students from underrepresented communities who are trained and graduate in NOAA-mission sciences.
   b. Annually, total number of EPP-funded post-secondary students who are trained and graduate in NOAA-mission fields relevant to this announcement.
   c. Annually, number of EPP-funded graduates who enter the NOAA mission workforce as hires by NOAA, NOAA contractors, NOAA partners, resource management agencies, academia or as entrepreneurs.
   d. Annually, number of EPP-funded graduates who participate in and complete agency mission-related postdoctoral level programs.
   e. Funds leveraged with NOAA EPP award (including post-secondary student support).

4. Each award recipient shall meet the award performance measures and annual goals, aligned with the EPP/MSI Program to increase the number of undergraduate and graduate students who gain NOAA mission-relevant STEM discipline-specific knowledge and skills that are the primary focus of the Center Type award (i.e. Atmospheric Sciences and Meteorology, Coastal and Marine Ecosystems, Earth System Sciences and Remote Sensing Technologies, and Living Marine Resources), enroll and complete degrees, and are prepared to enter NOAA mission-aligned STEM careers or pursue advanced education.

5. The NOAA EPP/MSI Cooperative Science Center (CSC) award recipient shall conduct both education and research. The award is designed to educate, train and graduate students
in disciplines that support NOAA mission-aligned Science, Technology, Engineering, and Mathematics (STEM); natural resources management, and policy fields. The primary outputs of the EPP/MSI CSC support NOAA Education Strategic Plan Goal.

6. Future workforce; primary Line Office strategic directions and/or priorities; and, number of students from underrepresented communities who are trained and graduate in NOAA mission sciences, particularly at MSIs. Each award recipient shall establish performance measures and meet annual goals, aligned with the EPP/MSI Program to increase the number of undergraduate and graduate students who gain NOAA mission-relevant STEM disciplines-specific knowledge and skills that are the primary focus of the Center Type award (i.e. Atmospheric Sciences and Meteorology, Coastal and Marine Ecosystems, Living Marine Resources, and Earth System Sciences and Remote Sensing Technologies), enroll and complete degrees, and are prepared to enter NOAA mission-relevant STEM careers or advanced education.

7. Future funding of a Cooperative Science Center award recipient shall be determined by progress in meeting the primary educational objectives in the Center Type key focus areas, knowledge, working skills and competencies of student beneficiaries: (i) increased number of Center-supported students from underrepresented communities who enter NOAA mission career paths at NOAA and NOAA mission-aligned enterprises; (ii) increased number of students from underrepresented communities who enroll in NOAA mission-aligned STEM majors, complete degrees; and, (iii) increased number of students from underrepresented communities who participate in meaningful NOAA mission-aligned STEM research at CSC and NOAA facilities while earning degrees in NOAA mission-aligned STEM degrees.

**CSC Education and Training.**

Post-secondary students supported by the Center are required to engage in Center activities including but not limited to: mentoring, tutoring, Center research, STEM engagement with local communities, etc. An award recipient must select and an annual cohort of post-secondary students for direct EPP/MSI support and publish the list of supported students on the CSC website. An award recipient must generate outputs and impacts that support the goals in NOAA EPP/MSI Program Objective, Program Priorities, applicable statutory authorities and Executive Orders.

An award recipient must demonstrate that the Centers annual student cohort is acquiring competencies in core fields aligned with the NOAA mission. An award recipient must demonstrate that the Centers student development programming is yielding successful applications for: (i) NOAA undergraduate scholarships, and (ii) other NOAA mission-aligned related experiential training and/or scholarships and fellowships An award recipient must demonstrate that the Centers education and training is guiding the skills development to allow each annual cohort to integrate human dimensions in the implementation of activities supporting the NOAA mission and goals.

**CSC Scientific Research**

Every EPP/MSI research-funded activity supported at the CSC under this award shall engage undergraduate and graduate students from underrepresented communities in meaningful NOAA mission-relevant STEM research in the primary focus areas of the Center Type as the students earn NOAA mission-relevant STEM degrees.
Postdoctoral Fellows Program. Each CSC shall establish a post-doctoral program to supports two-year fellowships and provide funding for two post-doctoral positions. During the two-year fellowship, the postdoctoral research shall be collaborative among the postdoctoral fellows, CSC scientists and NOAA scientists and shall address NOAA-mission science in mission critical areas of primary focus in the Center Type award. Only United States citizens shall be supported with NOAA EPP CSC funds as a CSC post-doctoral fellow. Each postdoctoral fellow supported by CSC funds shall participate in at least one NOAA-site based research opportunity that is directly related to the CSC, as outlined in the CSC Handbook. Administration

An award recipient must implement data management, longitudinal tracking, and public communication of results for the award investment.

EPP/MSI Center award recipient is required to participate in and host site visit(s) from NOAA evaluation contractor(s) to assess broader impacts, including those derived from the EPP/MSI Center award for direct student support, alumni, faculty, institutions, programs and other aspects. EPP/MSI Center award recipient is required to provide coordinated team engagement opportunities for Center students, faculty and staff to fully integrate into a Center-wide team to yield impacts that contribute to the desired EPP/MSI Program-level outputs and outcomes.

EPP/MSI Center award recipient is required to participate in the NOAA EPP/MSI CSC Recipient Network. EPP/MSI Center award recipient is required to plan joint student (all academic levels) sharing and collaboration among Center academic partners for cross-fertilization of ideas, best practices, methodologies and technology phenomenology (ies).

Annual Student and Performance Measures Tracking System.

All award recipients are required to submit annually, the student tracker database Center input via a web-based application. The data entry must be completed by September 30th each year. The Cooperative Science Center award recipient shall conduct training in responsible and ethical conduct of research for students, faculty, staff and researchers supported by EPP/MSI CSC funds.

The Cooperative Science Center award recipient shall develop a CSC Student Development Plan that includes the training approach, targets and competencies that will lead to identified educational outcomes for CSC students supported at each degree level. The competencies identified in the Student Development Plan shall indicate a clear alignment with the specific Center type, NOAA Strategic Plan and the EPP/MSI educational and workforce goals. Each CSC-supported student shall have an Individual Student Development Plan that shall include research internships at NOAA Facilities, presenting at national meetings, and training to develop knowledge and skills to allow the CSC students to develop NOAA mission-relevant STEM portfolios.

The Cooperative Science Center award recipient shall implement Longitudinal Performance Outcomes Tracking.
EPP MSI CSC Substantial Involvement and Collaborative Engagement

Description: Substantial Involvement Special Award Conditions
Amendment – CD-450
Type – Programmatic
Due Date: 10/22/2016

National Oceanic and Atmospheric Administration (NOAA) Office of Education, EPP/MSI Program will be significantly involved in the planning of research and student training activities at the Cooperative Science Center (CSC). The NOAA Line Offices will be involved in the: planning; execution as needed; site visits to verify output measures; data management; and collaboration on research activities. The specifics about substantial involvement by NOAA are identified below:

1.0. EPP/MSI Award Executed as A Cooperative Agreement
1.A. EPP/MSI CSC Cooperative Agreement Terms and Conditions of Award

The following special terms of award are in addition to, and not in lieu of, otherwise applicable OMB administrative guidelines, DOC grant administration regulations and Financial Assistance Standard Terms and Conditions referenced in Part VI.A. and B. and other NOAA administration policies. The administrative and funding instrument used for this program will be the cooperative agreement an "assistance" mechanism (rather than an "acquisition" mechanism), in which substantial NOAA programmatic involvement with the awardees is anticipated during the performance of the activities. Under the cooperative agreement, the NOAA purpose is to support and stimulate the recipients' activities by involvement in, and otherwise working jointly with, the award recipients in a partnership role; it is not to assume direction, prime responsibility, or a decision-making role in the activities. Consistent with this concept, the decision-making role and prime responsibility resides with the awardees for the project as a whole, although specific tasks and activities may be shared among the awardees and NOAA as defined below.

1.A.1. Principal Investigator Roles and Responsibilities.

The Principal Investigator (P.I.) will have the primary responsibility for defining the Center objectives, scope and framework within the guidelines of the NOAA Federal Funding Opportunity Announcement applicable to and incorporated by reference in this award, and for performing the education and training, and scientific research activities. The P.I. agrees to collaboration with the other members of the NOAA EPP/MSI CSC Recipient Network and to accept close coordination, cooperation, and participation of NOAA staff and advisors in those aspects of scientific and technical management of the project as described under 1. A.2. NOAA Responsibilities

The P.I. will:
- Establish partnership with NOAA.
- Conduct an annual internal Center-wide review to: (i) assess whether CSC is accomplishing goals according to the milestones agreed to at the time of award; (ii) identify challenge areas; (iii) make adjustments, as appropriate; and, (iv) communicate with NOAA
EPP/MSI about the results, identifying areas or adjustments, and solutions that will be implemented.

- Communicate with EPP/MSI to provide annual updates to the NOAA Chief Scientist, the NOAA Science Advisory Board, and relevant NOAA Councils.
- Determine approaches for achieving goals and set project milestones.
- Meet or exceed stated milestones.
- Accept and participate in the cooperative nature of the NOAA EPP/MSI CSC Recipient Network.
- Interact with all of the participants of the NOAA EPP/MSI CSC Recipient Network to determine data standards and exchange mechanisms to coordinate data received from each CSC component Center-wide administration and Management, education and training, scientific research.
- Determine database schema, develop data acquisition procedures, set curatorial standards for annotation, and set project milestones.
- Ensure that the data accumulated under the NOAA EPP/MSI CSC award are made publicly available and can be retrieved from the awardee through multiple methods of querying, including simple web interfaces for common standard queries and tools to allow the downloading of large datasets.
- Ensure that data accumulated at the NOAA EPP/MSI CSC Recipient Network are distributed to other resources in a standard data format that can be used by the stakeholders.
- Ensure that the NOAA EPP/MSI CSC award performance meets the quality standards and costs agreed upon at the time of award.
- Submit reports tracking progress of the CSC projects in any manner specified by award documents or the External Review Panel.
- Submit data for quality assessment in any manner specified for awardee by the NOAA Plan for Increasing Public Access to Research Results or the External Review Panel.
- Adhere to the general NOAA policies regarding sharing resources, data release, and resource sharing, as well as the specific NOAA data and resource-sharing policies proposed for recipients of Federal financial assistance awards, as modified by any pre-award negotiation or that might be established by the Program, during the course of performance of this activity.
- Submit periodic progress reports in a standard format that clearly aligns with and demonstrates activities and products from EPP/MSI funding for award objectives, as agreed upon by the Program, Technical Monitor, and the External Review Panel.
- Accept and implement any other common policies, guidelines and procedures that are developed and approved for the CSC awards by the NOAA OEd EPP/MSI CSC Program Manager.
- Keep the NOAA OEd EPP/MSI CSC Program Manager informed of all interactions with NOAA scientist(s), manager(s), and leadership.
- Attend annual Directors Meetings and the Biennial EPP/MSI Education and Science Forum.
- Ensure Center-wide application and adherence to the award terms and conditions for the funded objectives.
1.A.2. NOAA Responsibilities

NOAA will have substantial programmatic involvement that is above and beyond the normal stewardship role in awards, as follows. NOAA will have substantial scientific/programmatic involvement during the conduct of this activity through technical assistance, advice and coordination by the EPP/MSI Program Manager. The Program Managers responsibilities include but are not limited to the overall administration and management of this Cooperative Agreement.

NOAA will conduct an interim administrative review of the each EPP/MSI CSC awardee in 4th year, by an independent, expert external review team to assess whether the Program is accomplishing its goal and to set the stage for developing an additional 5-year award renewal opportunity. In the 4th year an independent expert panel review will be conducted. Additionally, the agency program officer will be responsible for the normal education and training, scientific and programmatic stewardship of the award and is named in the award notice. A NOAA scientist or manager will be assigned to serve as a NOAA Technical Monitor.

NOAA shall retain the option, including with the advice of the External Review Team and/or CSC Advisory Science Board, to withhold or reduce support for any cooperative agreement that fails to achieve its goals according to the milestones agreed to at the time of award.

For the awardee, a Technical Monitor will be appointed from each of the NOAA Line Offices that is the primary Line Office for the participating cooperative agreement. The role of the NOAA Technical Monitor will be to facilitate, and not direct, the CSC activities. It is anticipated that decisions in all collaborative activities will be reached by agreement of the NOAA EPP/MSI CSC Recipient Network, of which the PI is a member, and that the NOAA Technical Monitor will participate in this process. The NOAA Technical Monitor shall participate as a member of the NOAA EPP/MSI CSC Recipient Network.

The Technical Monitor will:

- Participate in awardee monitoring visit;
- Participate (with the Program Officer, P.I. and the other NOAA EPP/MSI CSC Recipient Network members) in the group process of contributing to: (i) collaboratively crafting research priorities for student research, (ii) deciding optimal research approaches and protocol designs, and (iii) contributing to the adjustment of research protocols or approaches as warranted. The Technical Monitor will assist and facilitate the group process and shall not direct the group process;
- Serve as a liaison between the awardee and the Line Office, NOAA advisory councils or boards;
- Coordinate the efforts of the awardee with other participants in the Line Office programs;
- Facilitate collaborations with the larger NOAA mission-relevant research community and hosting of CSC faculty at NOAA facilities or other bi-directional collaboration;
- Attend all NOAA EPP/MSI CSC Recipient Network meetings, assist in developing operating guidelines, quality control procedures, and consistent policies for dealing with recurrent situations that require coordinated action;
- Periodically report progress to the Line Office (including Assistant Administrator), EPP/MSI CSC Program Manager, and the annual NOAA EPP/MSI CSC Recipient Network meeting;
- Lend relevant expertise and overall knowledge of NOAA-sponsored research to facilitate the selection of scientists not affiliated with the awardee institutions who may serve on the CSC Advisory Boards, as appropriate;
- Serve as liaison between the NOAA EPP/MSI CSC Recipient Network and the CSC Advisory Board;
- Serve on awardee subcommittees, graduate student committees, and/or as mentors, as appropriate, and to evaluate projects submitted to the CSC for approval through the CSC administrative structure;
- Provide recommendations on the management and scientific technical performance of the award;
- Participate in data analyses, interpretations, and where warranted, co-authoring of the publication of results of studies conducted as part of the NOAA EPP/MSI CSC Recipient Network;
- As requested, assist awardees in the development approaches for dealing with situations that require coordinated action at CSCs; and,
- Advocate for and engage CSC in Line Office priorities, meetings, councils, and subcommittees, as appropriate.

**1.A.3. Collaborative Responsibilities**

To avoid duplication of activities, and to enhance collaboration, expand impact, and develop synergies; the NOAA EPP/MSI CSC Recipient Network is expected to work cooperatively with stakeholders and government representatives at the national and/or local level. Collaboration to achieve EPP/MSI CSC Program Objective and Priorities will be required. Collaboration includes, with other relevant award recipients, as appropriate, in implementing projects, and for the EPP/MSI Forum. NOAA collaboration and coordination with the CSC award recipient shall include, as appropriate:

- disseminating the products and impacts of the award jointly with recipient;
- working jointly with a recipient scientist or educators in carrying out the program purpose;
- training recipient personnel to work on the specific projects, as requested by award recipient; and,
- limiting recipient use of award funds to NOAA mission aligned scope of work, organizational structure, staffing, mode of operations, and other management processes, coupled with close monitoring or operational involvement during performance, as determined by the award terms and conditions.

Biennial EPP/MSI Biennial Education and Science Forum Center award recipient will participate in hosting the EPP/MSI Biennial Education and Science Forum. On a rotational basis, established CSCs are required to host the biennial NOAA Education and Science Forum and lead with NOAA the planning of the event. The Forum provides a venue where Center educational and scientific research results are shared. The purpose of the Forum is to allow NOAA education and scientific research accomplishments to be presented via technical and poster sessions by students, faculty, and NOAA scientists.
Funding for the Forum will be provided to the host center via the Grants process. The hosting center submits an Education and Science Forum application (including a detailed budget and budget justification) via Grants Online.

1.A.4. Dispute Resolution Process

Any disagreements that may arise in scientific or programmatic matters (within the scope of the award) between award recipients and the NOAA may be brought to Dispute Resolution. A Dispute Resolution Panel composed of three members will be convened which will include: a designee of the NOAA EPP/MSI CSC Recipient Network, one NOAA designee, and a third designee with expertise in the relevant area who is chosen by the other two representatives; in the case of individual disagreement, the first member may be chosen by the individual awardee. This special dispute resolution procedure does not alter the awardee's right to appeal an adverse action that is otherwise appealable in accordance with DOC regulations.

Description: Direct Student Support, Post-Doctoral Program and Pre-Publication Manuscript Submission

Amendment – CD-450
Type – Programmatic
Due Date: 10/22/2016

1. Student Eligibility for EPP/MSI CSC Beneficiary Support. Student must meet the stated Eligibility Requirements: (1) must be U.S. citizen; (2) full-time post-secondary student; however, graduate students at the writing stage of their thesis or dissertation, having met all other course requirements, could be exempt from the full-time post-secondary student requirement when enrolled in thesis or dissertation research.

2. EPP/MSI CSC funds for direct student support shall be provided no more than four (4) years for students pursuing undergraduate degrees, providing the student maintains a minimum 3.0 Grade Point Average for the current and prior academic term and is in a full-time academic status.

3. EPP/MSI CSC funds for direct student support shall be provided no more than three (3) years for students pursuing Master's degrees, providing the student maintains a minimum 3.0 Grade Point Average for the current and prior academic term and is in a full-time academic status.

4. EPP/MSI CSC funds for direct student support shall be provided no more than five (5) years for students pursuing doctoral degrees, providing the student maintains a minimum of 3.0 Grade Point Average for the current and prior academic term and is in a full-time academic status.

5. No EPP/MSI CSC funds may be used to support students who fail to meet the minimum 3.0 Grade Point Average for the current and prior academic term (semester or quarter) or to repeat courses previously paid for with EPP/MSI funds.

6. No EPP/MSI funds may be used to support any student engaged in full-time employment, outside of the Center, degree program and/or the academic institution. Full-time employment is considered 40 hours per week.

7. Each EPP/MSI CSC shall establish a post-doctoral program to supports two-year fellowships and provide funding for two post-doctoral positions. The postdoctoral fellows must be appointed within the first nine months of the award start date. During the two-year
fellowship, the postdoctoral research shall be collaborative among the postdoctoral fellows, CSC Distinguished Research Scientists and NOAA scientists and shall address NOAA-mission science in mission critical areas of primary focus in the Center Type award. Only United States citizens shall be supported with NOAA EPP/MSI CSC funds as a CSC postdoctoral fellow. Each postdoctoral fellow supported by EPP/MSI CSC funds shall conduct postdoctoral research that: addresses NOAA-mission science priorities areas; is collaborative among the postdoctoral fellows, CSC scientists, and NOAA scientists; participate in co-location of at least one-time. NOAA-site-based research opportunity that is six (6) consecutive months and not to exceed one (1) year; participate in preparation and implement of their own development plan; and, must adhere CD-450 Programmatic 10/22/2016 to the guidance published in the Federal Funding Opportunity NOAA-SEC-OED-2016-2004758.

8. All EPP/MSI CSC award recipients are required to submit the final pre-publication manuscripts of scholarly articles produced entirely or primarily with NOAA funding, to NOAA Institutional Repository after acceptance, and no later than upon publication. Such manuscripts shall be made publicly available by NOAA one (1) year after publication by the journal.

Description: Center External Evaluator Support on Award Funds Special Award Condition
Amendment – CD-450
Type – Programmatic
Due Date: 03/21/2017

External Evaluator: Award funds, not to exceed $50,000.00, may be used for the required external evaluator sub-contract prior to NOAA review, approval, and acceptance of the full Center-wide Evaluation Plan. No additional award funds may be used to support an external evaluator without NOAA (EPP/MSI and Grants Office) approval based on: (i) robustness of submitted evaluation plan; and, (ii) evidence of prior accomplishment(s) that will support being recognized as an expert in postsecondary education evaluation to assess education and training outcomes using best of class protocols consistent with the U.S. Department of Education and the National Science Foundation guidelines, http://www.nsf.gov/pubs/2013/nsf13126/nsf13126.pdf. Evaluators are expected to adhere to the Guiding Principles for Evaluators (http://www.eval.org/p/cm/ld/fid=51) and proposed CSC evaluations should be consistent with standards established by the Joint Committee on Standards for Educational Evaluation (http://www.jcsee.org/).

Description: NOAA Environmental Data and Information
Amendment – CD-450
Type – Administrative
Due Date: -

Environmental data and information, collected and/or created under this grant/cooperative agreement will be made visible, accessible and independently understandable to users, free of charge or at minimal cost, in a timely manner (typically no later than two (2) years after the data are collected or created), except where limited by law, regulation, policy or by security requirements.
1. The Data/Information Sharing Plan (and any subsequent revisions or updates) will be made publicly available at time of award and, thereafter, will be posted with the published data.

2. Environmental data and information produced under this award and which are made public must be accompanied by the following statement: These environmental data and related items of information have not been formally disseminated by NOAA and do not represent and should not be construed to represent any agency determination, view, or policy.

3. NOAA may at its own discretion, use information from the Data/Information Sharing Plan to produce a formal metadata record and include that metadata in a catalogue to indicate the pending availability of new data.

4. Failing to share environmental data and information in accordance with the submitted Data/Information Sharing Plan may lead to disallowed costs and be considered by NOAA when making future award decisions.

Description: New Award Special Award Condition
Amendment – CD-450
Type – Administrative
Due Date:

This award number NA16SEC4810008, to RESEARCH FOUNDATION OF THE CITY UNIVERSITY OF NEW YORK, supports the work described in the Recipient's proposal entitled "CSC-Earth System Sciences and Remote Sensing Technologies - ESSRST" dated March 30, 2016, and revised on August 22, 2016, which are incorporated into the award by reference. Where the terms of the award and proposal differ, the terms of the award shall prevail.

Description: Multi-Year Special Award Condition
Amendment – CD-450
Type – Administrative
Due Date: -

1.(MULTI-YEAR) The award period and budget(s) incorporated into this award cover a 5-year period for a total amount of $15,500,000 in Federal funds. However, Federal funding available at this time is limited to $2,975,000 for this funding period. Receipt of any prospective funding is contingent upon the availability of funds from Congress, satisfactory performance, continued relevance to program objectives, and will be at the sole discretion of the Department of Commerce. The Department of Commerce is not liable for any obligations, expenditures, or commitments which involve any amount in excess of the Federal amount presently available. The Recipient will be responsible for any and all termination costs it may incur should prospective funding not become available. No legal liability will exist or result on the part of the Federal Government for payment of any portion of the remaining funds which have not been made available under the award. Notifications affecting funding or notice of non-availability of additional funding for prospective years will be made only by the Grants Officer. The amendment to obligate prospective funding available shall be made on Form CD-451, "Amendment to Financial Assistance Award," if at all possible prior to the expiration of each year's activities. The funding period for this award is 09/01/2016 through 08/31/2017 and may be extended through 08/31/2021.
# CUNY CESSRST 2017 Summer Bridge Research Program

**June 19, 2017 to August 10, 2017**

**Week 4 through 8 Detailed Agenda**

## Week 4 (Jul 10-14, 2017)

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<tbody>
<tr>
<td>9:00 -12:00 Noon</td>
<td>Research Training</td>
<td></td>
<td>LUNCH</td>
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<td>Field Trip to NWS, Weather Balloon Launch, Upton, NY</td>
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<tr>
<td>12:00-1:00 PM</td>
<td>Lunch Break</td>
<td>Lunch Break</td>
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<td>Lunch Break</td>
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<td>1:00-2:00 PM</td>
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<td></td>
<td>Professional Development</td>
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<td>2:00-5:00 PM</td>
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<td>Core-Competency (NAC 6/105)</td>
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## Week 5 (Jul 17-21, 2017)

<table>
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<tr>
<th>Time</th>
<th>Monday, Jul 17, 2017</th>
<th>Tuesday, Jul 18, 2017</th>
<th>Wednesday, Jul 19, 2017</th>
<th>Thursday, Jul 20, 2017</th>
<th>Friday, Jul 21, 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 -12:00 Noon</td>
<td>Research Training</td>
<td></td>
<td>LUNCH</td>
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<tr>
<td>12:00-1:00 PM</td>
<td>Lunch Break</td>
<td>Lunch Break</td>
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<td>Lunch Break</td>
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<td>1:00-2:00 PM</td>
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<td>Professional Development</td>
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<tr>
<td>2:00-5:00 PM</td>
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<td>Core-Competency (NAC 6/105)</td>
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## Week 6 (Jul 24-28, 2017)

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<tbody>
<tr>
<td>9:00 -12:00 Noon</td>
<td>Research Training</td>
<td></td>
<td>LUNCH</td>
<td></td>
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<tr>
<td>12:00-1:00 PM</td>
<td>Lunch Break</td>
<td>Lunch Break</td>
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<td>Lunch Break</td>
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<tr>
<td>1:00-2:00 PM</td>
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<td></td>
<td>Professional Development</td>
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<td>2:00-5:00 PM</td>
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<td></td>
<td>Core-Competency (NAC 6/105)</td>
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## Notes
- **LUNCH**
  - Bring own lunch

- **Research Training**
  - (in your assigned research lab under the supervision of your CESSRST Advisor and Graduate mentors)
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</thead>
<tbody>
<tr>
<td>9:00 -12:00 Noon</td>
<td>Research Training (in your assigned research lab under the supervision of your CESSRST Advisor and Graduate mentors)</td>
<td></td>
<td></td>
<td></td>
<td>CESSRST Family (Picnic) Day</td>
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<tr>
<td>12:00-1:00 PM</td>
<td>Lunch Break</td>
<td>Lunch Break</td>
<td>LUNCH</td>
<td>Lunch Break</td>
<td>Lunch Break</td>
</tr>
<tr>
<td>1:00-2:00 PM</td>
<td>Research Training</td>
<td></td>
<td>Professional Development</td>
<td>Research Training</td>
<td></td>
</tr>
<tr>
<td>2:00-5:00 PM</td>
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<td></td>
<td>Core-Competency (NAC 6/105)</td>
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**WEEK 6 (Jul 31-August 4, 2017)**

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<tbody>
<tr>
<td>9:00 -12:00 Noon</td>
<td>Research Training (in your assigned research lab under the supervision of your CESSRST Advisor and Graduate mentors)</td>
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<tr>
<td>12:00-1:00 PM</td>
<td>Lunch Break</td>
<td>Lunch Break</td>
<td>LUNCH</td>
<td>Lunch Break</td>
<td>Lunch Break</td>
</tr>
<tr>
<td>1:00-2:00 PM</td>
<td>Research Training</td>
<td></td>
<td>Focus Group/meeting</td>
<td>Research Training</td>
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<td>2:00-5:00 PM</td>
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**WEEK 7 (Aug 7-August 11 2017)**

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</thead>
<tbody>
<tr>
<td>9:00 -12:00 Noon</td>
<td>Research Training and preparation of the Research Poster (in your assigned research lab under the supervision of your CESSRST Advisor and Graduate mentors)</td>
<td></td>
<td></td>
<td>End of Summer Research Symposium</td>
<td>Reflection, Evaluation/Exit Surveys</td>
</tr>
<tr>
<td>12:00-1:00 PM</td>
<td>Lunch Break</td>
<td>Lunch Break</td>
<td>LUNCH</td>
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<tr>
<td>1:00-2:00 PM</td>
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<td></td>
<td>Brown bag with HIRES interns</td>
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<tr>
<td>2:00-5:00PM</td>
<td>Research Training</td>
<td></td>
<td>Presentation Practice sessions (T-424)</td>
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</tbody>
</table>
### Appendix III: Research Topics – Summer Bridge 2017

#### Summer Bridge Research Project Chart

Name: ________________________________

E-mail: ________________________________ Phone: ______________________

*Please select 3 projects from the table below; rank them from 1 to 3 (1 being the highest and 3 being the lowest of your preference)*

<table>
<thead>
<tr>
<th>Preference</th>
<th>Research Project Title</th>
<th>Faculty Mentor</th>
<th>Graduate/Post Doc Mentor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Understanding urban flooding events in the U.S.</td>
<td>Indrani Pal</td>
<td>Indrani Pal</td>
</tr>
<tr>
<td>1</td>
<td>Is the weather getting weirder? A physical and statistical study of trends in weather variability</td>
<td>James F. Booth</td>
<td>Katherine L. Towey</td>
</tr>
<tr>
<td>2</td>
<td>Assessment of Lake Water Quality and Quantity using Satellite Remote Sensing</td>
<td>Tarendra Lakhankar</td>
<td>Adedoja Adeyeye</td>
</tr>
<tr>
<td></td>
<td>Global Food Security Analysis using Satellite Remote Sensing Data</td>
<td>Deepali Joshi</td>
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</tr>
<tr>
<td></td>
<td>Analysis of Vulnerable Infrastructures to Flood Events in the Continental United States</td>
<td>Arun Ravi</td>
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<tr>
<td></td>
<td>Global Flood Analysis</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Observing harmful algal blooms from satellite and there temporal changes using different techniques</td>
<td>Samir Ahmed</td>
<td>Ahmed El-Habashi</td>
</tr>
<tr>
<td>1</td>
<td>New York and New Orleans: Creation of Social-Vulnerability Index</td>
<td>Brian Vant-Hull</td>
<td>Jose Pillich</td>
</tr>
<tr>
<td>2</td>
<td>Mapping and Visualization of Satellite Data</td>
<td>Paul Alabi</td>
<td>Elius Etienne</td>
</tr>
<tr>
<td>3</td>
<td>311 Data Project</td>
<td>Michael Grossberg</td>
<td>Hannah Aizenman</td>
</tr>
<tr>
<td></td>
<td>Variability of Particulate Matter and Air Quality at Street Level in New York City</td>
<td>Prathap Ramamurthy</td>
<td>Josh Hrisko</td>
</tr>
<tr>
<td></td>
<td>The relationship between climate and food security</td>
<td>Reza Khanbilvardi</td>
<td>Ehsan Najafi</td>
</tr>
<tr>
<td></td>
<td>Understanding US Extreme Rainfall Events, Through Historical Data</td>
<td>Jorge E. Gonzalez-Cruz</td>
<td>David Melecio-Vazquez</td>
</tr>
<tr>
<td></td>
<td>Sensing the Atmospheric Boundary Layer</td>
<td>Alex Gilerson</td>
<td>Eder Herrera</td>
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<tr>
<td></td>
<td>Interpretation of satellite measurements over the ocean</td>
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<td></td>
<td>Observing NYC weather: Winds, Temperature, and Pollution</td>
<td>Fred Moshary and Mark Arend</td>
<td>Aris Fernandez</td>
</tr>
<tr>
<td></td>
<td>Assessing spatiotemporal variability in air pollution in urban coastal regions</td>
<td>Maria Tzortziou</td>
<td>Owen Parker</td>
</tr>
</tbody>
</table>

*being the lowest of your preference*
### NOAA CESSRST Center Wide Core Competency

#### Summer 2017 Schedule

All Workshops will be held in NAC 6/105 except for Computer Aided Workshop by Brian and Tarendra will be held in T-424)

**Notes:**
- Remote Sensing – Brian Vant Hull
- Professional Development – PD – Sobha Kavanakudiyil and Hazel Carter

### Schedule Table

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<tbody>
<tr>
<td>10:00AM</td>
<td></td>
<td></td>
<td></td>
<td>Remote Sensing – Brian Vant Hull</td>
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<tr>
<td>11:00 AM</td>
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<tr>
<td>12:00 Noon</td>
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<td></td>
<td>Professional Development – PD – Sobha Kavanakudiyil and Hazel Carter</td>
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<td>1:00PM</td>
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<td>2:00PM</td>
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<td>3:00PM</td>
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<td>Modeling, Algorithm Development, Visualization - Tarendra</td>
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<td>People Sciences: Planning Policy, Public Health and Population Science- Juliana Maantay</td>
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## Core Competency Curriculum Map

### Social Science (9 hours):
1. Foundations of Environmental Economics/Cost-Benefit and Risk Analysis; (3 hours) – by Kevin Foster
2. Sustainability and Sustainable Development; (3 hours) – by Yehuda Klein
3. Principles of Public Policy, Planning, Public Health, and Socio-Demographics. (3 hours) – by Juliana Maantay

### Professional Development (15 hours)
4. Social Skills – soft skills (Leadership, Time Management, Communications) by Sobha Kavanakudiyil and Hazel Carter

### Technical Core Competencies (~ 20 hours)
5. Remote Sensing-Brian (~9-10 hrs)
6. Modeling, Algorithm Development, Visualization-Tarendra (~9-10 hrs)
## APPENDIX V: DETAIL 5-YEAR MILESTONE, OUTCOME AND STUDENT NEED CHART

### Theme I: Coastal Resilience || Coordinator: Maria Tzortziou

<table>
<thead>
<tr>
<th>Task 1. CUNY-CREST Ocean Observatories in Critical Coastal Regions</th>
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</thead>
<tbody>
<tr>
<td><strong>Task Coordinator:</strong> Alexander Gilerson (CCNY)</td>
</tr>
<tr>
<td><strong>Investigators:</strong>  Roy Armstrong (UPRM), Rafael Rodriguez (UPRM), Jonathan Munoz (UPRM), Alexander Gilerson (CCNY), Maria Tzortziou (CCNY), Sam Ahmed (CCNY)</td>
</tr>
<tr>
<td><strong>NOAA Collaborators:</strong> Menghua Wang (NESDIS), Christopher Brown (NESDIS), Michael Ondrusek (NESDIS), Winston Luke (ARL), Xinrong Ren (ARL), Robert Warner (NOS), Mark Eakin (NOAA/NESDIS/Coral Reef Watch/STFAR)</td>
</tr>
<tr>
<td><strong>Outcome:</strong> Integration of satellite remote sensing data and field observations to characterize ocean and atmospheric properties and dynamics across ocean observatories, recommend enhanced atmospheric correction approaches for satellite ocean color algorithms developed for existing and future satellite ocean color sensors, and assess impacts of human activities and extreme events on coastal habitats (e.g., coral reefs) and coastal resources.</td>
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<thead>
<tr>
<th>Task 2. Quantifying coastal erosion in the Arctic, and assessing impacts on vulnerable coastal ecosystems and communities.</th>
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<tbody>
<tr>
<td><strong>Task Coordinator:</strong> Craig Tweedie (UTEP)</td>
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<tr>
<td><strong>NOAA Collaborators:</strong> Nicole Kinsman (Alaska Regional Advisor NOAA/NOS/National Geodetic Survey).</td>
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<tr>
<td><strong>Outcome:</strong> Development of new methods for delineating the position of the Arctic coastline and nearshore environment from high spatial resolution satellite imagery to improve the spatiotemporal resolution of coastal erosion assessments, especially near vulnerable arctic communities, and assessing impacts of coastal erosion and riverine input on nearshore water quality.</td>
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<tr>
<th>Task 3. Development of Coastal Water Quality Indicators</th>
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<tr>
<td><strong>Task Coordinators:</strong> Maria Tzortziou (CCNY)</td>
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<tr>
<td><strong>NOAA Collaborators:</strong> Christopher Brown (NESDIS), Menghua Wang (NESDIS), Rick Stumpf (NOS-NCCOS)</td>
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<tr>
<td><strong>Outcome:</strong> Development and evaluation of satellite algorithms for monitoring chlorophyll, dissolved organic carbon, particulate organic matter, and sediment dynamics in optically complex coastal waters, both for existing satellite sensors (e.g., VIIRS, MODIS, OLCI, Landsat) and future sensors (e.g., PACE).</td>
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<tr>
<th>Task 4. Development of in-situ and satellite-based environmental datasets for assessing resilience to disturbance in tropical coral reefs</th>
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<tbody>
<tr>
<td><strong>Task Coordinator:</strong> Kyle McDonald (CCNY, CUNY)</td>
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<tr>
<td><strong>NOAA Collaborators:</strong> Karsten Shein, Mark Eakin (NESDIS/Coral Reef Watch/STAR), Jim Hendee (AOML)</td>
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<td><strong>Outcome:</strong> Application of satellite and ground-based observations to increase the quantity, type, and coverage of in situ environmental data in coral reef ecosystems, and develop species distribution models to help improve the survival rates of coral nursery outplantings and objectively determine sites for coral nurseries.</td>
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<tr>
<th>Task 5. Improved monitoring of HABs and their impacts in coastal eutrophic systems</th>
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<tr>
<td><strong>Task Coordinators:</strong> Jennifer Cherrier (Brooklyn College, BC)</td>
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<td><strong>NOAA Collaborators:</strong> Steve Morton (NOS-CCEHBR), Rick Stumpf (NOS-NCCOS)</td>
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<td><strong>Outcome:</strong> Evaluation of the MH-GI system for mitigating pollutant loading as it relates to offsetting HAB growth and toxin production, and application of satellite data to assess the effectiveness of the MH-GI system for mitigation efforts.</td>
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<tr>
<th>Project / Task</th>
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<td>Theme I: Coastal Resilience</td>
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<tr>
<td>Task 1. CUNY-CREST Ocean Observatories in Critical Coastal Regions</td>
<td>1 PhD, 2 MS, 5 UG</td>
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<td>Task 2. Quantifying coastal erosion in the Arctic, and assessing impacts on vulnerable coastal ecosystems and communities.</td>
<td>1 PhD, 1 MS, 4 UG</td>
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<tr>
<td>Task 3. Development of Coastal Water Quality Indicators</td>
<td>3 PhD, 1 MS, 7 UG</td>
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<tr>
<td>Task 4. Development of in-situ and satellite-based environmental datasets for assessing resilience to disturbance in tropical coral reefs</td>
<td>2 PhD, 2 UG</td>
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<td>Task 5. Improved monitoring of HABs and their impacts in coastal eutrophic systems</td>
<td>2 PhD, 1 MS, 5 UG</td>
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## Theme II: Atmospheric Hazards || Coordinator: John Anderson

### Task 1. Severe Storm Prediction
**Task Coordinator:** James Booth (CCNY)
**NOAA Collaborators:** Yi Ming (GFDL), Tom Smith (NESDIS/STAR), Daniel Melendez (NWS), Arun Kumar (CPC)
**Outcome:** Improved understanding of atmospheric processes to improve NWS and GFDL research associated with hazardous weather events. This work will include analysis of ground-based and satellite observations and numerical models. It will focus on phenomena across a range of spatial scales, from the synoptic-scales (i.e., atmospheric blocking and extratropical cyclones) to the mesoscale (i.e., coastal convection and precipitation). This work is designed to characterize the processes for the sake of improving numerical models and improving our physical understanding, and hence our ability to forecast the weather hazards.

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### Task 2. Heat Stress and Urban Modeling
**Task Coordinator:** Jorge E. González (CCNY)
**NOAA Collaborators:** Bob Yu (NESDIS/STAR), Stanley G. Benjamin, Andrey Grachev (ESRL)
**Outcomes:**
- Heat-index nowcast products for urban environments will be developed: The index will consist of two major inputs; surface air temperatures and surface humidity. The surface air temperature product will be developed using a combination of statistical correlations between network ground observations and GOES-East skin temperature product. The surface humidity product will consist of adapting early stage products from MODIS to GOES-East. The heterogeneity of the two input and final product will be corrected using local ground observations. Furthermore, we will use the GOES-East skin temperature product to quantify thermal storage of urban environments such as NY City. The thermal storage will be characterized by their thermal response numbers product and validated with observed surface energy balance for NY City using flux tower measurements and soil moisture observations for above and underground sensible and latent heat flux.
- Improved urbanized numerical weather forecasting product with representation for urban land-surface processes: The key improvements in uWRF will consist on: a) sub-kilometer parameterization, configuration and validation for NYC as first test case, and b) in correcting for thermal storage using the above products (in 2). Sub-kilometer parameterization will consist in model validation with surface and PBL observations for selected cases and seasonal comparisons, and in potential improvements in the PBL parameterization compatible with current urban parameterizations. The thermal storage parameterization will be incorporated by data ingestion of TRN and in model development to account for energy exchanges in BEP/BEM from surface to the underground urban infrastructure. The ultimate goal is to have sub-kilometer operational products for NY as first case and transferable to other complex cities.

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### Task 3: Satellite Validation and Analysis
**Task Coordinator:** Barry Gross (CCNY)
**NOAA Collaborators:** Larry Flynn, Shobha Kondragunta (NESDIS/STAR), Mike Dutter (NWS-AKQ)
**Outcome:** Satellite Research Products: Low latency NOAA NESDIS STAR and CESSRST research products developed and generated directly from CUNY-CREST satellite receiving stations at CUNY, HU, and UPRM, for distribution to various research tools and stakeholders. Work will also include validation and improvement of atmospheric aerosol and trace gas products from GOES-East, SNPP/JPSS, and other satellite instruments, and application to Air Quality.

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### Task 4: The CUNY-CREST Earth System Observing Network (CESON) and Applications
**Task Coordinator:** Ruben Delgado (UMBC)
**NOAA Collaborators:** Pius Lee (ARL), Jeff McQueen (NWS), Alan Brewer (ESRL), Dennis Atkinson (NWS-OST), Mike Hicks (NWS-OOS)
**CI Collaborations:** Mike Hardesty (CIRES), Christoph Senff (CIRES), Aditya Choukulkar (CIRES)

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**CSC Collaborations:** Ricardo Sakai (NCAS)

**Outcome:** Compilation of PBL heights, dynamics and smoke/dust transport to the East Coast for weather and air quality model validation, and impacts on surface air pollution and health. These will include PBL and cloud-base height algorithm development for use from profiles collected from the NOAA owned and operated ASOS ceilometers and CESON lidars. Work will also include participation in NOAA and related field campaigns using CESON ground-based in-situ and remote sensing instrumentation.

**Theme III: Water Prediction and Ecosystem Services || Coordinators: Naresh Devineni/Tarendra Lakhankar**

**Task 1. Drought Risk Assessment and Ecosystem Outcomes**
**Task Coordinator:** Nir Krakauer (CCNY)
**NOAA Collaborators:** Xiwu Zhan (NESDIS/STAR), Cameron Speir (Southwest Fisheries Center), Roger Pulwarty (PSD/ESRL)
**Outcomes:** Estimating trends in natural hazards and hydrologic droughts, along with a complete database of demand-based drought index data and real-time probabilistic forecast methods for drought quantiles.

**Task 2. Flood Risk Assessment and Data Products**
**Task Coordinator:** Naresh Devineni (CCNY)
**NOAA Collaborators:** Bob Rabin (NSSL), Xiwu Zhan (NESDIS/STAR), Jack Harlan (IOOS), Dennis Atkinson, Ernesto Rodriguez (NWS)
**Outcomes:** A high-resolution blended precipitation product using our latest New York City urban Hydro-Meteorological Testbed (NY-uHMT) and remote sensing data for flood prediction and urban coastal vulnerability assessment.

**Task 3. Assessment and Application of National Water Model using Remote Sensing Data Products**
**Task Coordinator:** Tarendra Lakhankar (CCNY)
**NOAA Collaborators:** Kelly Mahoney and Rob Cifelli (PSD/ESRL) Ralph Ferraro (NESDIS/STAR) Ernesto Rodriguez (NWS)
**Outcomes:** Development of a new snow and ice climatology product, assessment of remote sensing based forcings, and their integration into the National Water Model. Exploration of the utility of the National Water Model for flash flood predictions.

**Task 4. Monitoring land-atmosphere-ocean fluxes**
**Task Coordinator:** Walter Oechel (SDSU)
**NOAA Collaborators:** Lauren Jarlenski and Mareike Sudek (NOS) Alex Tardy (NWS), Russ Schnell, Bryan Thomas and Jim Butler (ESRL/GMD)
**Outcomes:** Monitoring environmental and flux data from SDSU's eddy covariance flux towers and mapping regional ET of the recent decades (2000 - 2018) for implementation of SEBAL and METRIC models in the Western United States.

**Task 5. Use of UAS platforms for environmental intelligence and satellite product validation**
**Task Coordinator:** Rafael Rodriguez (UPRM)
**NOAA Collaborators:** Gary Wick (ESRL)
**Outcomes:** Application and development of multiband sensor technologies for monitoring environmental conditions in Land, Atmosphere and Coastal regions using UAVs.
## APPENDIX VI: RESOURCES AND FACILITIES

Resources and facilities from Prior, New EPP CSC awards and/or other leveraged Resources in CESSRST Implementation Plan

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<thead>
<tr>
<th>Theme/ Tasks</th>
<th>Major Facility or Instrumentation</th>
<th>Location</th>
<th>Pre-2016 award</th>
<th>2016 award</th>
<th>Funding Source</th>
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<td>Direct Broadcast Satellite Receiving Stations</td>
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<td>CUNY, NASA(HU), NOAA/IPSS, NOAA-EPP (Pre16 = $97K)</td>
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<td>* Maintenance and Annual license renewal</td>
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<td>Theme 1 Task 1,3</td>
<td>Portable Atmospheric Sensors: Aerosols and Ozone</td>
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<td>CUNY-CREST Lidar Network (Multi-wavelength Lidars)</td>
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<td>AERONET CIMEL Radiometers</td>
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<td>CUNY, DoD</td>
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<td>CUNY</td>
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<tr>
<td>Theme 2 Task 2,4</td>
<td>Wind Lidar Systems</td>
<td>CUNY, UMBC</td>
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<td>Theme 2 Task 4</td>
<td>Micro-pulse Lidars</td>
<td>CUNY, UMBC</td>
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<td>Theme 2 Task 3,4</td>
<td>Sounding Systems for MET and Ozone</td>
<td>CUNY, UMBC, HU</td>
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<td>DoD</td>
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<td>Theme 2 Task 3,4</td>
<td>PANDORA Spectrometers</td>
<td>UMBC, HU</td>
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<td>NASA, DoD</td>
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<td>Theme 2 Task</td>
<td>Equipment</td>
<td>Responsible Institution(s)</td>
<td>Sponsor(s)</td>
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<td>4</td>
<td>Scanning Lidars</td>
<td>HU</td>
<td>DoD</td>
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<tr>
<td>2,3,4</td>
<td>Microwave Profiling Radiometer</td>
<td>CUNY, UMBC</td>
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<td>3,4</td>
<td>OPO Enhancement for Lidar</td>
<td>HU</td>
<td>DoD</td>
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<td>4</td>
<td>Air Quality Analyzers: Aerosols, Trace Gases</td>
<td>CUNY, UMBC</td>
<td>NYSERDA</td>
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<tr>
<td>2</td>
<td>Flux Towers- Heat and CO2</td>
<td>CUNY</td>
<td>DoD</td>
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<tr>
<td>2</td>
<td>Thermal IR Cameras</td>
<td>CUNY</td>
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<tr>
<td>2</td>
<td>New York Urban Hydro-meteorological Testbed (NY-uHMT)</td>
<td>CUNY (NY City)</td>
<td>CUNY</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>CUNY-CREST-Snow Analysis and Field Experiment</td>
<td>CUNY (Caribou ME)</td>
<td>DoD, CUNY, NESDIS/STAR</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>CUNY-CREST-Soil Moisture Advanced Radiometric Testbed</td>
<td>CUNY (Millbrook NY)</td>
<td>NESDIS/STAR, USDA, NASA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Field Stations: Eddy Covariance Towers-12 total (SDSU network from Arctic to Desert Climates)</td>
<td>SDSU</td>
<td>NASA, SDSU</td>
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<tr>
<td>4</td>
<td>Ecological Analytical Lab</td>
<td>SDSU</td>
<td>SDSU</td>
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<tr>
<td>5</td>
<td>Drones and hyperspectral camera</td>
<td>CUNY, UPRM</td>
<td>CUNY, UPRM</td>
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</table>

* Existing Facilities/resources upgraded in new EPP Cycle after 2016.
**SOME OF THE CESSRST OUTREACH EVENTS**

**Scientific Seminar Series:** These include career and academic seminar series spanning the broad spectrum of Earth System fields including Remote Sensing, Climate Impacts, Sustainable Living, Energy and Environment, Water Resources, and Socio-Economics of the Environment. Expert speakers will represent industry, academia, research institutions, and federal and non-profit organizations.

**NOAA CESSRST Annual Technical Symposium:** CESSRST will host annual Technical Symposium on Earth System Science and Remote Sensing Technologies each year. Symposium hosting responsibilities will rotate among partner institutions on an annual basis. The symposium will bring together students from all cohorts to network within CESSRST and other centers and NOAA collaborators. Students will also showcase their research findings through poster or oral presentations.

**Career Pathways Workshop:** A key activity of the professional training program is the Center-wide Career Pathways Workshop, which aims to provide useful insights for all CESSRST graduate students (MS and Ph.D.) on professional career options in Earth System Sciences and Engineering. Professionals from industry, government and academia share their professional experiences. Students will participate in a 2-day retreat workshop held outside the campus, which serves to initiate a casual dialogue among invited professionals and the students and inspires students to envision their future professional lives. The sessions highlight different professional options for scientists and engineers that include: 1) A look beyond graduate studies, 2) Post-graduate research (government and academia), 3) Academic careers, 4) Government careers and 5) Industry and corporate careers.

**CESSRST/NESDIS Brownbag Series:** These bimonthly Brownbag seminars are held with NOAA-NESDIS, CESSRST scientists and students. Participants exchange knowledge via a remote seminar in order to increase collaborative research and partnerships.

**NOAA/NESDIS/STAR/CoRP Annual Symposium:** CESSRST students will continue to participate in the NOAA/NESDIS/STAR/CoRP Annual Symposium held in rotational basis between CESSRST and its partner institutions and other Centers (CIRA, CIMSS, and CICS). This is a great networking opportunity for students to showcase their research outcomes to the larger NOAA community (and serves as a good platform for expanding collaborative research between NOAA Cooperative Institutes (CIs) and CESSRST.

**NOAA EPP/MSI Biennial Education and Science Forum:** CESSRST students and scientists will actively participate in the NOAA EPP/MSI Biennial Education and Science Forum (www.eppforum2016.com) hosted by one of the NOAA EPP/MSI Cooperative Science Centers every two years. The purpose of the forum is to engage government, academia, private and industrial sectors, in commemorating the research and educational outcomes of the CSC communities. Students and researchers showcase their research in various technical sessions relevant to the NOAA’s strategic science and education goals and serves as a great avenue for networking and student professional development event/sessions.
RECRUITMENT RESOURCES FROM THE CESSRST AFFILIATED UNIVERSITIES

City College of City University of New York, NY
Career and Professional Development Institute
Rhea Christian, Associate Director, Recruiting Programs
North Academic Center, Room 1/116
160 Convent Avenue, New York, NY 10031
Phone - 6789 Fax - 6501; rchristian@ccny.cuny.edu

Hampton University, VA
URL: http://calendar.hamptonu.edu/
Hampton University Career Counseling and Planning Center
2 Frisell Street, Hampton, VA 23668
Phone: 757.727.5331 || Fax: 757.727.5935 || Email: careercenter@hamptonu.edu

San Diego State University, San Diego, CA
AZTEC Career Fair
Phone: (619) 594-6851 || Email: careerservices@mail.sdsu.edu
Campus Location: Student Services East (SSE) 1200
Center for the Advancement of Students in Academia (CASA), SDSU
Dr. Estralita Martin
CASA Director and Assistant Dean of Student Affairs
College of Sciences, GMCS 321B
esmartin@mail.sdsu.edu

University of Maryland, Baltimore County, MD
UMBC Career Services
Calendar: http://careers2.umbc.edu-calendar/
Director: Christine Routzahn (routzahn@umbc.edu), Phone: 410-455-3671
Math/Psychology Bldg. Room 201
100 Hilltop Circle, Baltimore, MD 21250
Phone: 410.455.2216 || Fax: 410.455.1075 || Email: careers@umbc.edu

University of Puerto Rico, Mayaguez, PR
Career Fair - 24 Feb 2016
Contact Info: Nancy Nieves Arán
Phones:(787) 832-4040: ext. 2070
Web: http://placement.uprm.edu/

University of Texas, El Paso, TX
Betsabe (Betsy) Castro-Duarte, MPA
Director
bcastro@utep.edu
University Career Center
MAJOR RECRUITMENT EVENTS/FAIRS

University and College Career Fairs (all CESSRST Campuses)

**Spring Calendar**
1) AMS Annual Meeting – Pre-AMS Career Fairs (January)
2) BEYA Conference (February)
3) NSBE Annual Convention (March)

**Fall Calendar**
1) Woman of Color Annual STEM Conference (October)
2) HACU Conference (October)
3) SACNAS Conference (October)
4) LAESA-SHPE Annual STEM Conference (November)
5) AGU Annual Meeting (December)