NOAA Cooperative Science Center for Earth Systems Science and Remote Sensing Technologies (CESSRST)

Cooperative Agreement # NA16SEC4810008
Six-Month Performance Progress Report
(March 1, 2017 to August 31, 2017)

SUBMITTED BY
The City College of New York, NY
(Lead 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, TX

SUBMITTED TO:
NOAA Educational Partnership Program
with Minority Serving Institution (EPP/MSI)

September 30, 2017
Table of Contents

Executive Summary ...................................................................................................................... 2

I. Accomplishments ......................................................................................................................... 3

II. Products of Award ......................................................................................................................... 34

III. Participants in Award Performance ............................................................................................ 34

IV. Impacts of Award ........................................................................................................................ 40

V. Changes / Challenges ................................................................................................................... 42

VI. Special Award Conditions .......................................................................................................... 43

VII. Financial Information .................................................................................................................... 49
Executive Summary

The new center – NOAA Cooperative Science Center for Earth System Sciences and Remote Sensing Technologies (CESSRST), funded by NOAA in response to the solicitation - FFO NOAA-SEC-OED-2016-2004758 was created on September 1, 2016. The current report provides updates for the reporting period – March 1, 2017 to August 31, 2017, submitted by the City College of New York, NY (lead Institution) and the partner institutions – Hampton University, VA; San Diego State University, CA; University of Maryland, Baltimore County, MD; University of Puerto Rico, Mayaguez, PR; and University of Texas, El Paso, TX. The new NOAA CESSRST center continues to provide education and training opportunities to a large cadre of post-secondary students, particularly from underrepresented minority group, in NOAA mission sciences, with a focus on Earth System Sciences and Remote Sensing Technologies. The new center’s activities that fall under three major program elements: (1) Education and Training; (2) Collaborative Research and (3) CESSRST Management which is being monitored and internally assessed by CESSRST management team and the CESSRST Dr. Director Reza Khanbilvardi and evaluated by an external evaluator. During the timeframe March 1, 2017 to August 31, 2017, NOAA-CESSRST designed, developed, piloted and evaluated several seminal components of its 2016-2021 Implementation Plan that addresses the overarching program goals of education and training of a diverse workforce in support of NOAA-mission related research and products. The six-month performance progress report provides an update on all the activities - Recruitment, Student Cohort Building, iSDP development, Core Competency & Professional Development, Summer Bridge/Undergraduate training, Collaborative Research, Early NOAA Engagement, Graduate research and NERTO synopsis, Communications and Social Science Integration as solicited in the FFO and the Special Award Condition. The report also address the monitoring/assessment and findings and steps to be taken to accomplish what we proposed for year II of the Implementation Plan. We conclude with what we have determined to be societal impacts, at this time and what program outputs have been addressed.

During this reporting period, a new center logo was created and the new website www.noaacrest.org has been continually updated and modified as needed. The content-based management system (CMS) website continues to serve as a critical information dissemination and communication outlet for sharing Center accomplishments with NOAA and external stakeholders. A robust and customized management information system (MIS) is being constructed using FileMaker software and will be launched by fall 2017. The MIS will serve as a universal web-based data collection and entry system for use by CESSRST students, staff, researchers, scientists and NOAA collaborators. A rest-ful API (Application Programing Interface) is also being created to integrate data from this system to the main center website.
I. Accomplishments

There is the option to indicate “not yet started” and include the expected start date in this section. NOTE: Images, tables, charts, or other graphics may be submitted in support of the Accomplishments section.

This section - accomplishments and its sub-sections - activities, objectives, results and key outcomes, will be reported under three major elements – Education, Collaborative Research and Management.

During this reporting period, revised five-year (2016-2021) CESSRST Implementation Plan was submitted in June 2017, to NOAA program office. As indicated in the Implementation Plan, CESSRST Consortium will meet the critical program goals - (1) conduct NOAA mission-aligned collaborative research; (2) recruit, train and graduate increased number of students – particularly from underrepresented and underserved minority community in NOAA related STEM fields; and (3) increase/attain institutional capacity by generating leveraged resources to sustain CESSRST education and research. CESSRST is committed to achieve the program outcomes and outputs as indicated in the plan in the next five years (2016-2021) keeping in line with NOAA’s strategic (Science & Research Memorandum, Social Science, Education and Diversity and Inclusion) Plans.

In order to achieve the program priorities, goals and the outcomes as outlined in the FFO and the Special Award Conditions, a five-year revised CESSRST Evaluation Plan was also submitted to NOAA Program Office in May 2017. The Evaluation Plan is under further revision to incorporate the overarching evaluation questions suggested by the program office that will be incorporated and submitted to NOAA via Grants Online in early October 2017.

What are the major goals of the project?

The overarching goals of CESSRST is to 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.

EDUCATION - Major Activities:

a. Recruitment:
During the current reporting period, NOAA CESSRST accomplished the successful recruitment and building of COHORT I pool of post-secondary students who are the primary beneficiaries of the program and its priorities. The candidates were selected based on the center-wide recruitment strategy (figure 1). During the months of March to August 2017, CREST participated in five (5) recruitment
events in and outside of New York City – National Society of Black Engineers (NSBE) (March 2017); Columbia University’s All IVY and Earth Institute (March 2017); Diversity Jobs-NYC Bilingual and Diversity Job Fair (April 2017); City College of New York Career and STEM Fair (Spring 2017). At these recruitment events, approximately 229 students learned about the opportunities offered by the NOAA-CESSRST (CREST) program, 90 of which are US citizens with an average GPA of 3.0 or higher. Approximately 38% (90) of these students were female; 60% (139) were male.

Targeted outreach/recruitment activities have proven to increase the number of applications submitted for program consideration. In turn, it has also empowered the outreach/recruitment team to develop dynamic ways to introduce the program to its’ diverse audiences. A program brochure was introduced recently that serves to re-enforce the marketing strategies used to expand our recruitment efforts.

The Outreach/Recruitment team has begun to identify additional local and national recruitment opportunities to expand its’ recruitment goals for the remainder of 2017 and next year.

---

**Cohort I student recruitment successfully closed with 33 students: 24 (79%) from URM communities and 9 (21%) non URM communities; 14 of which are Undergraduates (8 males, 6 females); 10 in Master’s program (7 males, 3 females); and 9 in Doctorate program (4 males, 5 females).**

---

**b. Professional Advancement and Career Engagement – PACE:**

NOAA-CESSRST implemented its center-wide education and training framework called PACE – Professional Advancement and Career Engagement to advance a holistic, robust and measurable education and training program. PACE aligns with the FFO with an intention to create long-term impacts through development of a 21st century NOAA mission-related STEM workforce (figure 1).

NOAA-CESSRST Education Committee and Core Competency subcommittee formulated:

1) **The Core Competency Curriculum**, which incorporates technical and social science skills and content knowledge for NOAA mission-related products and services. The Core Competency Curriculum is delivered through the Summer Bridge Program and is scheduled in the beginning three weeks.
2) **The Professional Development Seminar**, developed as part of the Core Competency Curriculum, focused on personal and professional leadership, time management, and effective communication;

3) **Professional Networking and Career Planning** involved webinars and presentations by NOAA-CESSRST faculty and researchers including topics covering NOAA’s mission and vision as well as opportunities like the Hollings Fellowship and the Lautenbacher Scholarship. Additionally, NOAA-CESSRST hosted the 2017 NOAA Satellite Conference on the City College Campus in New York City in July 2017.

4) **The Individualized Student Development Plan** (iSDP) as the title suggests, is a proposed plan that prompts Fellows and their faculty advisors to articulate important areas of a Fellow’s education and professional aspirations and goals;

5) **NERTO and requirements of early engagement with NOAA** was more clearly defined and progress was made in operationalizing that engagement for more immediate benefits to Cohort I, and Cohort II (which is being recruited at the time of this Performance Report Submission) and beyond for application to the experiences of Fellows in Cohorts III, IV and V; and,

6) **The Summer Bridge Program**, comprising Cohort I Fellows as well as undergraduate/graduate STEM students who could be recruited into the NOAA-CESSRST Fellows Program in intensive education and training of Core Competency and Professional Development, is as an important mechanism for education and training as well as for increasing student recruitment into the NOAA-CESSRST Program. Likewise, Summer Bridge also provided robust 6-week research experiences for participating students, not yet part of NOAA-CESSRST Fellowship Program, but who were [are] potential recruits to the Program.

All six seminal components of PACE drove the work and engagement of the period March 1-August 31, 2017.

c. **Early NOAA Engagement – NOAA Experiential Research and Training Opportunities (NERTO)**

During this reporting period - all cohort I graduate students (MS and PhD) have identified their NOAA Mentor and potential location of their NERTO internship, in coordination with their CESSRST Faculty Advisors. A detailed Graduate (NERTO) synopsis is available on the CESSRST website – [http://noaacrest.org/education/graduatesynosis](http://noaacrest.org/education/graduatesynosis). In addition, the students profile pages are located on the website - [http://noaacrest.org/about/our-people/category/cohort-i](http://noaacrest.org/about/our-people/category/cohort-i). The Students Letter of Understanding (LoU), NOAA Mentoring Agreement was created, and being shared with the NOAA mentor to ensure there is a proper communication and comprehension of the NERTO requirement per the special award condition. A new Standard Operations Procedure (SOP) and CESSRST Handbook (for students and faculty) is being created and will be made available to all the CESSRST members.
EDUCATION - Objective of Activities

Over the six-month timeframe, PACE was used to focus NOAA-CESSRST’s education and training specifically on FFO stipulated Outcomes 1, 2 and 3 and their respective Outputs.

During this reporting period –the focus/objective was to address Education Outcome 1, 2 and 3 (Per FFO) to increased number of CSC supported post-secondary students, trained annually.

The focus was on the following select outputs:

- Increase competence in using satellite data and GIS, statistical analysis, computer modeling and algorithm development
- Increase number of students (total an URM) participated in Professional Development
- Seminars, webinars and summer bridge workshops to develop skills and functional competencies to support NOAA mission STEM workforce.

EDUCATION - Key Outcomes/Achievement of Activity

- During this reporting period – the key outcomes were creation of Core Competency modules and implementing across the center for cohort I fellows; 2.) Professional Development Seminars, and 3.) Professional Networking and Career Planning; 4.) Individualized Student Development Plan (iSDP); and 5.) NERTO.
- As of August 31, 2017, 33 Undergraduate, Masters and Doctoral NOAA-CESSRST Fellows comprised Cohort 1 were recruited and began learning about PACE framework. Table 1 details the numbers of students and their institutions, some of who across the center, participated in the first session of core competency training held in summer 2017. Second, in terms of outcomes, The Core Competency, Professional Development Seminar indicates a solid design, development and delivery of critical NOAA-CESSRST Education priorities for NOAA Education and Training (per FFO Outcomes/outputs 1-3, listed above).

<table>
<thead>
<tr>
<th>Number of Fellows (33)</th>
<th>The City University of New York</th>
<th>Hampton University</th>
<th>University of Maryland Baltimore County</th>
<th>University of Puerto Rico, Mayaguez</th>
<th>San Diego State University</th>
<th>University of Texas, El Paso</th>
<th>Total Across all campuses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate</td>
<td>7</td>
<td>2</td>
<td>4</td>
<td>------</td>
<td>-----</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Masters</td>
<td>7</td>
<td>1</td>
<td>------</td>
<td>------</td>
<td>2</td>
<td>-----</td>
<td>10</td>
</tr>
<tr>
<td>Ph.D</td>
<td>4</td>
<td>------</td>
<td>2</td>
<td>2</td>
<td>1*</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>33</td>
</tr>
</tbody>
</table>

* Includes one (1) Ph.D student at UTEP who received the Lautenbacher Public Service Fellowship – for FY 2017-2018

- The Core Competency/Professional Development sessions comprised of 45 contact hours and intended to provide a Center-wide level of proficiency for all NOAA-CESSRST Fellows. These were delivered remotely and face-to-face through the first three weeks of The Bridge Program (see section: Summer Bridge). The Core Competency and Professional Development are a set of robust experiential mini-courses that were co-designed, co-developed and co-taught by an interdisciplinary team of NOAA-CESSRST from City College’s School of Education - Leadership Division; the Colin Powell
School for Civic and Global Leadership; Lehman College’s Department of Environmental, Geographic and Geological Sciences; and Brooklyn College’s Department of Economics. Their work resulted in approximately 45 contact hours of Core Competency and Professional Development. Please see below Core Competency Map and topical details (Tables 2 and 3)

**TABLE 2: The Core Competency Map**

### SOCIAL SCIENCE COMPETENCY (9 HOURS)

2. *Sustainability and Sustainable Development* (3 hours): Yehuda Klein, Chair, Economics Department, Brooklyn College, CCNY
3. *Principals of Public Policy, Planning, Public Health and Socio-Demographics* (3 hours): Juliana Maantay, Professor and Director, GIS Lab, Lehman College

### PROFESSIONAL DEVELOPMENT (15 HOURS)

4. *Leadership, Time Management and Communications* (15 hours): Hazel Carter, Department Chair and Associate Professor (co-Chair NOAA-CESSRST Education Committee; Sobha Kavanakudiyil, Lecturer, City College

### TECHNICAL CORE COMPETENCIES (20 HOURS)


---

### TABLE 3: Core Competency Topic and Skills Detail

<table>
<thead>
<tr>
<th>Core Competency Topic</th>
<th>Technical or Social Science Skills Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectroscopy and radiometry</td>
<td>The fundamentals of quantitative measurement of electromagnetic radiation</td>
</tr>
<tr>
<td>Radiative transfer theory</td>
<td>The fundamentals of geolocation and radiative transfer</td>
</tr>
<tr>
<td>Application of environmental satellites to earth systems science</td>
<td>The fundamentals of satellite data inversion</td>
</tr>
<tr>
<td>Management and processing of images</td>
<td>The fundamentals of hyperspectral and microwave remote sensing</td>
</tr>
<tr>
<td>Thermal Radiative Transfer (BB Radiation)</td>
<td>Application of environmental satellites to earth systems sciences</td>
</tr>
<tr>
<td>Foundations in Environmental Economics</td>
<td>The meaning of supply/demand curves; externalities and unintended consequences</td>
</tr>
<tr>
<td>Cost-Benefit/Risk Analysis</td>
<td>Policies such as: Command and control; Cap &amp; Trade; Taxation; deadweight loss</td>
</tr>
<tr>
<td>Sustainability and Sustainable Development</td>
<td>Green supply chain and supply chain management</td>
</tr>
<tr>
<td>Principles of Public Policy</td>
<td>Life cycle cost analysis</td>
</tr>
<tr>
<td>Principles of Planning</td>
<td>Hazard vs. Risk; Perceived Risk; Vulnerability &amp; Resiliency</td>
</tr>
<tr>
<td>Principles of Public Health</td>
<td>Qualitative data analysis; Likert scales, indices and thresholds</td>
</tr>
<tr>
<td>Principles of Socio-Demographics</td>
<td>Population dynamics, spatial distribution, differential impacts</td>
</tr>
</tbody>
</table>
2017 NOAA Satellite Conference: The highlight of the Professional Networking and Career Planning was the 2017 NOAA Satellite Conference that was held on the City College Campus on July 17-20, 2017. Besides attending the Conference, NOAA-CESSRST Fellows from Cohort I along with the other Summer Bridge Program students were able to engage either in person or virtually. In addition, exhibits of students and faculty research at the conference and Dr. Shakila Merchant presented on JPSS-SPARKS, which was accomplished through a partnership with IMSG, a NOAA contractor. Over the four days, nearly 400 NOAA professionals, staff and affiliated staff, colleagues, students and guest speakers from over 40 countries including United States attended the four days conference. Besides, several early career and mid-career professional and satellite data users attended the 2-day pre-conference workshop on GOES-R, JPSS and COMET held on July 15-16, 2017. Students particularly CESSRST had an opportunity to showcase their research through poster presentation at the Annual CoRP Colloquium which was held concurrently during the Satellite Conference.

- Over the six months, the ISDP and NERTO were clarified through the lens of NOAA-early engagement, as well as through frequent, direct email and phone student contact by Mr. Cesar Ortiz. Additionally, Dr. Merchant spoke with faculty advisors and with students to address questions; and, the Annual NOAA-CESSRST/NOAA meeting held in Maryland in August resulted in in-depth discussions and further clarification particularly regarding NOAA-mentors. Finally, the NOAA-CESSRST Letter of Understanding (LoU) was refined to more clearly address the requirements of NERTO, faculty advising and NOAA-mentors, among several other areas. The LoU was reviewed and approved by NOAA EPP-MSI colleagues prior to distribution.

- With regard to iSDP, all 33 NOAA-CESSRST Cohort I Fellows met with their faculty advisors to layout a “road map” for their fellowship period. This roadmap comprises 27 questions, that when addressed, supports the Fellow and NOAA-CESSRST advisor to “visualize” NOAA-CESSRST Fellowship journey.

- Finally - All members of Cohort I have completed their RCR training and submitted their certification to the NOAA-CESSRST RCR repository.
Ten (10) students across CESSRST (2 PhD, and 8 UGs) participated in the 8 weeks first summer bridge program held from June 19 to August 11, 2017. The highlights of the summer bridge was the one week orientation that included overview presentation about NOAA and its missions, opportunities at NOAA and CESSRST with special emphasis on the Hollings and Undergraduate Scholarship Program. This was followed by 2-weeks workshop on basics of Remote Sensing, GIS and MATLAB – that helped them integrate the classroom knowledge into their 5-weeks of summer research, that ended with a end of summer research symposium held on August 10, 2017. In addition, Summer Bridge students at UTEP (Rocky Garcia, Justin Johnson and Mathew Wood) participated in the UTEP summer research symposium, while Andrea Fenner at SDSU has done three weeks of fieldwork (supervised by Aram Kalhori), in Barrow to determine Arctic CO2 and CH4 fluxes and environmental drivers. She has visited NOAA ESRL facility in Barrow and met with Bryan Thomas, the potential NOAA mentor for her NERTO.

Below table (4) depicts the student summer research project titles:

<table>
<thead>
<tr>
<th>Theme I: Coastal Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assessing spatiotemporal variability in air pollution in urban coastal regions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Theme II: Atmospheric Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Is the weather getting weirder? A physical and statistical study of trends in weather variability</td>
</tr>
<tr>
<td>3. Interpretation of satellite measurements over the ocean</td>
</tr>
<tr>
<td>4. Observing NYC weather: Winds, Temperature, and Pollution</td>
</tr>
<tr>
<td>5. Mapping and Visualization of Satellite Data</td>
</tr>
<tr>
<td>6. Variability of Particulate Matter and Air Quality at Street Level in New York City</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Theme III: Water Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Analysis of Vulnerable Infrastructures to Flood Events in the Continental United States</td>
</tr>
<tr>
<td>8. Understanding urban flooding events in the U.S.</td>
</tr>
<tr>
<td>9. Global Flood Analysis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Theme IV: Ecosystems Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. 311 Data Project</td>
</tr>
<tr>
<td>11. The relationship between climate and food security</td>
</tr>
<tr>
<td>12. Assessment of Lake Water Quality and Quantity using Satellite Remote Sensing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Summary of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 project in Coastal Resilience; 5 in Atmospheric Hazards; 3 in Water Prediction; and, 5 in Ecosystems Services.</td>
</tr>
</tbody>
</table>
Collaborative Research: Major Activities

Research is an integral part of training the next generation of scientists, engineers, natural resource managers, 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.

Based on the suggestions and advise provided by CESSRST Technical Advisor – Vanessa Griffin and Technical Monitor – Harry Cikanek, CESSRST now has three research themes (1) Coastal Resources (2) Weather and Atmospheric Hazards, and (3) Water Prediction and Ecosystem Services. Across all themes, CESSRST collaborative research is in direct alignment with NOAA’s leading role in environmental stewardship and addressing economic and societal progress and problems through integration of remote sensing technologies with multidisciplinary research.

Theme I: Coastal Resilience:

NOAA Relevance and Societal Impacts: Improving coastal resilience depends critically on coastal intelligence and developing a deeper understanding of coastal processes and potential impacts of extreme weather and climate-related 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, advanced modeling, development of new remotesensing tools, and assessment of environmental and socioeconomic efficacy of developed approaches for mitigating the impacts of coastal stressors on nearshore habitats and coastal communities. 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. The research directly aligns with NOAA’s long-term mission of Resilient Coastal Communities and Economies; Weather Ready Nation; Climate Adaptation and Mitigation; Healthy Oceans. The research also aligns with the NOAA’s social science mission of NOAA’s impact on society is defined and measured; NOAA’s products and services strengthen societal decision-making. The NOAA line office and collaborators/mentors engaged in the Theme I research and training activities include Christopher Brown (NOAA/NESDIS); James Hendee (OAR), Karsten Shein (NESDIS), Mark Eakin (NOAA/NESDIS/Coral Reef Watch/STAR); Xinrong Ren (NOAA/ARL); Menghua Wang, NOAA/NESDIS/STAR; Rick Stumpf (NOAA/NOS); Mike Ondrusek (NESDIS); Robert Warner (NOS); John Walker (NOAA UAS Program); Xinrong Ren (ARL), Guangming Zheng (NOAA/NESDIS).

Other stakeholder/partners include EPA/Long Island Sound for collaboration and coordination of field activities, NASA/GSFC for access to instrumentation, and USGS/WHOI collaboration in planning of field activities, and USDA.

Theme I research and student cohort have been working closely with our NOAA Collaborators to refine the Theme I project/tasks objectives and ensure relevance to NOAA's strategic priorities. All recruited students have met with their NOAA advisors, and planning their NERTO activities for summer 2018. In addition, Dr. William Hernandez joined the NOAA CESSRST center as the first postdoctoral scientist in July 1, whose research primarily aligns with Theme I.

**Project I: CESSRST Coastal Ocean Observing Systems**

- During the first 6 months of the project, three graduate students (1 PhD student: Suhey Ortiz Rosa; and 2 MSc students: Owen Parker and Eder Herrera) to work on Theme I/Project I activities.
- The research group participated in a field campaign in the Chesapeake Bay, where instruments were deployed on research vessels to better understand impacts of trace gases on coastal ocean color retrievals.
- Using NASA SeaDAS software for OC satellite data processing, level 2 data of remote sensing reflectance from VIIRS sensor were acquired for the coastal site at CCNY’s Long Island Sound Coastal Observatory (LISCO) and a less coastal WaveCIS Gulf of Mexico’ AERONET-Ocean Color(OC) site for the period of 2012-2016. Characteristics of aerosols in atmospheric correction models are explicitly retrieved and compared with the ones from AERONET-OC data at these sites, primarily in terms of aerosol optical depth (AOD) and scattering phase functions (PF), thus characterizing the validity of the aerosol models and evaluating possible errors and reasons for discrepancies.

**Project II Development of Environmental and Coastal Quality Indicators**

- Conducted research towards development of harmful algal bloom (HAB) satellite retrievals using measurements from the NOAA Suomi NPP VIIRS sensor. Leveraged student Rachel Li, Usamaa Van and Claudia Duran (UG) worked on examination of retrieval accuracies of harmful algal blooms in the West Florida Shelf from VIIRS observations using neural networks and carried out quantitative comparisons with accuracies obtained using other techniques.
- Participated in the examination of the impact of temporal changes on satellite KB HABs retrievals.
• MS student Nia Rene joined Theme I/Project 2 in August 2017. During summer, Nia along with her CREST advisor Dr. Cherrier’s research group designed and set up the ecoWEIR mesocosm and began some preliminary work to evaluate the functionality of the ecoWEIR design vs. that NYC DEP green infrastructure design and compare the stormwater interception and pollutant removal efficiencies of the two designs for simulated historic rain events. Nia is now developing her thesis proposal.

### Key Activities – Theme I (Research and Training)

- During reporting period, six (6) CESSRST supported students [one Undergraduate (Stefanos Spiratos) and three Masters (Eder Herrera, Nia Rene and Owen Parker) and two Doctoral candidates (Andrea Gomez and Suhey Ortiz)] were recruited to work on Theme I projects.
- In addition, one postdoctoral scientist- Dr. William Hernandez was recruited with a focus on Theme I research.
- Andre Gomez initiated her NERTO internship at AOML lab in Miami, FL, on August 1, 2017 which was disrupted for a few weeks, since she had to leave Miami due to Hurricane Irma, however, she is back in Miami as of September 18 and continuing her NERTO activities.
- Eder Herrera and Owen Parker participated in the Summer Bridge Program as Graduate mentors, and finalized their NERTO/Graduate research synopsis and identified their NOAA mentors.
- Suhey Ortiz, also identified her NOAA mentor and finalized her NERTO/Graduate Synopsis. She also attended the NOAA Satellite Conference held at CCNY in July 2017.
- Both Andrea Gomez and Suhey Ortiz made oral presentation at the 13th Annual NESDIS/STAR/CoRP Symposium held on July 20, 2017 in CCNY, NY.
- Owen, Suhey, Eder and Andrea participated in some sessions of the Core Competency workshop in summer 2017.
- All student completed their RCR training.

### THEME II: WEATHER AND ATMOSPHERIC HAZARDS

**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. Theme II researchers will use innovative technology and integrative observations to study weather and 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 in support of the two social science areas: (1) Planning and Policy and (2) Population Science. The research aligns with NOAA’s social science mission - Institutionalize social science to further NOAA’s mission. The CESSRST scientists and NOAA collaborators for each project are listed in Section II of this report unless otherwise noted.
PROJECT I. Weather Hazards

Task 1: Storm and Storm Prediction

- Heavy precipitation and storm surge prediction continues to be a key task at NOAA. Efforts are underway to find interested NOAA scientists to both mentor students and perform collaborative research that will address these hazards through: (1) high-temporal resolution convective storm analysis, and (2) analysis and modeling of convective initiation in Puerto Rico. We have generated an initial analysis of extratropical cyclones in the GFDL global model. We have initiated a study of GOES-16 focused on midlatitude storms. During this period, we worked on the implementation plan and engaged with recruitment of Cohort I and Cohort II students.

- **Convective Initiation Products in Coastal Processes**: Given the recent detection of warming SSTs in the Caribbean region from 1982-2014 period (Glenn et al. 2015), analysis of precipitation trends was completed for the same period using satellite products. Results show that regionally averaged accumulated rainfall is decreasing for the Total Annual, Early Rainfall, and Dry Seasons by 1.02 mm yr\(^{-1}\), 0.29 mm yr\(^{-1}\), and 1.24 mm yr\(^{-1}\) respectively. The Late Rainfall Season shows an increasing trend of 0.74 mm yr\(^{-1}\). However, only the Dry Season trends from December to March, were determined to be statistically significant at the 95% test level. Per-grid analyses show that accumulated rainfall per season has been increasing in the southern part of the region, with high statistical significance in areas reflecting an increase of 4 mm yr\(^{-1}\) and greater. Principal component analysis results indicate that the first principal component (PC1) of the Dry Season has the highest variance of all seasons which is approximately 28% for precipitation and 40% for SSTs. Results from a linear model determined that SSTs explain the interannual variability and trend observed for precipitation during the 1982-2014 period, with the annual model yielding the highest adjusted R\(^2\) (0.706) when the first three modes are considered. Thus, the link between warming SSTs and rainfall during the same period is demonstrated on an annual mode.

Task 2: Heat Stress and Urban Modeling

- **Ensemble for Evaluation of WRF**: The plan for the evaluation of boundary-layer characteristics modeled by the Weather Research and Forecasting (WRF) model were initiated. The focus is an ensemble of 18 runs where the results from WRF are compared against boundary-layer observations from profiling instruments at The City College of New York. We are modeling two cases: one for the summer and another for the winter season. The use of the Primary Land Use Tax-Lot Output (PLUTO) is allowing for the use of high-resolution building data configured to be used in the BEP-BEM (Building Energy Parameterization – Building Energy Model) urban land parameterization coupled with MYJ and the Boulac boundary-layer schemes. For the other boundary-layer schemes, the single-layer Urban Canopy Model (UCM) will be used. There are also different surface-layer schemes that work for each boundary-layer scheme.

- **NOAA-CREST Summer Campaign**: Following the 2016 summer campaign that witnessed three heatwave events (1), an extensive field experiment was set up during the summer 2017 period. While the 2016 campaign focused on the interaction between the mesoscale high-pressure system and the local scale urban heat island effect, the 2017 campaigns main goal was to understand how the urban surface layer interacts with the mixed layer during heatwave episodes. In addition to boundary layer profilers that monitored the momentum and thermal characteristics of the mixed layer, a flux tower was set up on the CCNY campus to characterize the surface layer turbulence. The analysis of the data will help us to characterize the urban surface energy budget holistically by coupling surface measurements with boundary layer measurements. The characterization will ultimately enable us to utilize GOES16 measurements in urban areas. Apart from the Theme 2 faculty (Prathap Ramamurthy, Jorge Gonzalez,
Mark Arend, Fred Moshary), the campaign involved two PhD students, Josh Hrisko and David Melecio and a number of undergraduate students.

• Several statistical methods including Principal Component Analysis (PCA are applied to down scale MODIS observations to higher resolution. The aggregated LandSat-based surface temperatures have been compared to MODIS data over New York City and discrepancies have been identified between products.

• A Flux Tower with capability of measuring all surface energy balance components has been deployed on concrete surfaces at the New York City College of Technology, CUNY in Brooklyn, NY.

PROJECT 2: CREST Observing Systems for Weather and Atmospheric Process and Dynamics

Task 1: The CREST Earth System Observing Network (CESON)

1. Satellite Research Products: Low latency NOAA NESDIS STAR and CREST research products developed and generated directly from CREST satellite receiving stations at CUNY, HU, and UPRM, for distribution to various research tools and stakeholders. Work will also include development of GOES-East atmospheric and aerosol products. (Point of Contact: Barry Gross, John Anderson, Rafael Rodriguez-Solis)

The installation of the GOES-R receiving station at CCNY has been delayed due to College Logistical issues. The progress updates will therefore be provided in the next reporting period.

2. Compilation of PBL heights, dynamics and smoke/dust transport to the East Coast (in the form of air-mass histories) for 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. (Point of Contact: Fred Moshary, Yonghua Wu, Ruben Delgado, Belay Demoz, Patrick McCormick, and Jia Su).

• Active remote sensing measurements (lidar, ceilometer, radiometer, etc.) of multiple events of smoke plume transport to the eastern US coast during summer 2017. Measurements allow determining impact of particle pollution aloft to surface air quality and monitoring evolution of mixing layer dynamics (0-3 km) during Air Quality Action days.

• Collaboration with NOAA Center for Atmospheric Science and Meteorology (NCASM) scientist Dr. Siwei Li for determination of urban PM2.5 from ceilometer backscatter retrieval.

• Lidar measurements during the lunar eclipse on August 21, 2017.

• Development of differential absorption lidar at HU to obtain vertical ozone profiles.

• Installation of CIMEL sun photometer at HU for column measurements of optical aerosol properties. In addition, a rawindsondes system was procured. System provides in-situ vertical profiles of temperature, H2O mixing ratio and additional QC/QA for HU lidar retrievals. In addition, this instrument will serve as hands on training tool and the professional development of students in the fields of Atmospheric Science and Remote Sensing.

• Development of a mixing layer height (MLH) algorithm from Doppler Wind Lidar using covariance wavelet transforms and cluster analysis.

3. Validation and Application of OMPS limb profiler: ozone and aerosols comparisons and analysis will be carried out with Aura MLS and SAGE III-ISS. (Point of Contact: John Anderson and Patrick McCormick)

• Comparisons are underway between OMPS LP and Aura MLS ozone measurements. The focus is to classify what the altitude registration difference is with OMPS.
4. Validation of Chemical Transport Models: Error estimation, validation and refinement of the OAR/NCEP WRF-CMAQ and possibly CIMSS RAQMS air quality model forecasts when spatiotemporal variations are considered for specific parameters, such as ozone, UVB, and PM2.5. Work will include blending the OMPS ozone products with NUCAPS and support of GFDL efforts in quantifying aloft dust plume transport estimates. (Point of Contact: Barry Gross, Ruben Delgado, John Anderson, and Sam Shen)

- Lidar observations during this period allowed comparisons with and validation of model MLH and PM$_{2.5}$ for Baltimore-Washington and New York City metropolitan areas with the NAQFC model. This is an ongoing collaboration with NCEP/NWS (Jeff McQueen) in model validation work.

- HU has worked on modifying code provided by NOAA in order to produce Total Ozone from Assimilation of Stratosphere and Troposphere (TOAST) profiles. TOAST profiles are constructed using data from the OMPS-LP instrument on board the Suomi NPP. The TOAST algorithm produces daily global maps of profile ozone retrievals at various levels. In its current incarnation (version 5.2), 12 layers are produced, corresponding to the 12 Umkehr layers. This will be used to further develop a 100-layer TOAST analysis, which will be used as a new stratospheric a-priori first guess for the NOAA Unique Combined Atmosphere Processing System (NUCAPS) algorithm, which is NOAA's next generation processing system.

**Key Activities Theme II – Research and Training:**

- Twelve students [ six Undergraduates (Chris Luger; Christiana Sasser; David Barnes; Matthew Glover; Maurice Roots; Meredith Sperling); four Masters (Aris Fernandez; Geselle Coleman; Tyler Tucker; Yoribaldis Olivo); and two doctoral students (David Melecio-Vasquez and Joshua Hrisko)] were recruited and supported by CESSRST – cohort I funding and being trained in research pertinent to theme II research themes.
- All graduate students identified their NOAA mentor and finalized their NERTO/Graduate Synopsis. They will all be undertaking their NERTO in summer 2018.
- David and Joshua participated in the Summer Bridge as Graduate Mentors
- David, Joshua, Aris, Victor participated in the Core Competency Workshops in summer 2017, other students will complete their Core Competency training by Summer 2018.
- All student completed their RCR training.

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

This work aligns with the NOAA’s “Water Prediction” research priority. This theme aims at creating unified water prediction and modeling methodologies to aid the development of operational products and services. The theme includes climate-informed integrated water and ecosystems modeling, socio-economic impacts and vulnerability assessments, that directly aligns with NOAA’s Integrated Water Prediction. 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. Theme III focuses on developing a unified water prediction system using remote sensing of earth systems, and aligns with NOAA’s social science mission of NOAA’s products and services strengthen societal decision-making. Co-led by Naresh Devineni and Tarendra Lakhankar, the research is conducted in collaboration with Xiwu Zhan (NOAA/NESDIS/STAR); Ralph Ferraro (NOAA/NESDIS/STAR); Satya Kalluri, (NOAA/NESDIS/STAR), Yunyue Yu(NOAA/NESDIS/STAR); Michelle Stokes (NWS), Roger Pierce (NWS), Tim Brown (NWS); Felix Kogan (NOAA/NESDIS); Jeff Key (NOAA/NESDIS/STAR), Colm Sweeney (NOAA/OAR/ESRL), Pieter Tans (NOAA/OAR/ESRL), James Butler (NOAA/OAR/ESRL), Robbie Hood (NOAA UAS Program), Gary Wick (NOAA/OAR/ESRL)

**Project I. Hydrologic Extremes – A Systematic Risk Assessment of Droughts and Floods Using in-situ and Remote Sensing Products**

**Task 1. Demand sensitive drought risk assessment for the continental United States**

We designed algorithms required for developing the demand drought indices. We continued assembling data sources for the water demand catalog. Cassandra Calderella worked on downloading and processing AMSR-II soil moisture data. Cassandra completed RCR training during summer 2017 and her NERTO is being discussed with NOAA Collaborator Xiwu Zhan. We have recruited Abraham Rubel in cohort I to start working on database development. Ariel Avgi has been working on developing the linkages of drought to food security.

**Task 2: Urban flood modeling using in-situ and remote sensing products**

MS student Adedoja Adeyeye worked on installing weather stations, for urban Hydro meteorological Testbeds (uHMT) across the city. More than half of the anticipated weather stations network has been installed during summer 2017. He completed core-competency and RCR training. We also recruited Aye Phyu and Jahnelle Howe. They will be working on understanding the long-term precipitation and temperature extremes in the northeastern US, with a particular focus on the urban centers. This study will help us understand where, when and how different extreme flooding events occurred in the history, and the role of concurrent/antecedent weather conditions. We also recruited Cesar Hincapie into cohort II. Cesar will work on the Hydro meteorological Testbeds.

**Task 3: Development of models for weather and ocean forecasting, and hazard mitigation**

During the first 6-month time period, we recruited two PhD students (Carlos Wah-González at UPRM and Cassandra Calderella at CCNY – cohort I) to work on Flash Flood model using JPSS/GCOM-W data.

**Project II. Water Resource Assessments**

**Task 1. Automated System for Evapotranspiration Mapping**

Prof. Trent Biggs (SDSU) leads this task in NOAA collaboration with Michelle Stokes (NWS), Roger Pierce (NWS), Tim Brown (NWS), Satya Kalluri (NOAA/NESDIS/STAR). During this period, task researchers engaged with recruitment team for Cohort III, starting Sept 2018, with process overseen by Dr. Shakila Merchant.

**Task 2: Development and validation of Snow Water Equivalent data product**

During this period, MS student Stephany Paredes Mesa (cohort I) worked remote sensing application for estimating snow depth and snow water equivalent. NOAA Collaborator for this task Dr. Ralph Ferraro visited to ESSRST, discussed research and NERTO for summer 2018 with Stephany and CREST mentors. Stephany completed core-competency and RCR training. During the performance period, Stephany developed Matlab programs to evaluate MiRS and MSPPS and convert them to IMS grid format. She also conducted exploratory data analysis to compare MiRS and MSPPS with the IMS product.
Project III. Synoptic and Seasonal Monitoring of the Earth Systems

Task 1. Phenology

N/A

Task 2. Land-Atmosphere Fluxes

Prof. Walter Oechel (SDSU) leads this task with NOAA collaborators Colm Sweeney, Pieter Tans, James Butler from NOAA/ESRL. Student recruitment is under process. We recruited Ph.D. student Andrea Fenner, to SDSU/CESSRST program. All our students have now completed the core competencies during summer 2017 and completed RCR. Their research skills have been developed by visiting NOAA ESRL field locations in Barrow Alaska, and American Samoa. Andrea Fenner has done three weeks of fieldwork (supervised by Aram Kalhori), in Barrow to determine Arctic CO2 and CH4 fluxes and environmental drivers. She has visited NOAA ESRL facility in Barrow and met with Bryan Thomas, the potential NOAA mentor for her NERTO. He has done initial survey on patterns and controls on CO2 fluxes using boat-based pCO2 measurements in tropical coastal ecosystems. The integration of NOAA data in their research has been accomplished. M. Trunkhill had the opportunity to communicate with NOAA collaborators and initiated the NERTO training planning with Mareike Sudek at NMFS.

Task 3. Development of sensors for UAS platforms for Environmental Intelligence and Satellite Product Validation (crosscutting and collaborative with NCAS)

A PhD student (Carlos R. Wah-González) started working with task leader Prof. Rafael Rodríguez and his NOAA collaborators Robbie Hood (NOAA/UAS Program), Xiwu Zhan (NOAA/NESDIS/STAR), and Gary Wick (NOAA/ESRL).

Key Activities Theme III – Research and Training:

- Twelve students [four Undergraduates (Abraham Rubel, Ariel Avgi, Jahnelle Howie and Aye Phyu); three Masters (Adeyeye Adedoja, Stephany Parades Mesa, Michael Trunkhill); and four doctoral students (Cassandra Calderella, Carlos Wah-Gonzalez, Andrea Fenner and Breanna Gillespie)] were recruited and supported by CESSRST – cohort I funding and being trained in research pertinent to theme III research themes.
- All graduate students identified their NOAA mentor and finalized their NERTO/Graduate Synopsis. They will all be undertaking their NERTO in summer 2018 and 2019.
- Adeyeye and Stephany participated in the Summer Bridge as Graduate Mentors
- Andrea, Michael, Ariel, Rubel, Jahnelle and Aye participated in the Core Competency Workshops in summer 2017, other students will complete their Core Competency training by Summer 2018.
- All student completed their RCR training.

COLLABORATIVE RESEARCH: Specific Objectives:

CESSRST scientists and students continues to engage with NOAA Collaborators to refine the project/tasks objectives and ensure relevance to NOAA’s strategic priorities. Recruited students have met with their NOAA advisors, and started working on planning NERTO activities.

Specific Objectives for Theme I during this reporting period were:

- To develop a deeper understanding of coastal processes and potential impacts of extreme weather and climate-related hazards on coastal communities, businesses, natural resources, ecosystems and the services they provide
• Data analysis, and comparison on other AERONET-OC sites,
• Analyze process and compare atmospheric datasets from a network of ground-based remote sensing sensors, to assess spatial variability in atmospheric trace gas dynamics.
• Comparison of remote sensing measurements of total column amount of atmospheric trace gases with surface concentrations of trace gases using in-situ sensors.
• Continue detailed analysis and expansion on the satellite retrievals of HABs, including examination of false negative and positive statistics, and on temporal impacts and extending the work to include, consecutive satellite overpasses.
• Set-up greenhouse mesocosm and HAB time series incubation experiments to help establish relationships between chlorophyll fluorescence and main water bio-optical parameters in coastal waters.

**Specific Objectives for Theme II during this reporting period were:**

- Understand how to better constrain the ensemble forecast model of extratropical storm surge.
- Optimally blend multiple predictions, including both statistical and NWF products.
- Improve the understanding of island-scale convective processes and their effects on precipitation in tropics.
- Compare the observed and modelled potential temperature profiles and mixing ratios for three dates: a summer heat-wave case, a non-heat event summer day, and a winter date.
- Understand the statistics of Planetary Layer Height and comparison to weather forecast models (WRF) and to validate the OAR/NCEP WRF CMAQ chemical transport model for air quality forecasting.
- Construct the best robust PM25 24 hour forecast by combining different meteorological and prior pollution factors.
- Support particle pollution monitoring for local environmental agencies
- Support the NWS ceilometer testbed (evaluation and assessment of instrumentation and algorithm development of mixing layer height). Evaluate the range corrected attenuated backscatter from commercial ceilometers with a focus in the lowest few km. Assess the daytime mixing layer height determination from commercial ceilometers. Determine additional information that can be gained from ceilometers, such as elevated layers aloft and entrainment.
- Develop remote sensing technologies with a focus on multi-directions measurement of the distribution of aerosols (Horizontal and Vertical), clouds and winds for on-site observations and field campaigns.

**Specific Objectives for Theme III during this reporting period were:**

- Address the modeling, and prediction of floods and droughts, and how these may affect interlinked human activities at multiple scales of cities and river basins.
- Investigate drought risk for the United States using variations in both water supply and demands.
- Investigate modeling and prediction of floods using both in-situ and remote sensing data products.
- Provide automated mapping of ET at regional and national scales using remote sensing data and global climate grids.
- 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.
• Develop a global scale multi-year phenology dataset, derived from multiple satellite remote sensing datasets characterizing land surface, ocean, and cryosphere cyclic phenomena, providing a comprehensive characterization of phenology measures, and supporting investigation of trans-domain phenomena and teleconnections associated with regional feedbacks and global climate processes. Specific focus is on arctic and dryland landscapes that have increasingly been recognized for their role in the global carbon cycle.

**Overarching Objectives for Research and Training includes:**
- Recruiting students to fill in Cohorts 1 (if any) and II post-secondary students to be trained in NOAA mission aligned science projects developed by CESSRST faculty advisors in collaboration and engagement with NOAA scientists and mentors.
- Students will be provided training on basic CESSRST center-wide core competencies.
- Graduate students will then acquire through training, advance core-competencies unique to the specific objective they are working on.
- These advanced skills will be augmented by training gained in their associated project/task specific NERTO experience and mentorship from NOAA scientists collaborating on the project. Furthermore, the NOAA scientist will be on the graduate students committee

**COLLABORATIVE RESEARCH - Significant Results:**

**Significant Results from Theme I during this reporting period were:**
- Results from our aerosol characterization studies allowed to assess the validity of the aerosol models and evaluate possible errors and reasons for discrepancies. It is shown that the differences in AOD strongly depend on the wind speed at the location of study and should be associated with the modelling of the state of the ocean surface in atmospheric correction procedures.
- Analysis of remotely sensed measurements of atmospheric trace gas showed strong spatial and temporal variability in the total column amount of ozone and nitrogen dioxide along coastal waters, and demonstrated the impact of anthropogenic emissions on coastal and offshore marine air quality.
- We assessed the efficacy and accuracy of retrievals from VIIRS using neural network algorithms and carried out quantitative comparisons, which showed them to be superior to other retrieval approaches.

**Significant Results from Theme II during this reporting period were:**
- The NYC Summer Heat Campaign continued in summer 2017 with an expanded and coordinated suite of instruments that included boundary layer profilers (Ceilometer; MWR; Lidar), surface heat fluxes, aerosol measurements (AERONET), and several ground weather stations. Four CREST scientists participated in the campaign along with two doctoral students and several undergraduate students. The campaign captured one clear heat wave event. Results of the campaign will aid in understanding the evolution of the urban boundary layer, and will provide unique data records for model evaluation, and for satellite calibration.
- The three Eastern U.S. CESON stations (UMBC, HU and CCNY) can generate vertical wind profiles. A new portable Doppler wind lidar system was implemented at CCNY since May 2017. Students are trained in operation and processing data. The system is currently running continuously and the data is analyzed to study atmospheric dynamics and air quality. Various scan strategies have been explored to provide vertical wind profiles and to track plumes. The system is identical to UMBC and NOAA ESRL
wind lidar systems. Lidar retrievals of wind atmospheric parameters (i.e. speed, direction, turbulence, etc) and the validation of these parameters are the basis for the collaboration.

- Horizontal scanning micropulse lidar measurements were carried out at CCNY to observe the dynamic motion of aerosol particle pollution through NYC. Our horizontal distribution measurements were complemented with vertical measurements from a CL-51 ceilometer by Vaisala, PM$_{2.5}$ concentration measurements from an on-site air monitoring station managed by the New York State Department of Environmental Conservation, wind measurements from a co-located weather station, and satellite aerosol optical depth observations form VIIRS and MODIS. The synergistic combination of these data sets provided us with the information necessary to analyze pollution transport events and validate air quality model forecasts in collaboration with NOAA NCEP.

- Long range transport of wildfire smoke and its impact in the Eastern U.S. surface air quality was monitored with lidar observations during May-August 2017. Smoke plumes aloft observed originated from the wildfires in Canada and northwest U.S. A manuscript from May 2016 wildfire smoke transport vent in May 2016, in collaboration NOAA collaborators Jianping Huang and Jeff McQueen, is under preparation. The manuscript will be submitted to the peer review journal Atmospheric Environment in September 2017.

- Measurements of mixing layer height and dynamics during heat waves on May 17-18 and June 12-13, 2017 (collaborative with Project 1 Task 2). During these events, surface ozone concentrations were in the exceedance of NAAQS value (>70 ppb) while the PM$_{2.5}$ show a consistent increase up to 22–25 µg/m$^3$ in NYC area. MLH from NYC and Baltimore-Washington area, on June 10-13, 2017, were provided to NOAA collaborators (Jeff McQueen and Amanda Sleinkofer) for evaluating/improving the model capability.

- A differential absorption lidar was completed based on an optical parametric oscillator (OPO) laser. Preliminary results of ozone were obtained.

- Daily Aerosol Optical Depths at multiple wavelengths are obtained using a new CIMEL sunphotometer. HU joined the Aerosol Robotic Network (AERONET) and are using their protocols to provide routine data obtained from the sun photometer.

- UMBC PI, Ruben Delgado, appointed to planning committee of National Academy of Science, Engineering and Medicine workshop on “The Future of Boundary Layer Observing”.

- MLH determination algorithm developed for Doppler wind lidar measurements. Validation of algorithm was conducted with data sets collected during Ad-hoc Ceilometer Evaluation Study (ACES). Results from this effort help guide the EPA Photochemical Assessment Monitoring Sites (PAMS) program implementation for new hourly MLH requirement and supplement current efforts under NWS ceilometer test bed.

- Two ceilometers were deployed to monitor the MLH at Hampton Roads, VA to support the Ozone Water-Land Environmental Transition Study (OWLETS).

**Significant Results from Theme III during this reporting period were:**

- MS Student Stephany Parades Mesa has been engaged with NOAA Collaborator Ralph Ferraro to get feedback in her research and started using programing skills to process and comparing the snow data.

- Stephany Mesa presented her research to NOAA collaborator Ralph Ferraro on evaluation and comparison of MiRS and MSPPS into IMS grid format to compare MiRS and MSPPS with the IMS product.

  Communication with Xiwu Zhan, NOAA collaborator of Adedoja Adeyeye and Cassandra Calderella will be initiated to plan his visit to ESSRST to get research updates and provide feedback to student along with task discussions for NERTO in summer 2018.

- Similar communications have been made with Yuvene Yu and Ralph Ferrarro for visit to ESSRST.

- Michael Trunkhill presented his research and the preliminary results at the Marine and Wildlife Service in American Samoa entitled “Coral health and CO2 output”.

COLLABORATIVE RESEARCH - Key outcomes or other achievements:

- Mr. Harry Cikanek and Technical Advisor Dr. Vanessa Griffin were designated as CESSRST Technical Monitor and Advisor respectively in March 2017 by the NOAA Program Office.
- Both Harry and Vanessa visited CESSRST on April 26, 2017 and based on the technical advise and suggestions, the CESSRST Implementation plan was revised to focus and better align with the NOAA mission and interest. The research themes III and IV were merged to create one theme – Water Prediction and Ecosystem Services
- A Standard Operation Procedure (SOP) for more effective and coordinated ways for early NOAA engagement is being created, and will be provided to all CESSRST and NOAA scientists.
- All COHORT I students, and CESSRST faculty and scientists completed RCR training
- All graduate students and their Faculty advisors together created a graduate (NERTO) synopsis. Most cohort I students (nearly 15-18) will be undertaking NERTO internships during summer 2018.
- All students signed the CESSRST Letter of Understanding
- All COHORT I students are in the process of completing their iSDP form and will be creating their e-portfolio with the help of Education Lead and their faculty advisors.
- Andrea Gomez (first CESSRST NERTO Intern among Cohort I students) is currently participating in an internship (NERTO/SSIO) at AOML hosted by her NOAA mentor Jim Hendee/NOAA/AOML. This opportunity will help her learn deployment techniques for in situ loggers and how to utilize these data to validate satellite SST datasets.

CESSRST MANAGEMENT: Major Activities

The Key Personnel positions identified, recruited and updated during this reporting period:

<table>
<thead>
<tr>
<th>KEY PERSONNEL</th>
<th>Name</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<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></td>
</tr>
<tr>
<td></td>
<td></td>
<td>212.650.8009</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></td>
</tr>
<tr>
<td></td>
<td></td>
<td>212.650.8379</td>
</tr>
<tr>
<td>Distinguished Professor</td>
<td>William Rossow, PhD</td>
<td><a href="mailto:wbrossow@ccny.cuny.edu">wbrossow@ccny.cuny.edu</a></td>
</tr>
<tr>
<td>Data Manager</td>
<td>Paul Alabi</td>
<td><a href="mailto:kalabi@ccny.cuny.edu">kalabi@ccny.cuny.edu</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>212.650.5025</td>
</tr>
<tr>
<td>Communications and Outreach Manager</td>
<td>Olga Joseph</td>
<td><a href="mailto:ojoseph@ccny.cuny.edu">ojoseph@ccny.cuny.edu</a></td>
</tr>
<tr>
<td>Education Specialist/ Coordinator*</td>
<td>Nancy Degnan, PhD</td>
<td><a href="mailto:degnan.nancy@gmail.com">degnan.nancy@gmail.com</a></td>
</tr>
<tr>
<td>Recruitment and Student Affairs Manager*</td>
<td>Cesar Ortiz</td>
<td><a href="mailto:cortiz@ccny.cuny.edu">cortiz@ccny.cuny.edu</a></td>
</tr>
<tr>
<td>CESSRST External Evaluator</td>
<td>Janice Easton, PhD</td>
<td><a href="mailto:jeaston@ufl.edu">jeaston@ufl.edu</a></td>
</tr>
</tbody>
</table>

* New team members recruited during this reporting period
During the current reporting period, all CESSRST Committees met regularly to ensure:

- Integration and coordination between the three elements of CESSRST - Science, Education and Management;
- Collaborative communication and engagement of the CESSRST members across all partners institutions;
- The committees created center-wide frameworks for core competency and social sciences,
- An all hands-on committee meeting has been planned in October 2017.

**a. Center-wide communication Matrix**

A center-wide communication strategy is being evolved to communicate the center events, activities and success stories (*figure 2*). The quarterly newsletter depicting Center activities and success stories are located on the website - [http://noaacrest.org/publications](http://noaacrest.org/publications)
CREST’s Social Science theme is “Application of Remote Sensing Technologies in Linking Earth System Sciences to Societal Wellbeing and Decision-making,” and it aligns closely with NOAA’s Social Science Goal #2 of supporting and strengthening societal decision-making with NOAA and CREST research, products, and services. CREST’s Social Science theme focuses primarily on

- Environmental Economics
- Sustainability Science
- Public Health
- Planning and Policy
- Population Science

These social science perspectives are being integrated into CREST research and training programs. Ms. Jacqueline Rousseau of NOAA Program Office, arranged an all CSC meeting with the NOAA’s Chief Economist Ms. Monica Grasso and other NOAA social scientists on July 13, 2017. This meeting further helped CESSRST in extending the dialogue with Ms. Grasso by inviting her to serve on the CESSRST External Advisory Board. Ms. Rousseau and the program office also nominated two members from each center to serve on NOAA’s Social Science Community of Practice. Dr. Merchant and Dr. Devineni were nominated by CESSRST Director to represent CESSRST center.

Social Science Training - Educational and curricula activities increase integration of the social sciences into the CREST research projects and mission. One of our major tasks thus far has been to develop for students, Basic and Advanced Core Competencies in Socio-economic Drivers and Impacts of Earth Systems and Environmental Science. The learning modules for the Basic Social Science Core Competency are being delivered to undergraduate and graduate students in the first cohort of the program this summer.
The Advanced Competency in Social Science is intended for CREST Master’s degree and Doctoral students who have already demonstrated basic competency, and for this, we expect students to focus on specific aspects of the Social Sciences that are particularly relevant to their research topic, entailing both advanced coursework and integration within their thesis or dissertation research. The Theme leaders and investigators contribute to this effort by extensive mentoring of the CREST students on their research projects, and CREST’s Social Science seminars, roundtables, and symposia further reinforce the content of the core competency instruction. These research projects all provide valuable training for the students who are involved directly in the research, and students will also benefit from the new social science-oriented courses.

b. Center-Wide Data Management and Sharing Plan

1. Administrative Data Management (Student/Education Outcomes).

Year I Objectives:
- Survey Users and identify centers needs
- Architecture, design and build central management information system (MIS) – Extend FileMaker repository.
- Redesign Center Logo and build NEW center website
- Create and enhance partner institution websites (using matching templates)

Outcomes:
- A center’s website (http://www.noaacrest.org) is currently fully operational. The center logo was finalized during this reporting cycle. The website contents is constantly updated as new events and other web contents. The website will receive new Add-ons and extensions such as data links for products, reports etc.
- Each partner institution has been assigned sub-page/sub site under the main crest website with consistent templates.
- Our FileMaker Platform and Servers have been upgraded with additional user licenses. An online/web interface is currently being added to provide seamless use across all campuses.

2. Data Collection, Stewardship, General Management

Year I Objectives:
- Create online web frontend for center wide data collection and extend FileMaker.

Outcome:
- The central MIS (FileMaker) is still in development. The iSDP, NERTO, budgeting, data collecting tools have been collected and currently stored in temporary databases. Other interfaces such as monitoring, assessment, performance management and reporting, online core competency black/dashboards are being constructed.

3. Data Archiving, Preservation and Storage.

Year I Objectives:
- Added Storage to CESSRST Computational Cluster.
- GOES-R/16 GRB Installation

Outcome:
- The CESSRST computational and storage cluster is online. The additional storage equipment for handling high data volumes from both administrative and research outcomes
including full data archiving, storage and management has been purchased and is currently undergoing testing.

- GOES-16 GRB system installation at CCNY was delayed due to weather and also pending site approval from the CUNY Administration. GOES-16 will enhance CESSRST science research especially in the area of atmospheric hazards and severe weather events. We anticipate completion before the end of the year.

4. Data Publishing (web services and portals)

   **Year I Goals:**
   - NEW center website

   **Outcome:**
   - The Center’s website is online at http://noaacrest.org

   **c. Center Postdoctoral Plan**

   As per the SAC, one of two postdoctoral scientist was recruited during this reporting period. Dr. William Hernandez joined CESSRST as the first postdoctoral scientist, after his proposal and application was approved by NOAA Program Office. Dr. Hernandez has been appointed for one year and will be extended another year of fellowship based on his performance and availability of funds. His summer activities are reported under section VI-Special Award Condition.

   **d. Admiral Lautenbacher Public Service Scholarship Award**

   CESSRST Lautenbacher Public Service Scholar recently concluded his three-month summer research and community outreach work in Barrow (not Utqiagvik). Stephen made great progress during this summer not only by conducting research in the harsh climatic conditions in Alaska, but also met with two NOAA mentors – Nicole Kinsman, Alaska Regional Advisor for the National Geodetic Survey and Dr. Shachak Pe’eri, Branch Chief of the Chart Standards Groups. During his training he learned image processing techniques, valuable to apply to this academic and professional training as CESSRST Lautenbacher fellow. Besides, Stephen also had the opportunity to collect many data samples – such as in-situ water quality, sonar and benthic sediment samples, which he plans to integrate all datasets together to create a predictive models for various water quality measures and benthic habitats using related spectral signatures. Stephen also participated in various community outreach STEM events including a STEM summer camp for high school students from native villages across the North Slope of Alaska. He introduced students to major concepts in use for Earth Sciences and use of GIS techniques to create mapping tools of their local communities using the datasets he collected. He also taught them Web Mapping Applications (WMA) and helped create a site [www.barrowmapped.org](http://www.barrowmapped.org) to help understand the coastal erosion...
and raise environmental awareness about their community and changes due to weather and climate – a detailed report on Stephen’s work will be posted on the CESSRST website – www.noaacrest.org/publication

e. **Center-Wide Evaluation Plan**  
**Major Activities** – a) Site visit to CUNY in August 2017. Received updates on program plans from CREST Education Committee, Level II Core Competency Subcommittee, MIS/ISDP, and Outreach and Communication Team. Met with CUNY Institutional Review Board to review application policy and procedures. b) Surveyed HIRES 2017 students. c) Conducted interviews with Summer Bridge participants. d) Participated in regular Center Management and Subcommittee communications on their progress toward operationalizing the NOAA CESSRST 2016-2021 Implementation and Evaluation Plan. e) Revised Evaluation Plan as per NOAA Committed SAC comments.

**Significant results** –  
**a) Site Visit:** The site visit helped clarify how the NOAA CESSRST program is being operationalized and what still needed to be accomplished. The meeting with the Director of the CUNY IRB assured us that most of the assessments being included as part of the larger evaluation effort involve normal educational practices (exams, self-assessment, and pre-posttests) and are exempt from IRB review. Exit and Alumni Surveys however, are not considered exempt and need to submitted to CUNY IRB for approval.

**b) HIRES:** HIRES is not only a leveraged program targeting High School Students interested in STEM careers, it is also considered a recruitment tool that offers students a vehicle to enter the STEM pipeline. Students (n=18) reported that the program exceeded their expectations and all would recommend the HIRES program to their peers. The program exposed students to a variety of STEM opportunities, namely future CREST opportunities, and helped students clarify their career path. Two HIRES 2017 interns have joined City College in Computer Engineering Program and will be recruited as rising sophomore to apply for NOAA Undergraduate Scholarship and Hollings Program. HIRES program has been 100% leveraged to continue to serve as a great recruitment tool for incoming freshmen and sophomores into City College and CESSRST program.

**c) Summer Bridge:** Made recommendations to CESSRST Center Management and Summer Bridge (SB) program administrators on improving the SB 2018 program. The following summary and recommendations were based on the compiled interview data from SB program participants.

Overall, students were satisfied with their experiences in the 2017 Summer Bridge program. While participants discussed areas of needed improvement they were still pleased with having participated in SB. The following suggestions are aimed at program administrators and faculty as they develop the 2018 Summer Bridge.

1). **Organization and communication is critical to an efficient and effective program.** Students were not always certain of what was going on and what was expected of them. They reflected that this was mostly the case at the start and end of the SB program. One suggestion was a platform where faculty and students could communicate with one another.
Posting upcoming events and deadlines would be helpful. Students would also like to learn about one another and the various research projects prior to attending SB.

2) **Technical difficulties often exacerbate the communication and organization difficulties for distance students.** Develop a communication plan to counter any technical difficulties for students at distant sites. Explore options for those with time constraints such as recording sessions or scheduling workshops so that all can participate.

3) **Clarify the nested hierarchy of NOAA, NOAA-ESSRST CSC, and Summer Bridge.** In addition to the introduction of NOAA, NOAA-CESSRST CSC, and Summer Bridge during orientation, it would be worthwhile to explore these entities in more detail (e.g., line offices, careers and opportunities) as part of the Professional Development workshops or brown bag seminars. Students that complete Summer Bridge but are still uncertain as to what NOAA does highlights a lack of communication and understanding.

4) **Make clear future CREST campus-wide opportunities.** While most students were aware of the opportunity to apply for, or enter the CESSRST program, several did not. Some students viewed SB as a summer internship experience that simply ended with no future opportunity.

5) **If the SB students are expected to know they are part of a cohort or taking core competencies - this needs to be understood by all.** Only two students considered himself or herself part of a cohort or understood they were learning a set of core competencies. Students need to know expectations for the MATLAB, GIS, and Remote Sensing workshops.

6) **Professional Development workshop topics should be relevant and timely.** Students requested that the Professional Development topics align with what is happening in SB. A PD program curriculum and syllabus would help students and faculty develop a more meaningful program geared toward building student scholarship.

d) **Communications:** NOAA EPP has requested various changes and updates to the Education and Implementation Plan and the Evaluation Plan. Continued communication with the Center Management and Subcommittees is critical to making sure all partners are on the same page.

What training and professional development were completed during the reporting period for Center postsecondary students, early professionals, postdocs, and faculty?

- This has been elaborated in other sections of the report (Education and Management and Research activities).
- The Center-wide Core Competency (CWCC) Modules (BASIC level) was designed and delivered during summer 2017. Only some Cohort I students were able to attend the CWCC session due to various reasons including late planning by the CWCC committee. The CWCC modules included – 15 hours of technical core competencies – such as Remote Sensing, Computer Modeling, Data Analysis and Visualization; 9 hours of Social Science that included Environmental Economics, Sustainability and People Sciences; and 15 hours of Professional development on communication, leadership and self-assessment.
• The session will be repeated in Summer 2018 to include and ensure all COHORT I students participate and attain the basic CC levels.

The research related training activities are given below:

**Theme I:**
- Training of the graduate students on project methodology. Graduate students Owen Parker, Ed Herrera, Andrea Gomez, and Suhey Ortiz developed their project synopsis and are currently working on developing their thesis proposals. Parker and Herrera are also enrolled in a Remote Sensing course at CCNY taught by Dr. Tzortziou so that they can become more familiar with coastal ocean remote sensing applications.
- Recruited student Nia Rena (will join NOAA CESSRST in fall 2017), already started interacting with her future NOAA advisor, Steve Morton to discuss proposed experimental design and approaches. Ms. Rene is also enrolled in a Remote Sensing course at CCNY taught by Dr. Tzortziou so that she can become more familiar with how the information from her experiments can enhance remote sensing applications
- All students met with their NOAA advisors, discussed their project objectives and activities, and started planning NOAA internships at NOAA facilities.
- Recruited one postdoctoral research (research across all NOAA CESSRST Themes) who will join our team in summer-fall 2017.

**Theme II:**
- Students David Melecio-Vázquez, Josh Hrisko, and Equisha Glenn attended at the NOAA Satellite Conference in July in New York City and received advanced training in GOES-R products during the workshops.
- Two graduate students at CUNY through leveraged funding have been involved in downscaling of land surface temperature in urban regions.
- Cohort 1 Student Victor Dominguez (BE in Environmental Engineering): Completed the NOAA CREST summer core competency courses, which taught me skills in data communication and presentation, fundamentals of remote sensing, social impact of environmental sciences and interpersonal skills. He learned how to use the NOAA HYPSLIT model to compare trajectories with aerosol movement picked up in micro-pulse lidar horizontal scans.
- Cohort 1 Student Aris Fernandez (Masters, Electrical Engineering) participated in the Core Competency workshops during the Summer Bridge program; he trained in remote sensing and modeling, environmental economics, as well as Professional Development components. He has been trained on operation and data analysis form the wind Doppler lidar recently implemented at CCNY. He is mentoring leveraged undergraduate students (Anjeza Arapi) to enable an integrative approach for analyzing Doppler lidar data in relation to urban boundary layer studies and air quality research.
- Leveraged student Anjeza Arapi (CREST REU- Environmental Eng. undergraduate) has been engaged in assessment of optical properties of smoke plumes and clouds with a CCNY elastic-Raman lidar. She demonstrated significant enhancement of aerosol color-ratio and relative backscatter nearby low-level clouds, which indicate the interaction or transient zone between aerosols and clouds. She will continue to examine the discrimination of smoke and cloud from the satellite product (VIIRS) when the ground-lidar observations indicate transported smoke plumes in NYC area.
- Leveraged Student Adrian Diaz Fortich (EE PhD student) has been working on scan strategies for horizontal lidar scans in NYC to track movement of pollution. He also attended a workshop on entrepreneurship.
- Two teams of Senior Electrical Engineering students (8 students in total) were trained in remote sensing technology, designing and implementing a visible hyperspectral shadowband radiometer and UV Lidar. They were mentored by CREST researchers and leveraged Doctoral student Adrian Diaz.
- HU Cohort 1 Student Geselle Coleman (MS, Atmospheric Science) participated in the HU DBS workshop in June, 2017. She was trained on how to visualize and process data products from polar
orbiting weather satellites such as VIIRS on Soumi-NPP. She also attended the NOAA Satellite Conference and met her NOAA advisor, Dr. Jamee Sims of NESDIS/OSGS. Geselle also participated in the JPSS and GOES-R workshops as part of her professional development and training. Furthermore, she participated in at least 1 core competency module on-site at CCNY during the week of the conference. She completed the other available components remotely at HU. Furthermore, she attended the CESSRST Annual and External Advisory Board meetings in Silver Springs, MD. All of these events has allowed her to network with fellow CESSRST students and faculty and NOAA scientists and managers. Geselle also completed the CITI RCR training.

- HU Cohort 1 Student Maurice Roots and David Barnes (UG Physics and Math, respectively) were awarded the NOAA Hollings Scholarship. Maurice has begun formulating plans to develop the scanning lidar. David begun detailed comparison between OMPS LP and AURA MLS ozone measurements. He is focusing on classifying the altitude registration difference in the OMPS LP instrument. Maurice and David also completed the CITI RCR training.

- HU leveraged students Sean Leavor and Steven Buckner (both PhD, Atmospheric Science) participated in the HU DBS workshop in June, 2017. They were trained on how to visualize and process data products from polar orbiting weather satellites such as VIIRS on Suomi-NPP. Sean used this training to process and visualize some MODIS IR data to show the nighttime characteristics of the Kelut eruption. In addition, Sean was also trained to operate and maintain the sun photometer measurements. Steven trained in processing NUCAPS data obtained from the DBS server social science Core Competency. Sean and Steven completed the CITI RCR training.

- UMBC Cohort 1 students (Meredith Sperling, Christiana Sasser, Ephraim Alfa and Matthew Glover) completed the CITI RCR training.

- UMBC Cohort 1 students Christiana Sasser and Meredith Sperling gave oral presentations of their research at the 10th International Symposium on Tropospheric Profiling and the 13th Annual CoRP Symposium, respectively. The 10th International Symposium on Tropospheric Profiling was held in Fort Collins, CO at Colorado State University during May 30-June 2, 2017. The CoRP Symposium was held at CCNY in July 20, 2017.

**Theme III:**

- Andrea Fenner started working on the eddy covariance data and meteorological data from most recent years in Chaparral/semi-arid ecosystem and processed the data and presented in GCRG lab meeting to look at the drought condition and the impact of drought on CO2 and H2O flux patterns. M. Trunkhill has started his research in American Samoa on determination of initial pCO2 and CO2 flux patterns in coastal tropical ecosystems. He built his experiment in San Diego and completed the boat measurements in San Diego Bay several times to be prepared for the data collection and the boat measurements in American Samoa. The results indicate that during his time there, the coral reef ecosystems were sinks for CO2. Although the majority of the literature states that reef ecosystems are sources of CO2, there are exceptions during times of heavy precipitation when nutrients are stirred up and photosynthesizers become more active (Massaro et al., 2012). With the heavy rainfall that was experienced during our time on the island, we believe this was the case; however, further research should be done to confirm this.

- MS Student Stephany Parades Mesa has been engaged with NOAA Collaborator Ralph Ferraro to get feedback in her research and started using programing skills to process and comparing the snow data.

- Michael Trunkhill presented his research and the preliminary results at the Marine and Wildlife Service in American Samoa entitled “Coral health and CO2 output”.
How have the results been disseminated to communities of interest, including NOAA and other stakeholders?

Theme I:
- We continued close collaboration with our NOAA collaborators, including Menghua Wang, Christopher Brown, Michael Ondrusek, and Guangming Zheng from NOAA/NESDIS and NOAA contactor Alan Strong
- We have close collaboration with Dr. Steve Morton of NOAA NOS, Lee Marchman of the Environmental Resources Program at the FL DEP Stormwater Division, Alan Cohn the Director of Climate and Water Quality at the NYC DEP, and Rick Stumpf of NOAA NOS

Theme II:
- Researchers González, Hamidrea, Moshary, and Ramamurthy met with NESDIS Scientist Bob (Yunyue) Yu, lead scientist for GOES-R LST products to discuss collaborations including; data sharing, cal/val, and development of new products. Bob Yu agreed to host two or more students next summer as part of the NERTO program, and co-advice students who engage in this particular collaboration. (July 2017).
- Beta daily forecasting products for surface winds, temperature and precipitation from the high-resolution WRF were shared with NWs/Upton office for their evaluation. (June 2017).
- Researchers Mark Arend and Fred Moshary visited NOAA Mentor Alan Brewer (NOAA ESRL CSD) to discuss and update him on progress on research and developments at CCNY and further develop Aris Fernandez (Cohort 1) research work and NERTO arrangements for summer 2018.
- Students and faculty attended the 28th International Laser Radar Conference (June 26-30, 2017) and presented research results.
- Participation and role of CESON in WMO GAW. GALION lidar network was discussed with GALION leads.
- Students and faculty presented research results at the NOAA Satellite Conference and the 13 Annual CoRP Symposium (July 17-20, 2017 New York), and 10th International Symposium on Tropospheric Profiling (May 30-June 2, 2017 Colorado).
- CCNY and UMBC students and faculty attended the New York City Metro Area Energy and Air Quality Data Gaps Workshop (24th – 25th May 2017), and presented their research work. The meeting included attendees from NOAA, NASA, EPA, and state and local agencies and stakeholders.
- Meetings with air quality management for Maryland and NYC took place, separately, during the month of August to discuss leveraged remote sensing research conducted at CCNY and UMBC and its impact on policy/monitoring (Maryland Department of the Environment and NYS Department of Environmental Conservation) and health (NYC Department of Health).
- The CESSRST@HU continues the development of new lidar techniques and measurements for retrieving aerosols, water vapor, temperature, cirrus clouds, carbon dioxide and winds in the Earth’s boundary layer. Several instrument measurements are being developed and local campaigns organized for educating and training students. In addition, the students will continue using these data and new data from satellite and ground-based lidar developments.
- UMBC students continue to contribute to the Smog Blog, a daily diary of the U.S. air quality. Blog post require knowledge and assessment of NOAA satellite products such as VIIRS (AOD and smoke/dust flags) and the Hazard Mapping System Fire and Smoke Product.
- UMBC PI participated in first OAR Forum of Atmospheric Chemistry and Ecosystem Modeling (June 15-16, 2017) at NOAA Headquarters in Silver Spring, MD.

Theme III:
Jonathan Munoz Barreto was invited to present at the Emerging Technologies Workshop held in NCWCP NOAA facility in College Park, MD on August 21-22, 2017.
What actions will be taken by the Center during the next reporting period to accomplish the goals?

**Theme I:**

- We will continue the research and training activities, as described in the Implementation Plan. All Cohort I students will complete their degree specific CESSRST core competency training. In addition, during the next reporting period we will continue working with SeaDAS software and data from LISCO AERONET site to make aerosol comparisons. We will also deploy a new shipboard Pandora spectrometer on a boat for new measurements of the spatial and temporal variability of atmospheric trace gases in estuarine and coastal environments.
- Detailed analysis will be carried out on satellite retrievals of HABs, including examination of false negative and positive statistics, and on temporal impacts. We will be setting up greenhouse mesocosm and HAB time series incubation experiments. For research Task "Development of coastal water quality indicators", we will establish relationships between chlorophyll fluorescence and main water bio-optical parameters in coastal waters.
- Planning to hold a project meeting (in Fall 2017) with CESSRST faculty, students and NOAA collaborators participating in Theme I, to introduce new CESSRST students and faculty working on Theme I (or cross thematic) projects, begin to integrate research activities of all project researchers, and coordinate future activities.

**Theme II:**

- Theme II/Task I/Project II team members are in the process of receiving Level-II data from GOES-R for Land Surface Temperature (LST) products for cal/val purposes in a close collaboration with Bob (Yunyue) Yu, GOES-R LST Team lead, for two regions of US; Northeast and South Central US (Texas-Arizona). The access to the data and validation against ground sensors and other satellite data will be invaluable in advancing the Team goals for thermal stress products.
- Data from the summer 2017 NYC Summer Heat Campaign will be processed and analyzed leading likely to a few publications addressing BL evolution, energy balance, and the role of aerosols in urban BL.
- Atmospheric profiling of particle pollution events for air quality advisory alerts and forecasting model validation/verification. Mixing layer height and atmospheric profiling database for modeling assessment.
- Contacts have been made with NOAA to receive processed intermediate GOES-R land surface temperature before they are released publically. The data will be processed to obtain high-resolution land surface temperature over urban regions (starting with New York City) to the level of Landsat resolution (30m).
- One Master student and one undergraduate student, both supported by CESSRST, will join the downscaling and providing land surface temperature team in September 2017.
- Research work will be exploring high pollution regional events to assess the most important predictor factors using a combination of HYSPLIT back trajectories and integrated satellite AOD from GOES-GASP and potentially GOES-R.
- Work in collaborations with NOAA on transport and air quality model validation. CESSRST is working on dissemination of observations products to both state and NWS air quality forecasters (i.e. MLH from CESSRST profilers for variation of forecast atmospheric parameters)
- Work will initiate on infusion of NOAA and CESSRST data into local Stake Holder support systems for health and air quality. Maryland Department of the Environment and UMBC are developing the white paper for the summer 2018 interagency field campaign OWLETS II in Maryland between NASA,
NOAA and EPA. Campaign will include of participation of students and faculty of NCAS-M.

- CESSRST faculty will attend the “Building a Weather-Ready Nation by Transitioning Academic Research into Operations Workshop,” to be held on November 1-2, 2017, at the National Center for Weather and Climate Prediction, College Park, Maryland.

**Theme III:**
- All the recruited students under Theme III will participate in core-competency training covering several topics including remote sensing, modeling, algorithm development, visualization, professional development, etc. Graduate students will undertake their NERTO internship in summer 2018 at the NOAA facility. One of the collaborator Dr. Ralph Ferraro will be visiting CESSRST in Sept 2017 to discuss the students’ research and NERTO at NOAA facility.

**EDUCATION:**
**Design and develop a Pre- and Post- test for MATLAB, GIS and Remote Sensing mini-courses.**

**Specific Objective 1:** To create and administer appropriate pre- and post-tests intended to offer insights on where students began in their learning and where they end up. Likewise, it may be useful to offer the post-test at two times. First at the end of the 2-week intensive period and then at the end of the research period, as these skills will have been utilized by students in the research process.

**Key Outcome/Achievement 1:** Quantitative and qualitative tool to establish important baselines as well as engage in real-time feedback and guidance to Rising Sophomores.

**Clarification of expectations would be helpful.**

**Specific Objective 3:** To emphasize that the process of research may, at time, be unclear, so that students understand that the learning can come in stages

**Key Outcomes/Achievements 3:**
Schedule and design a panel discussion at Orientation with NOAA-CESSRST Fellows, Summer Bridge Rising Sophomores and other prospective students, alumni and key faculty/research members to discuss what it is to engage in research, highlighting that research can be uncertain and messy [and that this is actually a good thing] but that roles and responsibilities can and ought to be established and revisited as needs arise.

Ensure that student advising, that takes place during the Summer Bridge Program, includes conversations on the process and expectations as well as how students feel that they are managing their research and their mentee/mentor relationship. Questions to probe students will be developed in concert with the Student Affairs Director, the Education Expert, the Assistant Director and the External Evaluator. Both the Student Affairs Director and Education Expert will set up meetings with faculty, researchers and NOAA-CESSRST Graduate Fellows to provide feedback how Rising Sophomores report they are adjusting, in real time, and ensure that where possible, expectations that are not clear, can be clarified.

**More information about NOAA, NOAA line offices and NOAA-CESSRST would be helpful; and,**
Greater explanation of the cohort structure and how it applies to Rising Sophomores would also be helpful.

**Specific Objective 4/5:** To codify and publish key information for NOAA-CESSRST Fellows, and prospective students who will/may become NOAA-CESSRST Fellows

**Key Outcomes/Achievements 4/5:** Currently, the Education Expert and Student Affairs Manager are revising the *NOAA-CESSRST Undergraduate and Graduate Student Handbook*. The Handbook describes a number of important areas for NOAA-CESSRST Fellows among them:

a. A full description of NOAA and its mission, NOAA line offices and the relationship of NOAA-CESSRST to the offices
b. Early NOAA engagement and NERTO; NOAA SSIO and Hollings Fellowship;
c. The Individualized Student Development Plan (ISDP) importance and usefulness; and,
d. The cohort structure as a feature of NOAA-CESSRST Education and Training in fulfillment of the FFO workforce development goals.

The Handbook also reviews the components of the NOAA-CESSRST Letter of Understanding (LoU) and features a section on Frequently Asked Questions, the FAQ.

The Handbook will be shared in draft form with NOAA Program Officers and will be published by the next reporting period. It will then be distributed to Rising Sophomores during the Summer Bridge Programs and be emailed to current Undergraduate and Graduate Cohort I Fellows. Likewise, by the next report, Cohort II Fellows will receive The Handbook.

The distance learning platforms improvement.

Specific Objective 6: To enhance the sense of community and interconnectedness fellows and students have/need across NOAA-CESSRST campuses and to equip faculty and presenters to be more effective in teaching face to face and at a distance, simultaneously.

Key Outcome/Achievement 6: NOAA-CESSRST is currently researching platforms that may be able to enhance those currently in use, or replace them altogether, ensuring that the objectives of this activity are fulfilled.

Materials and engagement be facilitated for those at a distance by earlier interaction and more frequent communication with NOAA-CESSRST staff

Specific Objective 7: To provide early and frequent contact with Cohort I and II fellows who will be taking the Core Competency and equip them to be more active participants if they are at a distance. Activity 2 will also likely support those Fellows who are engaged face-to-face.

Key Outcome/Achievement 7: Communication and flow of information/questions/any curricular products ought to become more facile

Support faculty to shape the content of Core Competency to better fit the needs of students while also informing the Advanced Competency that needs to happen for all Cohorts, center-wide, in years 2, 3, 4 and 5.

Specific Objective 8: To provide a baseline understanding of the NOAA-CESSRST Core Competency design and delivery, given the heterogeneity of skills levels among the Graduate NOAA-CESSRST Fellows; to engage in real-time guidance and feedback to Fellows who are involved in learning; and to better frame the NOAA Social Science Theme.

We intend to produce full Core Competency syllabi and thus, present main points of discourse, complete topics of lectures including greater details about Core Competency content knowledge and skills acquisition and their link to NOAA-CESSRST Themes and research projects. These syllabi are intended to inform the Advanced Core Competency courses delivered at each campus of NOAA-CESSRST.

II. Products of Award

There are no limitations to the number of entries a Center submits. In reporting, keyword information can be directly pulled from Thomson Search and on Research.gov. NOTE: Recipient may provide images, tables, charts, or other graphics in support of the Products section. Recipient may include high-resolution photos.

Within the Products section, recipient can list any products resulting from the FY16 CSC award, during the specified reporting period, such as:

- **Degrees Awarded**: None during this reporting period
- **Publications in Journals**: 6 (Theme I – 2 and Theme II – 4; Theme III – 0)
- **Books**: None during this reporting period
- **Book Chapters**: None during this reporting period
- **Thesis/Dissertations**: None during this reporting period
- **Conference Papers, Posters and Presentations**: 23 (Theme I – 4 and Theme II – 19)
- **Other Publications**: None during this reporting period
- **Technologies or Techniques**: Modular Hybrid Green Infrastructure
- **Patents**: Patent for ecoWEIR technology to be issued spring 2017
- **Inventions**: None during this reporting period
- **Licenses**: None during this reporting period
- **Websites**: None during this reporting period
- **Other Products**: None during this reporting period

III. Participants in Award Performance

There are no limits on the number of participants listed for this section; however, the Center is required to list all participants who have worked one-person month or more for the project reporting period. NOTE: Conversion of percentage of effort to person months is as follows. To calculate person months, multiply the percentage of effort associated with the project times the number of months of the appointment. For example: 25% of a 9 month academic year appointment equals 2.25 (AY) person months (9 x 0.25 = 2.25).

a. What individuals have worked on the project?
b. What organizations have been involved as partners?
c. What other collaborators have been involved?
d. Have NOAA collaborators or contractors been involved?
<table>
<thead>
<tr>
<th>Name</th>
<th>Organization/Location</th>
<th>Project Role/Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEME I – Coastal Resilience</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CESSRST Advisors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr. Maria Tzortziou</td>
<td>CCNY/ EAS Dept.</td>
<td>Theme I Coordinator, Task-2/Project-2 Co-Coordinator, Investigator</td>
</tr>
<tr>
<td>Dr. Alex Gilerson</td>
<td>CCNY/ EE Dept.</td>
<td>CESSRST Ocean Observatories in Critical Coastal Regions</td>
</tr>
<tr>
<td>Dr. Roy Armstrong</td>
<td>UPRM</td>
<td>CESSRST Ocean Observatories in Critical Coastal Regions</td>
</tr>
<tr>
<td>Dr. Jennifer Cherrier</td>
<td>Brooklyn College-CUNY</td>
<td>Improved monitoring of HABs and their impacts in coastal eutrophic systems</td>
</tr>
<tr>
<td>Dr. Sam Ahmed</td>
<td>CCNY/ EE Dept.</td>
<td>Improved monitoring of HABs and their impacts in coastal eutrophic systems</td>
</tr>
<tr>
<td>Dr. Jonathan Munoz</td>
<td>UPRM</td>
<td>Investigator</td>
</tr>
<tr>
<td><strong>CESSRST Postdoc</strong></td>
<td>CESSRST Advisors -</td>
<td>CESSRST Advisors -</td>
</tr>
<tr>
<td>Dr. William Hernandez</td>
<td>CESSRST, Postdoctoral Scientist</td>
<td>Researcher, remote sensing and GIS</td>
</tr>
<tr>
<td><strong>NOAA Collaborators/Mentors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr. Rick Stumpf</td>
<td>NOAA-NOS/NCCOS</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>James Hendee</td>
<td>NOAA AOML</td>
<td>New NOAA Mentor</td>
</tr>
<tr>
<td>Karsten Shein</td>
<td>NOAA NCDC</td>
<td>New NOAA Mentor</td>
</tr>
<tr>
<td>Dr. Steve Morton</td>
<td>NOAA-NOS/CCEHBR</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Dr. Michael Ondrusek</td>
<td>NOAA/NESDIS/STAR</td>
<td>NOAA collaborator</td>
</tr>
<tr>
<td>Dr. Mark Eakin</td>
<td>NOAA/NESDIS/STAR</td>
<td>NOAA collaborator</td>
</tr>
<tr>
<td>Dr. Al Strong</td>
<td>NOAA/NESDIS/STAR</td>
<td>NOAA collaborator</td>
</tr>
<tr>
<td><strong>THEME II – Atmospheric Hazard</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CESSRST Advisors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fred Moshary</td>
<td>CCNY</td>
<td>Atmospheric dynamics and remote sensing of aerosols and plume transport</td>
</tr>
<tr>
<td>Barry Gross</td>
<td>CCNY</td>
<td>Satellite remote sensing of aerosols. Satellite remote sensing of PM2.5 pollution. Statistical PM2.5 estimation and forecasting</td>
</tr>
<tr>
<td>James Booth</td>
<td>City College of New York</td>
<td>Improved P-ETSS storm surge modeling system</td>
</tr>
<tr>
<td>Johnny Luo</td>
<td>City College of New York</td>
<td>GOES-R Storm Now Casting and Validation of GFDL GCM Lightning Simulations with GOES-R</td>
</tr>
<tr>
<td>Jorge Gonzalez</td>
<td>City College of New York</td>
<td>Convective initiation products in coastal processes Heat Stress and Urban Modeling lead</td>
</tr>
<tr>
<td>Sam Shen</td>
<td>SDSU</td>
<td>Lead, supervision, theory development</td>
</tr>
<tr>
<td>Prathap Ramamurthy</td>
<td>CCNY</td>
<td>Urban thermal product.</td>
</tr>
<tr>
<td>Hamidreza Norouzi</td>
<td>City Tech (CUNY)</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Miguel Vélez-Reyes</td>
<td>UTEP</td>
<td>Multispectral Remote Sensing Products</td>
</tr>
<tr>
<td>John Anderson</td>
<td>HU</td>
<td>CESON Activities</td>
</tr>
<tr>
<td>Robert Loughman</td>
<td>HU</td>
<td>OMPS Aerosol Analysis and consultant</td>
</tr>
<tr>
<td>Pat McCormick</td>
<td>HU</td>
<td>CESON Activities</td>
</tr>
<tr>
<td>Jia Su</td>
<td>HU</td>
<td>Ground-based remote sensing observations and</td>
</tr>
</tbody>
</table>
Ruben Delgado  
UMBC  
Remote Sensing Observations and Data Analysis, Algorithm Development of Mixing Layer Height

Belay Demoz  
UMBC  
Coordinator of Ceilometer NWS Testbed

Rafael Rodriguez Solis  
UPRM  
UPRM DBS point of contact

**CESSRST Research Scientist**

Moises Angeles (Leveraged)  
CCNY  
Climate Analysis for the Caribbean-Leveraged Postdoc

Brian Vant-Hull  
CCNY  
Senior Research Scientist, Urban Heat Island, Satellite thermal products

Yonghua Wu  
CCNY  
Lidar observation and data analysis

Mark Arend  
CESSRST/CCNY  
Urban Observations, meteorological surface and remote sensing Observations and Data Analysis

Yonghua Wu  
Yonghua Wu  
Yonghua Wu

**NOAA Collaborators/Mentors**

Satya Kalluri  
NOAA NESDIS STAR  
Collaborator/ GOES R Long Wave Products

Jeff McQueen  
NOAA (NWS)  
Air quality forecast model product

Jiangping Huang  
IMS & NOAA (NWS)  
Air quality forecast model product

Larry Flynn  
NOAA NESDIS STAR  
OMPS and NUCAPS Analysis

Shobha Kondragunta  
NOAA NESDIS STAR  
Low latency distribution of satellite derived aerosols and air pollution products.

Dennis Atkinson  
NOAA NWS  
NWS Ceilometer Network

Michael Hicks  
NOAA/NWS  
NWS ceilometer network

Pius Lee  
NOAA/ARL  
Air Quality Forecast/Modeling

W. Alan Brewer  
NOAA/ESRL  
Lidar remote sensing and observations, lidar technology

Russell Vose  
NOAA/NESDIS/NCEI  
Data Products and Data Management

Tom Smith  
NOAA NESDIS STAR  
Severe Storm Forecasting in Southern California

**Other Collaborators**

Mike Ku  
NYC DEC  
NYS air quality research and modeling

Hai Zhang  
IMSG  
VIIRS EPS Aerosol Products for DBS

Dennis Atkinson  
NOAA NWS  
NWS Ceilometer Network

Michael Woodman  
Maryland Dept. of Environment  
Air Quality Forecast and Management

Tom Eisel  
NYC Office Mayor’s Office  
Technical Contact with NYC on applications of Meteorology and remote sensing on weather impacts on infrastructure

**THEME III – Water Prediction**

**CESSRST Advisors**

Naresh Devineni  
City College of New York  
Faculty, Lead, supervision, theory development

Tarendra Lakhankar  
City College of New York  
Scientist, Lead, supervision, theory development

Reza Khanbilvardi  
City College of New York  
Faculty, Lead, supervision, theory development
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Position/Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nir Krakauer</td>
<td>City College of New York</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Balazs Fekete</td>
<td>City College of New York</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Reza Khanbilvardi</td>
<td>City College of New York</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Prathap Ramamurthy</td>
<td>City College of New York</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Jonathan Munoz</td>
<td>UPRM</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Rafael Rodriguez</td>
<td>UPRM</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Peter Romanov</td>
<td>City College of New York</td>
<td>Scientist, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Craig Tweedie</td>
<td>UTEP</td>
<td>Scientist, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Trent Biggs</td>
<td>SDSU</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Kyle MacDonald</td>
<td>City College of New York</td>
<td>Faculty, supervision, theory development</td>
</tr>
<tr>
<td>Fred Moshary</td>
<td>City College of New York</td>
<td>Faculty, supervision, theory development</td>
</tr>
<tr>
<td>Alex Gilerson</td>
<td>City College of New York</td>
<td>Faculty, supervision, theory development</td>
</tr>
<tr>
<td>Miguel Velez-Reyes</td>
<td>UTEP</td>
<td>Faculty, supervision, theory development</td>
</tr>
<tr>
<td>Walter Oechel</td>
<td>SDSU</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Donatella Zona</td>
<td>SDSU</td>
<td>Faculty, supervision, theory development</td>
</tr>
<tr>
<td>Rafael Rodriguez</td>
<td>UPRM</td>
<td>Faculty, Lead, supervision, theory development</td>
</tr>
<tr>
<td>Roy Armstrong</td>
<td>UPRM</td>
<td>Faculty, supervision, theory development</td>
</tr>
<tr>
<td>Jonathan Munoz</td>
<td>UPRM</td>
<td>Faculty, supervision, theory development</td>
</tr>
<tr>
<td>Belay Demoz</td>
<td>UMBC</td>
<td>Faculty, supervision, theory development</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NOAA Collaborators/Mentors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Felix Kogan</td>
<td>NOAA/NESDIS/STAR</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Xiwu Zhan</td>
<td>NOAA/NESDIS/STAR</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Roberto Garcia</td>
<td>NWS – San Juan</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Edward Clark</td>
<td>National Water Center</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Robb Wright</td>
<td>NOAA’s Office of Response and Restoration</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Satya Kalluri</td>
<td>NOAA/NESDIS/STAR</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Ralph Ferraro</td>
<td>NOAA/NESDIS/STAR</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Chris Grassotti</td>
<td>NOAA/NESDIS/STAR</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Michelle Stokes</td>
<td>NWS</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Roger Pierce</td>
<td>NWS</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Tim Brown</td>
<td>NWS</td>
<td>NOAA Collaborator</td>
</tr>
<tr>
<td>Jeff Key</td>
<td>NOAA/NESDIS/STAR</td>
<td>Collaborator/Mentor</td>
</tr>
<tr>
<td>Xiwu Zhan</td>
<td>NOAA/NESDIS/STAR</td>
<td>Collaborator/Mentor</td>
</tr>
<tr>
<td>Colm Sweeney</td>
<td>NOAA/OAR/ESRL</td>
<td>Collaborator/Mentor</td>
</tr>
<tr>
<td>Pieter Tans</td>
<td>NOAA/OAR/ESRL</td>
<td>Collaborator/Mentor</td>
</tr>
<tr>
<td>James Butler</td>
<td>NOAA/OAR/ESRL</td>
<td>Collaborator/Mentor</td>
</tr>
<tr>
<td>Mareike Sudek</td>
<td>NOAA/NMFS</td>
<td>Collaborator/Mentor</td>
</tr>
<tr>
<td>Bryan Thomas</td>
<td>NOAA/OAR/ESRL</td>
<td>Collaborator/Mentor</td>
</tr>
<tr>
<td>Shachak Pe’erii</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other Collaborators</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Michael Cosh</td>
<td>USDA</td>
<td>Collaborator</td>
</tr>
</tbody>
</table>
For the reporting period, specific questions are listed below. For award participants, recipient must provide information for:

### Students (Cohort I) CESSRST Leveraged Students

<table>
<thead>
<tr>
<th>Name</th>
<th>Major &amp; Degree Level (UG, MS, PhD)</th>
<th>Institution (CUNY, UTEP, HU, UMBC, UPRM, SDSU)</th>
<th>Student’s role in the task/project description</th>
<th>CESSRST Advisor</th>
<th>Internships /Presentations /Publications if any</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theme I: Coastal Resilience</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Omar Lopez</td>
<td>MS</td>
<td>UPRM</td>
<td>Water sampling and analysis</td>
<td>Roy Armstrong</td>
<td></td>
</tr>
<tr>
<td>Rezwon Islam</td>
<td>UG, EE</td>
<td>CUNY</td>
<td>Processing of the satellite imagery to analyze FL-[Chl] relationship</td>
<td>Alex Gilerson</td>
<td>CUNY REU Student. Sampling fluorescence reflectance from ocean color satellite imagery using fluorescence line height (FLH) algorithm”, AMS Seattle, WA, Jan 2017</td>
</tr>
<tr>
<td>Claudia Duran Garcia</td>
<td>Undergraduate, ESE, CCNY</td>
<td>CUNY</td>
<td>Evaluation of Karenia brevis detection techniques using MODIS and VIIRS imagery against in situ measurements on the West Shelf of Florida</td>
<td>Sam Ahmed</td>
<td>Summer REU program at CUNY</td>
</tr>
<tr>
<td>Rachel Li</td>
<td>Undergraduate, ESE, CCNY</td>
<td>CUNY</td>
<td>Assessing Spatiotemporal Variability in NO₂ and O₃ Along the Korean Peninsula Using Remote Sensing and Ground-Based Observations</td>
<td>Maria Tzortziou</td>
<td>Summer REU program at CUNY</td>
</tr>
<tr>
<td>Usaama Van</td>
<td>Undergraduate, EE, CCNY</td>
<td>CUNY</td>
<td>Using Remotely Sensed Data and In-Situ Measurements to</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Theme II: Atmospheric Hazards</strong></td>
<td><strong>Understand Carbon Fluxes between the Kirkpatrick Marsh and Rhode River estuary in the Chesapeake Bay</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equisha Glenn</strong></td>
<td>PhD.</td>
<td>CCNY</td>
<td>Correlations of SSTs with Convective Processes in the Tropics</td>
<td>Jorge Gonzalez</td>
<td>(AMS 2017). Will join Cohort II in Fall 2017</td>
</tr>
<tr>
<td><strong>Sam Lightstone</strong></td>
<td>PhD, Electrical Engineering</td>
<td>CUNY</td>
<td>Development of algorithms for 24 Hour PM25 forecasts using both VIIRS and GOES-R products.</td>
<td>Barry Gross</td>
<td>NYSERDA Fellowship 20K / Year</td>
</tr>
<tr>
<td><strong>Anjeza Arapi</strong></td>
<td>UG, Environmental Engineering</td>
<td>CUNY</td>
<td>Lidar observations and data analysis</td>
<td>Fred Moshary and Yonghua Wu</td>
<td>CESSRST REU Student. Presentation at AMS annual meeting</td>
</tr>
<tr>
<td><strong>Adrian Diaz Fortich</strong></td>
<td>Electrical Engineering, PhD</td>
<td>CUNY</td>
<td>Aerosol Transport Dynamics in Urban Areas</td>
<td>Fred Moshary</td>
<td>Presented at SPIE, ILRC 28, and NYSERA/NESCA UM workshop</td>
</tr>
<tr>
<td><strong>Sean Leavor</strong></td>
<td>Atmospheric Science, PhD</td>
<td>HU</td>
<td>Global Volcanic Aerosol Tracking</td>
<td>Pat McCormick</td>
<td>Presented at the 28th Annual ILRC</td>
</tr>
<tr>
<td><strong>Steve Buckner</strong></td>
<td>Atmospheric Science, PhD</td>
<td>HU</td>
<td>Infusing OMPS LP ozone measurements into NUCAPS</td>
<td>Pat McCormick</td>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Theme III: Water Prediction and Ecosystem Services</strong></th>
<th><strong>Understand Carbon Fluxes between the Kirkpatrick Marsh and Rhode River estuary in the Chesapeake Bay</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maegan Salinas</strong></td>
<td>MS student, Geography</td>
</tr>
<tr>
<td><strong>Candace Alagata</strong></td>
<td>Undergraduate Student</td>
</tr>
</tbody>
</table>
What individuals have worked on the project? (Expand as needed)

<table>
<thead>
<tr>
<th>Name</th>
<th>Management (includes budget, data/MIS, Evaluation and internal day-to-day administration)</th>
<th>Education (includes Core Competency, summer bridge, Outreach and Communications)</th>
<th>Collaborative Research (Includes training, coordinating NERTOs, dissemination, reporting and communications)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reza Khanbilvardi</td>
<td>35%</td>
<td></td>
<td>5%</td>
</tr>
<tr>
<td>Shakila Merchant</td>
<td>50%</td>
<td>40%</td>
<td>10%</td>
</tr>
<tr>
<td>William Rossow</td>
<td>20%</td>
<td>20%</td>
<td>60%</td>
</tr>
<tr>
<td>Fred Moshary</td>
<td>20%</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Olga Joseph</td>
<td>50%</td>
<td></td>
<td>50%</td>
</tr>
<tr>
<td>Georgina Fekete</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paul Alabi (through Microburst)</td>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elizabeth Day Miller</td>
<td></td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Janice Easton (through Evaluation by Design)</td>
<td>70%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Maria Tzortziou</td>
<td>5%</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Jorge Gonzalez</td>
<td>10%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Naresh Devineni</td>
<td>5%</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Tarendra Lakhankar</td>
<td>25%</td>
<td></td>
<td>75%</td>
</tr>
<tr>
<td>James Booth</td>
<td>5%</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Prathap Ramamurthy</td>
<td></td>
<td></td>
<td>15%</td>
</tr>
<tr>
<td>Alex Gilerson</td>
<td></td>
<td></td>
<td>15%</td>
</tr>
<tr>
<td>Barry Gross</td>
<td></td>
<td></td>
<td>15%</td>
</tr>
<tr>
<td>Eugene Leykin</td>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yonghua Wu</td>
<td></td>
<td></td>
<td>17%</td>
</tr>
</tbody>
</table>

IV. Impacts of Award

What is the impact on the development of future workforce candidates for the principal discipline(s) of the award and NOAA mission-aligned support of the project?

None during this reporting period

What is the impact on other disciplines and Program Level Outputs and Outcomes aligned with the 2016 FFO?

None during this reporting period
What is the impact on the development of candidates for the NOAA mission future workforce?

None during this reporting period

What is the impact of the Center activities to build institutional capacity in support of the objectives of the NOAA FY16 CSC award?

None during this reporting period

What is the impact of the NOAA award on the Center’s data and information resources? To whom and how this is information and the Center accomplishments communicated.

None during this reporting period. The new CESSRST Communication staff in coordination with the CESSRST management team is working on creating a Strategic Plan for communication of the Center accomplishments to NOAA, other stakeholders and congressional delegates of all states where CESSRST institutions exist.

How has the Center successfully conducted transfer of research results and new technologies in support of NOAA mission-aligned R2X?

None during this reporting period.

What were the societal impacts of the Center research activities? How were or are the impact results communicated to the general public.

- Severe weather and air quality events have major ecological, human-health, and socio-economic impacts. Sustained remote-sensing observations at local, regional, and global scales are critical to a scientific understanding of the current and future state of Weather. Atmospheric measurements coupled to satellite remote sensing and surface observations of gases and aerosols allows NOAA to improve and validate numerical forecasts for weather and air quality that will minimize the impact of extreme events on public health and property. In addition, the three CESSRST Direct Broadcast Satellite (DBS) receiving systems will provide both weather and air quality forecasters and emergency managers near real-time access to NOAA satellite products with sufficient lead-time to analyze and incorporate this information into their forecasts and warnings thus potentially influencing local to regional real-time decision making. Theme II project results can save lives by alerting and preparing the public to oncoming severe weather events such as hurricanes and to poor or life-threatening air quality episodes. The spatiotemporal variations of the critical pollutants are essential to advise the public on health impact.

- Venus of communications include local agencies such as NYC Department of Health and Mayors Office, NYS DEC, MD Department of Environment, etc.
The discussion on adaptation and mitigation invariably comes to recognize that many of the potential impacts on society are felt through changes in the regional water resources. These changes may manifest as change in the intermittency or frequency and intensity of rainfall events, alteration or extension of the dominant wet/warm/cold season(s), or shift in the inter-annual frequency and persistence of wet and drought years. Such extremes can have adverse impacts on the natural ecosystem, society and the economy of the region. Consequently, it is important to explore strategies for adaptation to natural hazards and to manage the potentially impacted sectors. In this work, we will address this significant area, exploring the modeling, and prediction of floods and droughts, their climate and atmospheric determinants, and how these may affect interlinked human activities at multiple scales of cities and river basins.

Evapotranspiration and Snow are the key element for many socioeconomic activities because of its high significance for agriculture and water management. Long term observing of snow-based indices will provide an additional value for decision-makers, for example when planning investments for tourist infrastructure, protection measures against avalanches, or environmental planning.

Results from the study will be presented to decision makers (NWS, Emergency Management), residents, and community advocacy groups.

V. Changes / Challenges

If not previously reported in writing to NOAA through other mechanisms, provide the following additional information or state, "Nothing to Report", if applicable.

Changes in performance of the award objectives - approach and reason(s) for change:

Dr. Nancy Degnan replaced Dr. Elizabeth Day-Miller in June 2017 as our new Education Expert. The reason for this change was because Dr. Miller was located in West VA, it became difficult to accomplish the program objectives and goals and having daily interactions.

Actual or anticipated problems or delays and actions or plans to resolve them:

Due to Hurricane Maria and severe devastation of the Puerto Rico Island, attempts are being made by the CESSRT Director and management to communicate with the UPRM members (students, faculty and staff) to assess the need and the extent of support that may be required in order help the team to get back to normalcy. Special attempts are being made particularly for the graduate students – Suhey and Carlos who are planning to do their NERTO this summer, and may need to collocate to another CESSRST lab/institution. Plans are underway to also offer help through CCNY and CUNY leadership through donations and charity events.
Changes that have a significant impact on expenditures:

None during this reporting period

**VI. Special Award Conditions**

This report section is intended to provide information on progress under each special award condition for the specific reporting period. This is not cumulative reporting.

Accomplishments (provide evidence) in implementing of:

**Center Evaluation** – activities completed for the Evaluation Plan that assesses program progress and measures, the impact of activities related to intended education, and training, research and outcomes of the CSC.

**Direct Student Support - Participant Beneficiaries**

Increase in 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.

**EPP CSC Award Postsecondary Student Cohort(s) Supported (provide for each student by name):**

- Tuition:
- Stipend:
- Travel:
- NERTO:
- One-time Research:

(Please see appendix – 1 for the CESSRST Student tracker database)

**Professional Development - Award Recipient Must Report Activities Accomplished for**

1. **Rising Sophomore Experiential Training Program.** Provide activities completed for IV., B., 8.1.2 (i) 1. thru 3. (FFO pg. 39). Students must be identified by name, home academic institution, academic year and major.
CESSRST institutionalized the first summer bridge program in summer 2017 [http://noaaCESSRST.org/education/education](http://noaaCESSRST.org/education/education). Seven (7) rising sophomores from all CESSRST partners’ institutions and their affiliated community college students were recruited. CESSRST Information sessions were held across all campuses to increase recruitment efforts. Three out of seven students are eligible to apply for the NOAA scholarships.

More efforts in terms of recruitment and outreach are in place to identify a strong cohort of rising sophomores to train them to submit a strong application(s) for NOAA Hollings and Undergraduate Scholarship Program.

2. **Individual Student Development Plan.** Center activities to ensure completion, monitoring and student success.

A new CESSRST management information system (MIS) is being developed that will enable all CESSRST supported students to create their Individual Student Development Plan (ISDP). The CESSRST MIS will be fully developed and expected to be beta tested by October 2017 and available for the cohort I students to complete their online ISDP portfolios. The new MIS system is web-based interactive system – that will be available to CESSRST advisors, NOAA mentors, CESSRST administrators and NOAA Program Office as needed. The MIS will also have the ability for the researchers (students, faculty) conducting NOAA CESSRST related research to undertake responsible conduct of research (RCR). The system will track, alert and ensure all RCR are completed within the 6 months of their admission into the program.

3. **Student Preparation for Success in the Career Path Relevant to the Center Award.** Provide Center activities with activity titles, dates completed, participants, outcomes for Center measures of success.

The students preparation for success in the career path relevant to CESSRST will be achieved in three levels – (1) creation of the ISDP; (2) Core Competency, Professional Development and NERTO tracking; and (3) Self-Assessment during various evaluation/survey tools which are being developed by our CESSRST Evaluator. These survey tools are being devised and will be submitted for approval by the CUNY IRB prior to their administration. The surveys will help assess and document the learning outcomes of the students and evidence of success.

**Post-Doctoral Program -**

Center Process to Recruit and Select Postdoctoral Fellows

For each Fellow provide Approved Postdoctoral Plan including anticipated number and proposed dates for publication submissions; activities; NOAA-facility tenure; and, anticipated products in support of Center priorities for education and training.
Dr. William Hernandez has been recruited as our first postdoctoral scientist. Application are being sought for the second Post Doc position, which is available online http://www.noaacrest.org/apply/noaa-crest-post-doc-application.

In the next five years CESSRST will hire 4 to 5 postdoc scientists with 2 year plan for each candidate. Dr. William Hernandez, submitted his postdoc proposal to CESSRST, which is being reviewed by NOAA program office.

Please note that Dr. Hernandez’s plan to visit NOAA/NESDIS/STAR and CESSRST to finalize his Post Doc plan in October has been postponed due to the recent devastation in PR Island).

However his activities and progress updates for summer 2017 is given below.

Research Activities:
- Enhanced the VIIRS water quality data products by providing a bottom albedo correction in shallow coastal areas.
- Collected field Data Water Quality Parameters and Optical Properties of La Parguera and Guanica

Outreach Activities:
- Submitted to NOAA Coral Reef Conservation Program (CRCP) a summary for publication as a newsletter entitled A multi-sensor approach of ocean color tools to monitor Land-based Sources of Pollution (LBSP) over coral reef in priority watersheds.
- Showcase of postdoc work in the NOAA/NOS/NCCOS Project Explorer website https://coastalscience.noaa.gov/projects/detail?key=294

Mentoring Activities:
- Support for graduate students fieldwork for water quality data, optical in situ measurements in coastal environments (Theme I) in Guanica and La Parguera.
- Support for graduate students in satellite data image analysis and GIS in CREST Theme I research areas.
- Contacted Dr. Maria Tzortziou to develop a plan for mentoring and support of CUNY students research activities. Follow–up meeting was scheduled for early September 2017.
- Reviewed CREST graduate student Suhey Ortiz-Rosa thesis dissertation proposal.
- Discussions with potential CREST graduate student Omar Lopez on possible research and thesis topics.

Publications:
- Reviewed Results and Discussion sections and prepared graphs for article entitled High-resolution sensors for water quality in near-shore environments to be submitted for the Journal of Remote Sensing Special Issue on Water Quality.
- Final edits and included review and comments from Dr. Roy Armstrong for article entitled Inherent Optical Properties in Coastal Waters from High-Resolution Sensors to be submitted to the Journal of Geophysical Research in Fall 2017.

Conferences/Symposia:
• Submitted abstract entitled: **Higher-resolution sensors for water quality in near-shore environments** for participation in the poster session of the Ford Fellows Conference 2017 to be held in San Juan, PR on September 29-30, 2017.

**Training:**
• Processed Landsat 8 OLI and Sentinel 2A MSI imagery using ACOLITE (self-taught) from User Manual.

**Networking:**
• Participation in NOAA/NESDIS/STAR/CYW Monthly Megacall (NOAA Lead: Dr. Mark Eakin)

**Pre-Publication Manuscript Submission**
Provide anticipated number and proposed dates for Center submissions for both faculty and students

It is anticipated that a minimum of two papers will be submitted by each thematic researchers by the students and faculty. CESSRST supported students are required to publish a minimum of one or two peer-reviewed papers as a graduate student – as part of their professional competency training. This will be reiterated and discussed with the student at the cohort meetings that will be coordinated by the CESSRST Education Coordinator beginning of each semester. During this reporting period 6 peer reviewed publication has been published.

**NOAA Substantial Involvement and Collaborative Engagement**

Identify NOAA mentors and collaborators, including: mentor and aligned student mentored; start date and time mentorship time commitment; Line Office affiliation; and, project title.

Several NOAA collaborators have already been identified (see section III). In addition, several collaborative discussions undertook during this reporting period between CESSRST faculty and NOAA mentors to ensure early engagement and involvement of NOAA mentors in graduate student training and NERTO internships.

Communications are also underway to expand collaborative research opportunities at OAR/GFDL, Princeton, NJ. Conversations are underway with Dr. Ramaswamy, Director, GFDL and Whit Anderson, Deputy Director, GFDL. Communications are also underway to expand students SSIOs at Great Lakes Research Labs, in coordination with Bob Rabin/NSSL and Drew Gronewold from OAR/GLREL. We anticipate atleast 2 SSIO opportunities for CESSRST supported students by next summer.

**CSC Programmatic Special Award Conditions**

Recipient must provide accomplishments for Programmatic Special Award Conditions that address the education and training, scientific research and administrative functions
in the award including, for example, outcomes from Advisory Board Meetings, effective management for all key personnel positions, early engagement with NOAA in performance of award, outcomes of Center meetings, integration of human dimensions in all award activities, implementing longitudinal outcomes tracking, and overall Program-level metrics for the EPP/MSI CSC postsecondary awards as a Federal STEM Education Agency-mission Future Workforce, for reporting period (NOT cumulative).

A. Provide FY16 Center award information for:

1. **Number of EPP-funded post-secondary students from underrepresented minority communities** who are trained 24 (8=UG and 16 Graduate) and graduate **None** in NOAA-mission sciences.
2. **Total number of EPP-funded post-secondary students who are** trained 33 (14=UG; 10=MS and 9=PhD) and graduate **none so far** in NOAA-mission fields relevant to this announcement.
3. **Number of EPP-funded graduates who enter the NOAA mission workforce as hires** by NOAA **NONE**, NOAA contractors **NONE**, NOAA partners **NONE**, resource management agencies **NONE**, NGO community **NONE**, academia **NONE**, or as entrepreneurs **NONE**.
4. **Number of EPP-funded graduates who participate in and complete NOAA agency mission-related postdoctoral level programs** **NONE**.
5. **Total new funds $3,113,022 leveraged with NOAA EPP award** (including post-secondary student support).

B. Provide FY16 Center award information to demonstrate contribution to supporting CSC Desired Program level Outcomes and Outputs defined in FFO p. 7 - 10, for this reporting period.

A Center Evaluation Plan has been submitted. In addition – several assessment/monitoring and evaluation tools are being created to help assess and demonstrate evidence of program outcomes (4 Education; 2 Science and 4 Management) and several outputs.
NOTE:
INSERT BLANK PAGE BEFORE NEXT SECTION OF REPORT
VII. Financial Information

a. Total NOAA funding breakout

FY 16 Award Center base funds: Indicate how funds were used for the reporting period, using award budget categories to provide detailed information for reporting period. Unobligated balances will be compared with SF 425 reporting.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration/Management</td>
<td></td>
<td>$59,640.67</td>
</tr>
<tr>
<td>Research Scientists/Postdocs</td>
<td></td>
<td>$78,758.94</td>
</tr>
<tr>
<td>Technician /IT</td>
<td></td>
<td>$-</td>
</tr>
<tr>
<td>Faculty Summer Salaries</td>
<td></td>
<td>$64,572.04</td>
</tr>
<tr>
<td>MTA Tax</td>
<td></td>
<td>$470.60</td>
</tr>
<tr>
<td>Fringes &amp; Benefits (Total)</td>
<td></td>
<td>$58,206.75</td>
</tr>
<tr>
<td>Travel -Domestic (Staff)</td>
<td></td>
<td>$17,631.10</td>
</tr>
<tr>
<td>Student Travel</td>
<td></td>
<td>$15,988.98</td>
</tr>
<tr>
<td>Student Fellowship</td>
<td></td>
<td>$204,411.03</td>
</tr>
<tr>
<td>Student Tuition</td>
<td></td>
<td>$55,652.21</td>
</tr>
<tr>
<td>Office Supplies General</td>
<td></td>
<td>$840.90</td>
</tr>
<tr>
<td>Computer Supplies &amp; Software &amp; Maintenance</td>
<td></td>
<td>$8,741.88</td>
</tr>
<tr>
<td>Education, Recruitment &amp; Outreach</td>
<td></td>
<td>$18,448.51</td>
</tr>
<tr>
<td>Seminars/Outreach</td>
<td></td>
<td>$-</td>
</tr>
<tr>
<td>Publishing</td>
<td></td>
<td>$-</td>
</tr>
<tr>
<td>Shipping and Postage/Mailing/Communication</td>
<td></td>
<td>$334.63</td>
</tr>
<tr>
<td>Program Evaluators (Evaluation by Design)</td>
<td></td>
<td>$-</td>
</tr>
<tr>
<td>Satellite Receiving Data Manager/Consultant</td>
<td></td>
<td>$45,200.00</td>
</tr>
<tr>
<td>F&amp;A Costs</td>
<td></td>
<td>$82,006.32</td>
</tr>
<tr>
<td>Subcontractors (invoked so far)</td>
<td></td>
<td>$61,724.00</td>
</tr>
<tr>
<td>Subcontractors (Budgeted)</td>
<td></td>
<td>$1,066,516.00</td>
</tr>
<tr>
<td>Subcontractors (rollover)</td>
<td></td>
<td>$-</td>
</tr>
<tr>
<td><strong>TOTAL NET Expenditure</strong></td>
<td></td>
<td><strong>$1,426,944.56</strong></td>
</tr>
</tbody>
</table>
Postsecondary Direct Student Support:

See appendix I

b. Total leverage funding breakout

Indicate funding source, type (grant or contract), amount, Center PI, project title; and, how funding contributed to the FY 16 Center award for:

Postsecondary Student Support: - Not Available

Collaborative Research (see below chart)

<table>
<thead>
<tr>
<th>Funding Agency</th>
<th>Funding start date</th>
<th>Funding end date</th>
<th>Name of Principal Investigator/ CO PI</th>
<th>Total Funding Amount</th>
<th>Number of Performance Period</th>
<th>6 month funding (March 1-September 30 2017)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NASA</td>
<td>02/23/2016</td>
<td>01/14/2018</td>
<td>TZORTZIOU, MARIA</td>
<td>$53,251.00</td>
<td>3</td>
<td>$14,064.12</td>
</tr>
<tr>
<td>NASA</td>
<td>09/01/2017</td>
<td>08/31/2018</td>
<td>TZORTZIOU, MARIA</td>
<td>$45,000.00</td>
<td>1</td>
<td>$22,561.81</td>
</tr>
<tr>
<td>NASA</td>
<td>09/01/2017</td>
<td>08/31/2018</td>
<td>MCDONALD, KYLE</td>
<td>$44,625.00</td>
<td>1</td>
<td>$22,737.80</td>
</tr>
<tr>
<td>DoD</td>
<td>7/15/2017</td>
<td>7/14/2018</td>
<td>GILBERSON, ALEX</td>
<td>$331,088.00</td>
<td>1</td>
<td>$165,998.79</td>
</tr>
<tr>
<td>NSF</td>
<td>4/1/2017</td>
<td>3/31/2018</td>
<td>TZORTZIOU, MARIA</td>
<td>$544,159.00</td>
<td>1</td>
<td>$270,826.97</td>
</tr>
<tr>
<td>NASA</td>
<td>8/11/2017</td>
<td>9/10/2017</td>
<td>TZORTZIOU, MARIA</td>
<td>$70,062.64</td>
<td>1</td>
<td>$426,214.39</td>
</tr>
<tr>
<td>NASA</td>
<td>8/8/2017</td>
<td>8/7/2018</td>
<td>TZORTZIOU, MARIA</td>
<td>$682,277.00</td>
<td>1</td>
<td>$342,075.69</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Theme I - Sub total</strong></td>
<td><strong>$1,770,462.64</strong></td>
<td></td>
<td><strong>$1,266,115.58</strong></td>
</tr>
<tr>
<td>NSF</td>
<td>07/01/2017</td>
<td>12/31/2017</td>
<td>MOSHARY, FRED</td>
<td>$50,000.00</td>
<td>1</td>
<td>$49,863.39</td>
</tr>
<tr>
<td>NASA</td>
<td>04/02/2017</td>
<td>04/02/2018</td>
<td>MOSHARY, FRED</td>
<td>$75,000.00</td>
<td>1</td>
<td>$37,603.02</td>
</tr>
<tr>
<td>NASA</td>
<td>07/10/2017</td>
<td>07/09/2021</td>
<td>LUO, ZHENGZHAO</td>
<td>$430,829.00</td>
<td>1</td>
<td>$53,853.63</td>
</tr>
<tr>
<td>JET PROPULSION LABORATORY</td>
<td>01/01/2017</td>
<td>12/31/2017</td>
<td>LUO, ZHENGZHAO</td>
<td>$40,000.00</td>
<td>1</td>
<td>$20,054.95</td>
</tr>
<tr>
<td>UNIVERSITY OF WISCONSIN</td>
<td>08/18/2016</td>
<td>08/17/2017</td>
<td>GLADKOVANA, IRINA</td>
<td>$92,017.00</td>
<td>2</td>
<td>$46,134.90</td>
</tr>
<tr>
<td>NYS Energy Research &amp; Development Authority</td>
<td>02/26/2015</td>
<td>08/31/2017</td>
<td>GROSS, BARRY</td>
<td>$40,000.00</td>
<td>5</td>
<td>$7,960.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Theme II - Sub total</strong></td>
<td><strong>$727,846.00</strong></td>
<td></td>
<td><strong>$215,470.62</strong></td>
</tr>
<tr>
<td>DoD</td>
<td>09/15/2017</td>
<td>09/14/2018</td>
<td>DEVINENI, NARESH</td>
<td>$762,097.00</td>
<td>1</td>
<td>$382,095.34</td>
</tr>
<tr>
<td>NASA</td>
<td>09/01/2017</td>
<td>08/31/2018</td>
<td>GROSS, BARRY</td>
<td>$39,792.00</td>
<td>1</td>
<td>$19,950.66</td>
</tr>
<tr>
<td>COLUMBIA UNIVERSITY</td>
<td>04/01/2017</td>
<td>03/31/2018</td>
<td>LUO, ZHENGZHAO</td>
<td>$41,200.00</td>
<td>1</td>
<td>$20,656.59</td>
</tr>
<tr>
<td>VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY</td>
<td>11/17/2016</td>
<td>11/16/2019</td>
<td>KRAKAUER, NIR</td>
<td>$340,969.00</td>
<td>2</td>
<td>$56,880.11</td>
</tr>
<tr>
<td>MICHIGAN TECHNOLOGICAL UNIVERSITY</td>
<td>07/12/2016</td>
<td>07/11/2018</td>
<td>MCDONALD, KYLE</td>
<td>$150,000.00</td>
<td>2</td>
<td>$37,551.44</td>
</tr>
<tr>
<td>INSTITUTO TECNOLOGICO DE SANTO DOMINGO (INTEC)</td>
<td>03/02/2015</td>
<td>03/01/2018</td>
<td>GONZALEZ, JORGE</td>
<td>$306,220.00</td>
<td>5</td>
<td>$51,036.67</td>
</tr>
<tr>
<td>NASA</td>
<td>8/17/2017</td>
<td>8/16/2018</td>
<td>MCDONALD, KYLE</td>
<td>$591,828.00</td>
<td>1</td>
<td>$296,726.95</td>
</tr>
<tr>
<td>Columbia University</td>
<td>8/1/2017</td>
<td>7/31/2018</td>
<td>DEVINENI, NAESH</td>
<td>$180,927.00</td>
<td>1</td>
<td>$90,712.03</td>
</tr>
<tr>
<td>NSF</td>
<td>8/1/2017</td>
<td>7/31/2018</td>
<td>GONZALEZ, JORGE</td>
<td>$317,835.00</td>
<td>1</td>
<td>$159,354.09</td>
</tr>
<tr>
<td>University of Maryland</td>
<td>9/1/2017</td>
<td>8/31/2018</td>
<td>KHANBILVARDI, REZA</td>
<td>$184,495.00</td>
<td>1</td>
<td>$92,500.93</td>
</tr>
<tr>
<td>NOAA</td>
<td>9/1/2017</td>
<td>8/31/2018</td>
<td>KRAKAUER, NIR</td>
<td>$69,688.00</td>
<td>1</td>
<td>$69,497.60</td>
</tr>
<tr>
<td>NASA</td>
<td>5/2/2017</td>
<td>5/1/2018</td>
<td>VANT-HULL BRIAN</td>
<td>$103,836.00</td>
<td>1</td>
<td>$52,060.63</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Theme III - Sub total</strong></td>
<td><strong>$3,088,887.00</strong></td>
<td></td>
<td><strong>$1,329,023.03</strong></td>
</tr>
<tr>
<td>NSF</td>
<td>07/01/2017</td>
<td>06/30/2022</td>
<td>GONZALEZ, JORGE</td>
<td>$2,315,184.00</td>
<td>1</td>
<td>$231,518.40</td>
</tr>
<tr>
<td>PINKERTON FOUNDATION</td>
<td>06/01/2017</td>
<td>05/31/2018</td>
<td>MERCHANT, SHAKIRA</td>
<td>$567,000.00</td>
<td>4</td>
<td>$70,895.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Grand Total</strong></td>
<td><strong>$8,469,379.64</strong></td>
<td></td>
<td><strong>$3,113,022.63</strong></td>
</tr>
</tbody>
</table>