2016-2021 Implementation Plan for Cooperative Agreement #:NA16SEC4810006

NOAA COOPERATIVE SCIENCE CENTER FOR ATMOSPHERIC SCIENCES and METEOROLOGY

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I. Executive Summary

The Cooperative Science Center in Atmospheric Sciences and Meteorology (ASM) vision is a diverse and inclusive technical workforce that supports a healthy and sustainable environment and a more resilient nation in the face of increasing vulnerability to weather extremes and environmental threats. Our goal is to produce technically and environmentally literate professionals, with focus on underrepresented populations, who will directly contribute to the NOAA workforce through science, service, and stewardship. The ASM will address the recently identified and urgent need for more effectively evolve its services to better address the increasingly complex environmental, societal, and economic challenges that extreme weather and a changing climate present. The proposed ASM will utilize research-training as a tool to address NOAA's education goals with specific emphasis post-secondary education to serve future workforce needs.

The primary goal of the ASM is to use collaborative research as a mechanism to educate and produce a highly-skilled cadre of technical and environmentally literate professionals, with focus on underrepresented populations, who will directly contribute to the NOAA workforce through science, service, and stewardship.

Training post-secondary students through the collaborative research in partnership with NOAA facilities, scientists, and personnel. The primary outputs will be the graduates of this program. Additional outputs will be scientific and technical advancements that support NOAA's mission, including but not limited to, model improvement, service assessments, and tools to enhance community literacy, especially among underserved populations.

The ASM is comprised of a thirteen-member academic consortium with Howard University as the lead institution. The partnership has nine partners as sub-awardees and four partners (related through a non-funded articulation agreements). The institutional composition is four Historically Black Colleges/Universities (HBCUs), three Hispanic Serving Institutions (HSIs), two Minority-serving Institutions (MSIs), and three non-MSIs. With the changing National demographic, it is useful to define Historically White Institutions (HWIs) as those academic institutions whose incipient MSI designation is not a result of strategic effort, nor a historical investment, nor significant experience in mentoring minority students. These new designations result from the national changes in racial demographics of their student populations at large. Most often they are not reflective of the student populations in STEM fields where students of color remain woefully underrepresented. A detailed identification of the institutional partners is provided in Table 1. The geographic distribution of academic partners coupled with the extended relationships through NOAA facilities allows for a Nationwide impact to be made. The current partnership reflects thirty-one (31) participating faculty from institutions in eight (8) states and two (2) institutions from a US territory that span from the east coast to the west coast of the continental US. Over 50% of the participating faculty have current experience working with NOAA scientists in collaborative fashion. The partnership also includes the leading producers of African American and Latino students in STEM disciplines – specifically the top producers of

African American and Latino PhDs in atmospheric sciences at the PhD level (HU), the top producer of African Americans in meteorology at the BS level (JSU) and the top producers of Hispanics in geosciences and physics (UPRM, UTEP, and SDSU).

Academic Institution	Historical Designation	Minority-Serving Designation	Relationship in ASM
Howard University	HBCU	MSI	Lead, graduate and undergraduate education
Jackson State University (JSU)	HBCU	MSI	undergraduate education
University of Puerto Rico Mayaguez (UPRM)	HIS	MSI	graduate and undergraduate education
University of Texas El Paso (UTEP)	HSI	MSI	graduate and undergraduate education
University of Maryland Baltimore County (UMBC)	HWI	MSI	graduate and undergraduate education
University of Maryland College Park (UMD)	HWI	MSI	graduate and undergraduate education
University at Albany (UAlbany)	HWI	Non-MSI	graduate and undergraduate education
Pennsylvania State University (PSU)	HWI	Non-MSI	graduate and undergraduate education
San Jose State University (SJSU)	HWI	MSI	graduate and undergraduate education
Fort Valley State University (FVSU)	HBCU	MSI	undergraduate education
San Diego State University (SDSU)	HWI	Non-MSI	undergraduate education
Tuskegee University (TU)	HBCU	MSI	undergraduate education
Universidad Metropolitana de San Juan (UMET)	HSI	MSI	undergraduate education

Table 1: Identification of institutional partners in the ASM and their MSI designation

The partnership is also distinguished by strong representation from the social, behavioral, economic (SBE), and communication sciences among the Howard University faculty participants (50% of the initial pool of faculty are in SBE and communication sciences fields) in addition to the traditional STEM disciplines. We anticipate that additional SBE faculty from multiple institutions will be incorporated into CSC activities as future collaborations and opportunities within NOAA develop.

The success of the ASM will build from the fifteen years of capacities and relationships with NOAA scientists developed through a prior cooperative agreement. Representatives from all institutions will be engaged in the management of the center education functions, communication strategy, and NOAA collaborations. Partners will participate in the development of center-wide policies and documents (e.g. evaluation plans, implementation plans, student development plans) and provide input on engagement with external stakeholders. The center-wide coordination will be implemented through a combination of monthly virtual meetings, bi-monthly site visits by the lead institution to partner sites, and multiple opportunities for physical exchanges to ensure that the partnership strengthens over time.

a) Summary of postsecondary education and training activities

The ASM will implement a five-tiered approach to developing a new talent pipeline in atmospheric, meteorological, environmental, and SBE fields from underrepresented minorities and underserved communities. It will be comprised of programs that address five key factors attributed to attrition at the transition points along the education pathway: 1) equity and access, 2) professional development, 3) education, 4) informed and strategic mentoring, and 5) distinction (as indicated by degrees and/or employment in NOAA mission fields). Figure 1 illustrates conceptually the aim of ASM to provide equity and greater access to professional development, education, and mentoring at key stages and sustain these critical inputs as a way to successfully maintain the talent pipeline so that students can distinguish themselves with advanced degrees and/or careers within NOAA or other STEM fields.

Figure 1: Five-Tiered Approach to Develop Talent Pipeline

The ASM will promote equity and access to training in NOAA mission fields by utilizing its multimodal network of HBCUs, MSIs, and HWIs. The undergraduate cluster will focus on undergraduate recruitment, training, and professional preparation. This group would include representatives from all institutions. The graduate and postdoc cluster will include HU, UMD, SUNY, UMBC, UPRM, and UTEP. Both clusters will engage in the development and management of programs specific to their sector of postsecondary education with the express intent of developing a pipeline from the undergraduate cohorts into graduate programs with emphasis on the programs offered in the graduate and postdoc cluster and ultimately into careers in their fields of expertise. Success will be considered as placement in a graduate program of NOAA relevance, into the NOAA workforce, or into a NOAA stakeholder career.

The ASM will seek out partnerships across NOAA with emphasis on Weather Ready Nation (WRN) opportunities within the NWS but extending to OAR, NESDIS, and other NOAA line offices. The ASM will strengthen education and research capacity in NOAA mission fields with emphasis on programs at the MSI partners through collaborative, center-wide engagement with NOAA including:

1. Inclusion in ASM management by involving institutional PIs in a variety of decision-making teams and focus groups
2. Annual NOAA facility visits that involve students and faculty from across the ASM
3. NOAA-sponsored technical training, which will be made available to all students and postdocs in the ASM
4. Experiential learning opportunities during which students from the ASM will spend extended periods of time at various NOAA facilities including but not limited to the Sterling Test Center, the NOAA Ronald H. Brown, ESRL, PMEL, and NSSL.
5. Co-advising of graduate students. Graduate thesis committees will include membership from multiple faculty of ASM institutions wherever relevant.
6. Collaborative research. Our intention is for each research project to have the dual purpose of engaging the student in training that enriches their understanding of the NOAA culture and needs as well as contributing directly to NOAA's science and research needs. Students will thus be full participants in every project and we will seek to engage multiple ASM faculty and institutions on each project.

The ASM will seek to increase student recruitment, retention and graduation in NOAA mission fields at the partner institutions by relieving financial stresses on minority students and by providing more early opportunities for engagement and support. Financial barriers are one of the chief concerns of students pursuing advanced degrees and the ability to commit resources to students for the course of their advanced study is a primary reason for the success of prior programs.

Finally, the ASM will engage with and raise awareness of communities that are traditionally underrepresented in NOAA mission STEM, natural resources management, and policy careers. These efforts will largely involve partnerships with ongoing efforts within the MSI academic communities and leveraged funding.

The ASM will sponsor a variety of inclusive interactions that extend across the Center institutional partners in order to foster continuous interactions among students. These opportunities include passive interactions such as electronic communications (e.g. ASM website communications and ASM email announcements), virtual interactions (e.g. webinars and chat sessions), and face-to-face engagement (e.g. site visits, team meetings, EPP Forums, and specialized training). Another more forward-looking example is that students will be involved in the ASM focus teams. This interaction will give them the opportunity to not just observe how research projects are designed and implemented but to participate in this process early in their development. The ASM will continue to engage in high-impact public events such as the Colour of Weather™ networking reception at the American Meteorological Society annual meetings and will seek to find ways of expanding this event at other professional meetings.

b) Summary of scientific research

The ASM research activities will be used to educate and train students and are defined with a nested structure of themes, focus areas, and projects. The three ASM scientific themes are high-level vision statements that directly connect ASM science goals to WRN and the Next-

Generation Science Plan (NGSP) strategic goals. As shown in Figure 2, the ASM themes enable a clear mapping of project level collaborative activities into NOAA relevance.

Interdisciplinary scientific research for building resilient communities against weather extremes. Under this theme, ASM faculty and students will perform timely and usable research designed to support the following WRN Roadmap objectives: "reduced loss of life, property, and disruption from high-impact events; and improved freshwater resource management."

Innovative observations for advancing the analysis and prediction of weather, climate, and atmospheric chemistry. Within this theme, the ASM will support research and applications that take greater advantage of novel and traditional environmental observations particularly those that close observational gaps in NOAA operational network that limit WRN forecast metrics.

Interdisciplinary research in support of building healthy communities. The ASM will pursue collaborative and interdisciplinary research to integrate atmospheric and meteorological sciences most heavily with SBE as the NOAA goals for improving high-resolution ozone, smoke, dust, and other particulate matter forecasts; data on extreme temperatures; and expanded predictive capabilities that include water quality will directly involve assessments and the development of effective means of communicating the risks of these hazards to vulnerable communities.

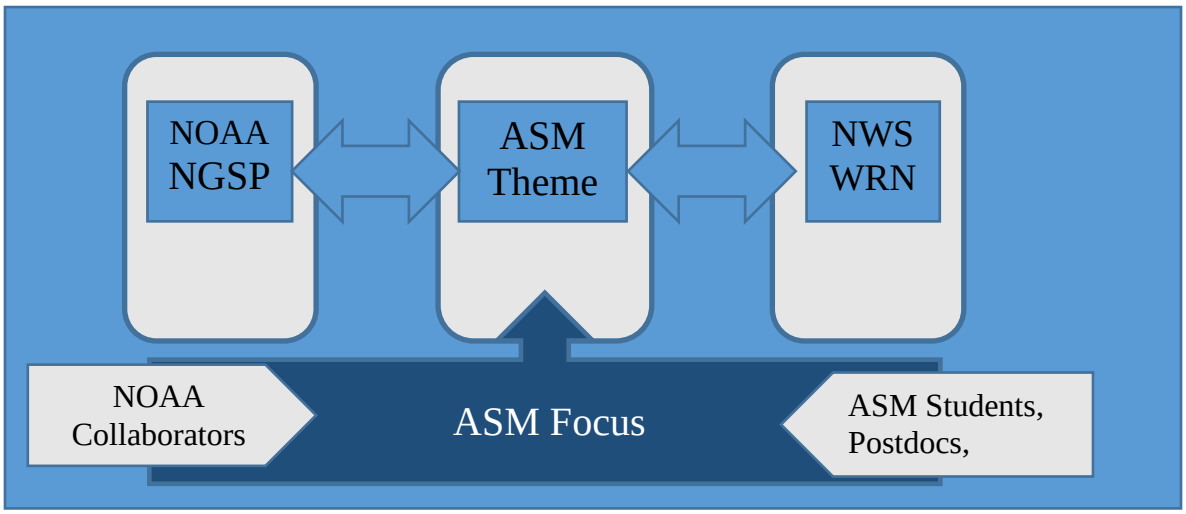

Figure 2: Schematic showing the connections between the ASM Themes, the Strategic Plans of NOAA and NWS, and the ASM Focus Areas. The project level collaborations involve both NOAA and ASM students, postdocs, and faculty.

There are five interdisciplinary focus areas initially defined for the project level collaborations with NOAA. These focus areas represent areas of opportunity to engage with

specific NOAA facilities, NOAA scientists, NOAA assets, and NOAA partners and stakeholders. Finally, projects are defined within each focus area. Within the focus area, collaborative groupings – of NOAA scientists, NOAA stakeholders, ASM faculty, and ASM students comprise the individual project teams. The specific projects will be developed by engaging with NOAA at multiple levels such as proposals and white papers to Line Office managers, SSIO opportunities, and strategic discussions between NOAA scientists and stakeholders with ASM leadership and faculty regarding collaborations.

The project teams will be coordinated by the ASM management team through study designs that utilize existing scientific expertise, observational infrastructures and modeling capacities at the partner institutions as well as NOAA facilities (NOAA vessels, aircraft, and other research platforms, NOAA laboratories, and NOAA-designated field test sites).

Integration of Social, Behavioral, and Economic Sciences Research and Training
The ASM will combine SBE and Communication Sciences (SBEC) research into ASM activities in two principal ways. First, it will sponsor SBEC research and training focused on NOAA needs as it relates to communicating and understanding perceptions and response to forecast and risk information and social and economic risk and resilience. Second, the ASM will support SBEC research that will be integrated into weather, climate, and air quality research to facilitate improvements in products for impact-based decision-making.

The ASM team for SBEC is comprised of faculty members from various disciplines including communications economics, sociology, psychology, and public relations who will collaborate with atmospheric scientists and meteorologists, where appropriate, to train students on decision-making, human behavioral risk response, risk communications, social and economic impacts of extreme weather, and the diversity dimensions of preparedness, response, and recovery efforts. The ASM members will leverage their significant experience engaging NOAA in these areas and co-mentoring students to ensure that they gain the types of perspective that enables a new generation of services that protect the well-being of all communities. The social and behavioral scientists within ASM will directly engage NOAA personnel in ongoing discussion of service needs in order to design collaborative research training.

c) Summary of administrative functions

The ASM executive management team (EMT) will include a Director, Assistant Director, a Program Manager, an Education Expert, and Distinguished Scientist. The Assistant Director will represent the Center administratively when the Director is unavailable to attend key NOAA meetings in person or via teleconference. For the purposes of improved management, the ASM will employ a Program Manager to manage the day-to-day activities of the Center and leveraged programs and facilities associated with the Center. The aforementioned parties will comprise the executive team and will meet together with representatives from the post-award services unit (PASU) at Howard University; who are responsible from contracts, purchasing, and finances, to form a financial management team (FMT). The FMT will meet monthly while the executive team will have weekly meetings.

The EMT will be responsible for providing recommendations to the Director in all key decisions affecting the design of education, research, and administrative strategies and approaches for a particular project. NOAA interactions are expected to occur on a regular basis through meetings with EPP, NOAA technical monitors, NOAA Line Offices, and through the CSC Leadership Alliance.

Each of the Partner Institutions will have an institutional co-PI who assumes responsibility for managing and reporting on the education and research training components at their home institution and serves as the primary point of contact for fulfilling the Terms and Conditions of their respective subcontracts. The Institutional PIs will interface with the EMT on all matters of broad ASM relevance including but not limited to student development, NOAA collaborations, ASM collaborations with NOAA stakeholders, reporting, student tracking and communications.

Partners will also engage in ASM management through two teleconferences. A monthly teleconference will be led by the Director and focus on administrative, educational, and reporting issues. The other teleconference will be bi-monthly and will be led by the Distinguished Scientist and will focus on more specific science issues. Additionally, the ASM will host an annual meeting for all members of the ASM to attend, share lessons learned, and review progress towards goals. The meeting will also be a venue to provide common experience of professional development (e.g. ethical conduct of research) to students from across the entire Center. This meeting will rotate among relevant NOAA facilities and partnering institution facilities.

The ASM will form an external advisory board (EAB) and utilize an external evaluator that will be independent from the program evaluation that EPP provides. These elements of management and administration adhere to the guidelines of the NOAA CSC Handbook and stipulations of the FFO under which this award was made.

II. Table of Contents

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III. Introduction

a) Purpose of the Implementation Plan

This implementation plan is designed to present the framework that the ASM will follow over its course of operations to fulfill the proposed education and training, scientific research, and administrative goals. Moreover, it will address the functional integration of all Center partners in performance, throughout the award period to satisfy the funded award objectives. The ASM proposes to incorporate and synchronize "best practices" in all aspects of its functioning across all partnering institutions. The purpose of the implementation plan is to lay out the milestones for the various components of the ASM, describe the mechanisms for management, evaluation, and tracking, and outline the quantitative and qualitative performance indicators for measuring success.

By “best practices” we do not mean simply adopting methods and measures that have been used elsewhere. This approach fails to recognize the complexities of both the societal barriers, educational pitfalls, and institutional challenges that MSIs historically and routinely encounter. Rather, *we will employ a combination of the ideas, methodologies, and collective experiences developed and adapted by our lead investigators, who have been working on the front lines educating minority students and engaging them in meaningful research in NOAA-relevant STEM and SBE disciplines in addition to NAS reports and model programs (many of which we have created ourselves).* The ASM will also derive significant wisdom and develop its own “best practices” from the lessons learned from the past fifteen years as participants of the EPP program as NOAA Center for Atmospheric Sciences (NCAS). Uncontestable evidence of this is the fact that over the past decade Howard University has outpaced the entire nation in producing African American and Hispanic PhDs in Atmospheric Sciences with a 98% employment rate in their desired fields of study. This compares favorably to any of the top programs and consortia in the Nation whose funding and investments dwarf that of the ASM.

b) Synopsis

This implementation plan addresses the functional integration of all Center partners in performance (largely illustrated in the logic models), throughout the award period to satisfy the ASM objectives. Social science is an integral component of the Center – specifically elements of communications, sociology, psychology, and economics were part of the original proposal and continued efforts will be made to engage students and faculty from the partnering institutions with NOAA in the fields of public policy. While Geographic Information Systems (GIS) is often mentioned as a field, we treat this as an essential tool or methodology and incorporate it into the training and professional development sections so that students of the ASM receive greater exposure to this tool across all disciplines.

The implementation plan begins with a description of the management and administrative components. The administrative component of the ASM is centered at Howard University and the coordination of both the sub-awards and the affiliate partners is described in this section. This section also addresses the “Special Award Conditions” included in the award package. This is followed by the ASM post-secondary education and training plans. In this

section the goals, strategies, and performance metrics for the various activities designed to enrich and prepare students for careers at NOAA will be described. The final section is the ASM scientific research function. We posit that because research is about expanding, cultivating, and deepening knowledge that there are always educational aspects in research. Fundamental elements of research are central to the most highly sought skills and outcomes in modern education – critical thinking, evidence-based inquiry, problem-solving, the ability to analyze complex problems, and the ability to express thoughts in both oral and written forms (communication skills). Thus, we do not present the programmatic aspects of the Center in a form that rigorously separates education and research.

The ASM will continue to advocate and implement our philosophy of research as education over the course of the project cycle. Rather than operating as if an impenetrable chasm exists between the two pillars of knowledge acquisition, we will operate with the understanding that research – beginning at the undergraduate level not only enhances parochial education, but through informed collaboration, also provides significant contributions to environmental (with focus on the atmospheric and meteorological) sciences, applications, and the intersections of atmospheric science and society.

Many, if not most, of the broader and most pressing questions related to weather and climate cannot be fully addressed through microscale research. However, the combination of individual, short-term studies typical of undergraduate projects and to a larger extent, thesis research through networks of research teams can more effectively identify and analyze important regional and national patterns. Through the development of innovative experiential research projects between students, faculty, and NOAA scientists at the different partner sites, the ASM will maximize the engagement of students in the pursuit of authentic, transformative, publication quality data. This allows for integration of data across time, space, and physical scales, with implications extending well beyond the traditional laboratory/model and the individual college campuses. Rather than being prescriptive, the projects will evolve from discussions between ASM staff, scientists, and NOAA personnel at a variety of levels. Knowledge generation will be brought to fruition within the various programmatic elements (summer research experiences, academic year research experiences, involvement in field campaigns, workshops, thesis research, project-based courses, etc.) Rather than using one-size-fits-all rubrics, we will engage in more organic development of the students by providing a menu of opportunities and engagement with Education specialists (the Education Expert), multiple faculty expertise from across the Center, NOAA personnel, professionals from our private sector partners, alumni, and postdoctoral fellows. The opportunities are communicated Center-wide through documentation (primarily the ASM student handbook, FAQ sheets, and pdfs on the ASM website), electronic communications (e.g., ASM website, ASM email, webinars, chat sessions), and face-to-face engagement (e.g. site visits, team meetings, EPP Forums, special events, and specialized training).

c) Products and Outcomes/Deliverables

While the detailed descriptions of these will follow in sections V – VII, we will present the high-level relationships between the ASM products and outcomes with the Program-level

outputs and outcomes in the logic model and table below. These visual depictions are useful for a quick reference to how the ASM will operate, manage, and evaluate success with respect to the program goals.

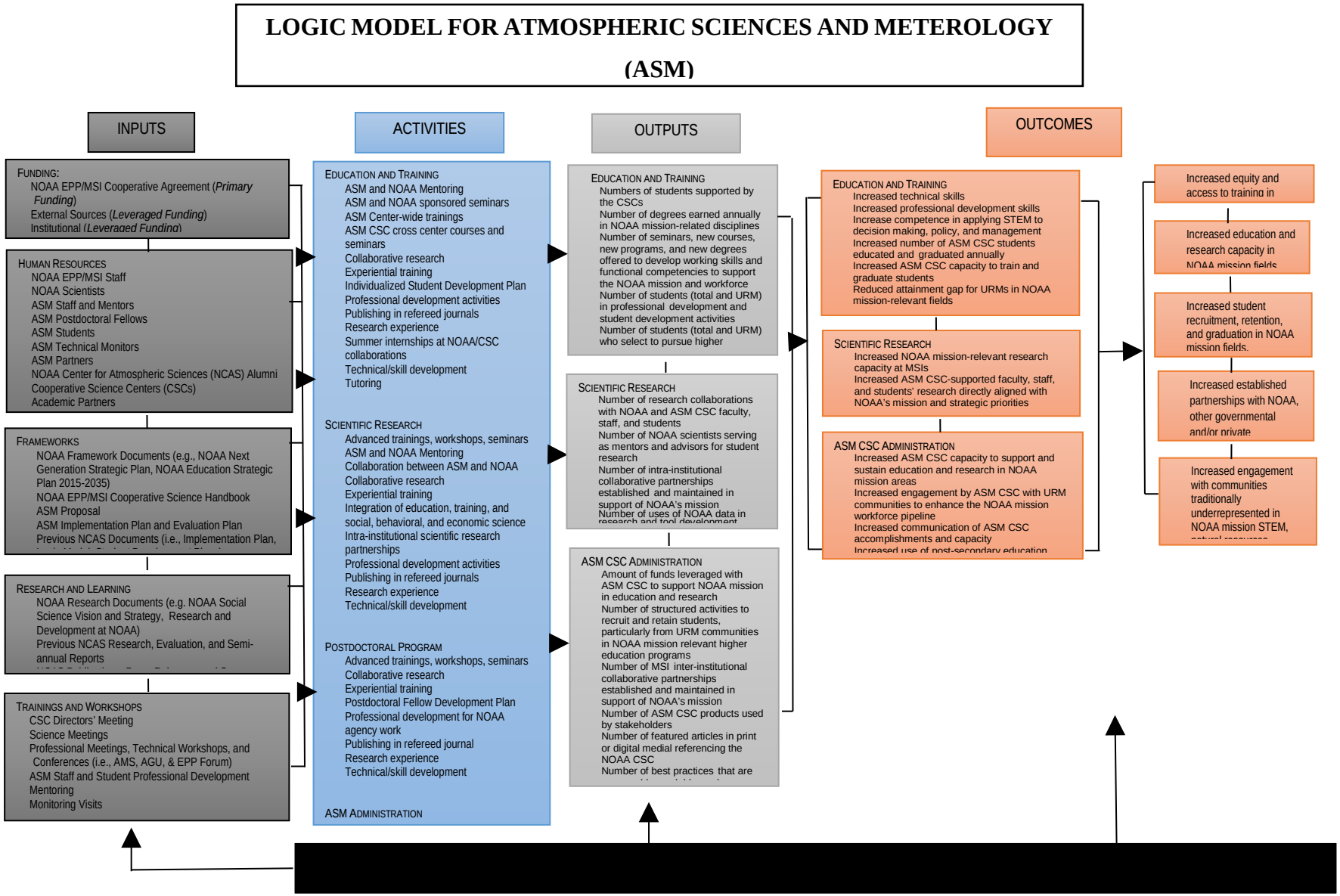


Table 2: ASM Logic Model

	Program Level Outcomes	Program Level Outputs	ASM Strategies, Products and Outputs
Education	1. Increased number, annually, of CSC post-secondary students, trained.	o Increased quantitative and analytical skills; o Increased competence in applying STEM to decision making, policy and management; and, o Increased skills to use large data sets, geographical information systems (GIS) and statistical analysis, computer modeling, and algorithm development.	Metrics associated with training activities including but not limited to workshop attendance, new courses offered, internship and experiential training opportunities offered, and the number of ASM post-secondary students involved in research activities will be used evaluate the effectiveness of the programs described in the Education and Training plan. **We anticipate that the number of students trained will increase by 30% each year from a baseline of 20 students in year 1.**
	2. Increased number of CSC post-secondary students educated and graduated annually	o The number of degrees earned annually in NOAA mission-related disciplines. o The number of students (total and URM) who participated in professional development opportunities, to include at least one on-site experiential research and training opportunity at a NOAA lab, office, or facility with tangible training and research: (a) for a minimum duration of 4 consecutive weeks, and (b) resulted in a publication or an oral or poster presentation to experts, peers, and/or other stakeholders.	The metrics in column 2 will be used as guidance to evaluate the effectiveness of the programs described in the Education and Training plan. **We anticipate annual graduate production that will increase from a baseline of 10 students by 25% each year for a total of 84 graduates across all levels by year 5.**
	3. Increased CSC capacity to train and graduate students.	o Number of seminars, new courses, new programs, and new degrees offered to develop working skills and functional competencies to support the NOAA mission and workforce. o Total numbers of students supported by the CSCs and degrees awarded that reflect the changing demographics of the nation (Census Bureau 2014 National Projections, http://go.usa.gov/c2VfP).	The ASM proposes Center-wide webinars, new training workshops, and interactions to specifically address this outcome. **The ASM will also support development of ten (10) new and shared courses, ten (10) workshops, and twenty-five (25) webinars across all institutions by the end of year 5.**
	4. Reduce the attainment gap for URMs in NOAA mission-relevant fields	Increased number of URM students in student development activities that will lead them to the attainment of degrees and/or employment in NOAA mission fields.	The partnership of schools has been selected specifically to address these specific outcomes and outputs through the Education and Training plan. **The ASM will be working to**

		o Increased number of URM students who select to pursue higher education in NOAA mission fields.	**define baselines for this goal during year 1.**
	Program Level Outcomes	Program Level Outputs	ASM Strategies and Approaches
Scientific Research	1. Increased NOAA mission-relevant research capacity at MSIs	Number of research collaborations with NOAA and CSC faculty, staff and students. o Number of NOAA scientists serving as mentors and advisors for student research. o Number of intra-institutional collaborative partnerships established and maintained in support of NOAA's mission. o Number of uses of NOAA data in research and tool development. o Number of inter-institutional collaborative partnerships established and maintained in support of NOAA's mission.	The ASM will monitor these outputs and use them as guidance metrics for all research activities. The targets for the five-year period are: **200 NOAA collaborations** **30 intra-institutional partnerships** **30 collaborative projects with NOAA per year**
	2. CSC-supported faculty, staff and students' research directly aligned with NOAA's mission and strategic priorities.	o Number of peer reviewed publications, presentations, and tools developed by faculty, staff and students. o Use of CSC research results and tools by NOAA and other stakeholders. o Number of instances CSC publications are cited.	The ASM will monitor these outputs and use them as guidance metrics for all research activities. The annual targets are: **Fifteen (15) publications per year** **Thirty presentations per year at professional meetings with at least 75% having student co-authors or presenters. The five-year target for NOAA co-authorship will be 50%**

Table 3: Program Level Outcomes, Outputs, and ASM Strategies

d) Risk Analysis

The deliverables presented above are based on the assumption that the ASM will receive annually the amount of funds stipulated in the proposal budget. Thus, a major factor that could affect the ability of the ASM to meet the benchmarks stated in this plan are the funds allocated each year. The ASM will aggressively pursue funding from other sources (both internal and external to NOAA) to ensure as much as possible that the above benchmarks are met, if not exceeded. Indeed, under the current funding requirements, most faculty are contributing their time without financial compensation and this poses a significant risk with respect to mentor attrition. Corollary risk factors are institutional support and succession planning. The ASM leadership will meet semi-annually with institutional leadership on a semi-annual basis to discuss plans for faculty recruitment and retention, in-kind support, infrastructural support, and financial management of the award.

The ASM institutional partners have experience working in various multi-institutional projects and are aware that innovative and prototypical work is subject to a number of operational risks. Such risks have been identified and presented below. In many cases the entries in the final column indicate possible solutions to overcome the risks. The EMT will lead the management of the project which will oversee and monitor developments and risk.

The proposed ASM involves the application of innovative research technologies, tools and standards for the training of competent and "job-ready" graduates. An essential element of our approach is an integrated view towards problem-solving. Beyond the technical realization of the project objectives the general risk of the project lies in the effective and high-throughput matriculation of students in an ever-changing environment and the incalculable number of opportunities within NOAA. The Center is also a sizeable administrative endeavor and management across this number of academic institutions also involves various elements of risk. As an institution of higher learning and individuals with demonstrated success in education, we already cope with many of these issues on a day-to-day basis. However, we also realize the complexity of this issue and that it requires dedicated programmatic and practical verification.

The executive team will attempt to anticipate, identify, and manage those factors that are critical to the final success of the project. For this purpose, the consortium will define methods and procedures to identify, assess, monitor and control areas of risk. Significant risks and contingency planning will be conducted as an ongoing element of the management strategy throughout the course of the execution of the proposed ASM. The ASM will seek to follow the standard ISO 31000 risk management principles and guidelines wherever possible within the framework of the institutional policies.

Finally, the ASM will hire an external evaluator to assist with a center-wide evaluation and to develop a plan for continuous improvement throughout the award period. Among their tasks will be the construction of a scale-aware plan for ensuring that all three functions of the ASM map onto the FFO, award conditions, and implementation plan. We anticipate that this will be in place by the end of the first quarter of the second year. This will give adequate time for the evaluator to engage the full center (13 academic members) – especially after coming on board during the second half of the first year of operation.

Risk Description	Evaluation and Risk Level	Resolution
Full integration of partners in Center Activities	Low	Such problems may arise when the plan of activities is not fully understood by all participants or personal incompatibilities arise during the work. Previous experiences within these partnerships has enabled significant trust and positive working relationships that will be maintained at consortium level.
Poor quality of deliverables and delay in meeting timeline	Low	This is unlikely to be a problem due to the previous experience of all partners The progress of the project will be assessed at frequent intervals (monthly teleconferences) to predict possible delays and act accordingly.

Technical problems arising during project execution	Moderate	A first step towards addressing technical issues is holding regular discussions and evaluating problems before they start. The experience of the Director and team have wide experience with these issues, and have already solved similar problems in the past. This experience should facilitate efforts of all of the partners to reach to the project objectives
Need to replace an academic partner for non-compliance or performance	Low to Moderate	Details will be provided in the Implementation Plan
Need to replace key personnel (i.e. faculty resignations) outside the management scope of the Center PI.	Low to Moderate	Details will be provided in the Implementation Plan
Need to address new/emerging NOAA challenges	Moderate to High	While we anticipate this as an opportunity as well as a challenge, details will be provided in the Implementation Plan
Budget anomalies	Moderate to High	These will be addressed through a team approach that involves the NOAA technical monitors, the executive team from the Center and the advisory board.
Equipment failure and/or replacement costs	Moderate	This is a natural and anticipated occurrence for field scientists and will be accounted through regular maintenance plans
Student Retention and Recruitment (including a grievance process)	Moderate:	Center will team with institutional units to broaden and enhance recruitment and retention strategies. Further details will be provided in the Implementation Plan

Table 4: Initial ASM Risk Assessment

e) Maintenance Plan for Equipment

No new equipment is proposed within the ASM Center's budget. However, significant instrumentation will be utilized by the center's students and other investigators. Much of this instrumentation was obtained over the past 15 years as a part of the NOAA-funded NCAS activities. Maintenance, calibration, and repair of instrumentation are considered a standard expenditure in the supplies/materials budget category. No more than 10% of the value of the instrumentation (depreciated value estimated at about $250K) is expected on such items over the course of the project. Priority use of such funds will be given to instrumentation that directly affects student's thesis and dissertation research.

IV. Center Administrative Function

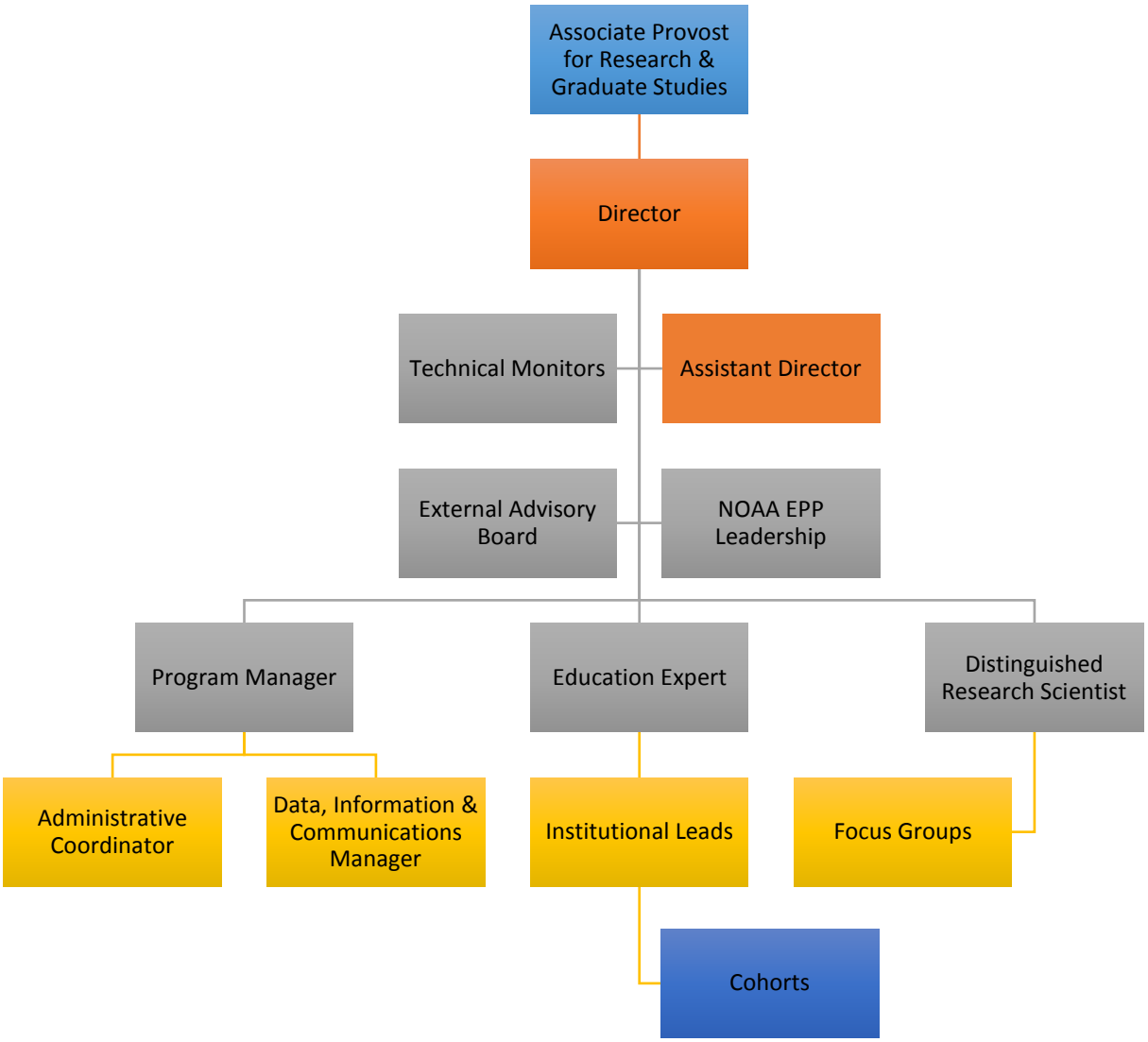


Figure 3: ASM Organization Chart

b) Center Personnel Roles and Responsibilities

Director

Dr. Vernon Morris will serve as the Director of ASM. Dr. Morris is a Professor of Chemistry and Atmospheric Sciences. Dr. Morris served as the Principal Investigator (PI) and Director of the NOAA Center for Atmospheric Sciences (NCAS) at Howard University from 2001 through 2017. The Center Director/Principal Investigator will have direct reporting obligations to the office of the Associate Provost for Research and Graduate Studies. This line of reporting places ASM in a unique position to obtain an audience with the University's chief research officer. The Center Director will dedicate 40% of his time during the calendar year to the management and administration of the award. The Center Director will focus the Center activities so that they respond to the training and development needs and capacities of participating graduate and undergraduate programs associated with the ASM. The Director will provide the executive leadership for the ASM, strategic communications, design the overall scientific focus and plans and provide oversight and management, and planning for implementation of all aspects of the ASM programmatic activities. The Director is responsible for ensuring that all three functions of the ASM map to the FFO, the proposal award documents, and the implementation plan throughout the award performance period. He will have two major groups that will work directly with him in support of his efforts: an advisory group (technical monitors, external advisory board, and NOAA EPP leadership) and an executive management team (EMT) that will be comprised of the key Center staff positions.

Assistant Director

Dr. Terri Adams will serve as the Assistant Director. Dr. Adams is an Associate Professor in the Department of Sociology and Criminology and served as the Social Sciences, Behavioral Science, and Economics (SBE) Lead for NCAS from 2006 – 2016. Dr. Adams will act on behalf of the Center Director in instances of his absence and represent the ASM at NOAA and CSC meetings accordingly. Dr. Adams will also serve as the chief point of contact for the Dean of the College of Arts and Sciences to facilitate support for the Atmospheric Sciences program and the ASM within the largest academic unit on the campus.
Dr. Adams will serve as the lead for social, behavioral, economic and communication sciences (SBEC) within the ASM. She will provide recommendations to the Director in all key decisions affecting the design of center-wide research strategies and approaches for SBEC. She will also work directly with the Director to assure effective and timely accomplishments for the award objectives, reporting, products and outcomes generation. Dr. Adams' time commitment to the award will be negotiated with the Dean annually but remain no less than 30%. The ASM proposes to satisfy the FFO conditions for 100% time by supporting two individuals (the Program Manager defined below and Dr. Adams at a minimum of 30% time, which results in a 1.3 FTE assigned to a 1.0 FTE position, thereby exceeding the FFO FTE requirements.

Program Manager

Ms. Kimberly L. Smith will serve as the Program Manager of the ASM. Ms. Smith served as the Program Manager for NCAS from 2008-2017. She has previously served as a Program

Manager of a National Science Foundation (NSF) sponsored GK-12 program and the lab manager at the National Institute of Digestive and Kidney Diseases/National Institute of Health (NIDDK/NIH). Ms. Smith holds degrees in Microbiology and Biology (B.S. and M.S., respectively). Ms. Smith will report directly to the Director. Ms. Smith will allocate 100% of her time to CSC activities. Specifically, she will be responsible for the daily operations of the ASM office and as such have responsibility for staff management and budgetary functions. Ms. Smith will oversee programmatic functions involving the students, student tracking and scheduling, generating monthly activity reports, ensuring the generation of the annual reports, student databases, and ensuring that internal (on-campus) reports are delivered to NOAA in timely fashion. Further responsibilities of the Ms. Smith are to provide follow-up reports for major meetings and programmatic interactions and maintaining priorities of ASM in event planning and scheduling.

Distinguished Research Scientist

The Distinguished Scientist is a position designated for an individual who has made a major impact on a NOAA-relevant field of study -- within atmospheric sciences or a relevant geoscience discipline, and can provide expertise, leadership, and grantsmanship in support of the ASM. A tenured full professor faculty line to serve as the ASM Distinguished Scientist has been designated, an offer has been made, and negotiations to fill the position within the first year of the award are underway. This position will allocate 100% of their time during the nine-month period of the academic year towards Center-wide coordination, leadership, and management of ASM research at all levels, including students. This position has already been advertised, potential candidates have been selected and interviewed. Recommendations for hire have been articulated by current Dean of the Arts &Science, that the position initially be located in the Department of Interdisciplinary Sciences, while a proposal for a new Department of Geosciences is being vetted in the College.

Dr. Morris will serve in the capacity of Distinguished Scientist until the position is filled.

Education Expert

Dr. Jo-Anne Manswell Butty will serve as the Education Expert for the Center. Her responsibilities will include implementing the education strategy and student development plan across 13 institutions. Dr. Manswell Butty will be responsible for ensuring that all Center-supported students are successfully gaining the Center's Education Plan-defined, education, training, experiential and professional development to attain the working skills and competencies for the agency mission future workforce. She will work closely with the Data, Information, and Communication Manager to monitor, guide, and provide timely interventions as well as produce data for timely award-required reporting for Center-wide education and training, including all students gaining Center-wide core competencies, communicating achievements, identifying evidence-based best practices and strategies for continual internal assessments. Dr. Manswell Butty has extensive experience in: a) program evaluation in local, national, and international settings in the areas of education, STEM, and public health; b) research including conceptualization, design, quantitative and qualitative methodologies, data analysis, technical report writing, and publications; c) professional development among students and teachers to improve student development, classroom

quality, and teacher efficacy; c) university teaching both face-to-face and online in various areas such as educational psychology, human learning, and education research, and d) grants administration with the application and successful acquisition and management of multi-year federal, state, and local grants.

Data Information and Communication Manager
A data, information, and communication (DIC) manager position will be created and filled within the first year of the award. The role of this position is to manage student tracking and associated information, general communications of center achievements to the public and stakeholders through the ASM web site, and increasing public access to outputs of the federally-funded research. A positioned description has been developed and the position is currently being advertised.

Ms Kimberly Smith will perform the activities of the DIC manager until the position is filled.

Administrative Coordinator
The administrative coordinator will manage the daily calendar of the ASM, Asst. Director, and Director by scheduling internal and external meetings, appointments, travel, special events and maintaining confidential information. This person will oversee incoming correspondence and requests for the ASM Asst. Director attention; triage to other staff members as appropriate; prioritize items that need immediate attention; and prepare and edit letters, memos and other correspondence for the ASM Asst. Director. She will be responsible for organizing and maintaining electronic and paper files; ensuring that materials are accessible in a timely manner and kept confidential; reconciling travel expense reporting; maintaining financial records; assisting with purchases; organizing office coverage of front desk and phones; as well as plan office meetings and events.

Ms Kadidia Thiero, the Outreach Coordinator on the NCAS award, will perform these duties until the position is filled.

Partner/Affiliates Institutional Leads
Each of the MSI Partner Institutions will have a lead investigator who assumes responsibility for managing the education and research training components at their home institution, integration of the various components, and serve as the primary point of contact for the EAB and the ASM. The lead investigators at the HBCUs and HSIs are Drs. Fadavi, Armstrong, and Fitzgerald at JSU, UPRM, and UTEP, respectively. The lead investigators at the other institutions are Drs. Demoz (UMBC), Joseph and Min (UAlbanyA), Chaio (SJSU), Fuentes (PSU), Liang (UMCP).

Each lead investigator will be responsible for ensuring that the Terms and Conditions of their respective subcontracts are fulfilled. The ASM will host two teleconferences – one monthly meeting that focuses on science and another bimonthly meeting that focuses on administrative issues, student training, and outreach. These teleconferences will be held on alternating months. Each Partner will provide a monthly status update to the EMT. This status update will be a brief synopsis of the Partner's activities of the past month. This will

aid in the production of materials such as keeping the ASM Website update and provide information for the ASM Newsletter. It is expected that the PIs at each institution will meet on at least a monthly basis to assure the integrity of the status update.

A science teleconference (including PI's and Technical monitors) will be held on a bi-monthly basis.

The ASM will engage all of its partner institutions in several other modes of communications. These would include site visits from the EMT and other partners, an annual meeting that would rotate among NOAA facilities and partner institutions, NOAA facility visits, and ad hoc teleconferences and calls. In the past the annual meeting has been co-located with the annual advisory board meeting. It is anticipated that this cost-effective practice will continue.

Focus Groups

The Center will employ focus groups to organize scientific research efforts into projects that contribute to achieving the goals of one or more of the broader research themes. Each project team will be comprised of subject matter experts from ASM partnering academic institutions, NOAA collaborators from the appropriate line offices and/or contractors, and student trainees. Postdoctoral fellows will also be involved in these same projects. The project teams will operate with the aim of producing basic research that undergirds the science goals, technology transfer and integration, translational research to support applications and impact-based decision support, and applied research designed to improve NOAA operations (models and observing systems) and services (better analyses, predictions, and user-inspired products).

Cohorts

ASM students will matriculate through the program as cohorts. An ASM cohort is defined as student appointments up to two years for bachelor and master's students and up to three years for doctoral students. A new cohort will be established with each year of funding. As a result, there will be five (5) cohorts of students for the five years of funding. Cohorts will report directly to their advisors (partners/affiliates leads).

External Advisory Board

The external advisory board (EAB) will be comprised of no more than ten individuals taken from NOAA, other federal agencies, academia, and private sector professionals who have stature and knowledge in critical areas of expertise that support ASM programmatic activities. The EAB will be formed within the first year of ASM. The role of the external Advisory Board is to:

- Serve as an advocacy group on behalf of the ASM
- Review ASM plans, activities, and management on an annual basis.
- Provide guidance and feedback to the Director on the research, educational, and outreach programs of the ASM,
- Assist in promoting the visibility of the ASM,

- Help to identify additional and future funding opportunities, and
- Assist in long-term strategic planning for the ASM

Technical Monitors and NOAA EPP Leadership

The ASM Director will regularly (at minimum monthly) interface with NOAA EPP Leadership through calls or in-person visits. Two technical monitors have been designated for the ASM; Dr. Ming Ji, Director of the Office of Science and Technology Integration (OSTI) within the NWS and Dr. Jason Tuell, Director of the NWS Eastern Region. The technical monitors will ensure that the science and policy conducted at the ASM is compatible with NOAA and, in particular, the NWS. The modes of interaction from the decision and risk-management perspective are provided in Tables 3 and 4. Additionally, they may engage the ASM by

(i) participating in the evaluation of projects submitted for approval through the ASM administrative structure;

(ii) participation in annual meetings;

(iii) evaluation and review of technical reports and ASM strategy and guidance publications;

(iv) serve as subject matter expert mentors and/or advisors on graduate student thesis or dissertation committees;

(v) coordinate and/or facilitate experiential research and training opportunities for CSC post-secondary students and postdoctoral fellows at NOAA facilities

ASM Ombudsman

During the first annual meeting, the ASM will seek to identify an ombudsman-like officer, who will serve as a neutral arbiter for resolving complaints with specific focus on student issues within the ASM. This person would be committed to achieving redress for the individual, but also, where they identify systemic failings, to seek changes in the work of the bodies in their jurisdiction, both individually and collectively.

c) Center Decision-Making Process

The ASM executive management team (EMT) will include a Director, Assistant Director, Program Manager, Education Expert, and Distinguished Scientist. The aforementioned parties will comprise the executive team and will meet together with representatives from the post-award services unit (PASU) at Howard University; who are responsible from contracts, purchasing, and finances, to form an internal management team (IMT). The IMT will meet monthly while the EMT will have weekly meetings that will collect action item summaries to maintain a unified sense of priorities of the ASM.

The EMT will be responsible for providing recommendations to the Director in all key decisions affecting the design of education, research, and administrative strategies and approaches for a particular project. NOAA interactions are expected to occur on a regular basis through meetings with EPP, NOAA technical monitors, NOAA Line Offices, and through the Center Champions Committee. The EMT will work to support the Director in ensuring that all three functions of the ASM map to the FFO, the proposal award documents, and the implementation plan throughout the award performance period.

Each of the Partner Institutions will have an institutional lead who assumes responsibility for Management (including financial) and reporting on the education and research training components at their home institution and serves as the primary point of contact for fulfilling the Terms and Conditions of their respective subcontracts. Partners will engage with the EMT through the two bimonthly teleconferences – one led by the Director that focuses on administrative, educational, and reporting issues and another, led by the Distinguished Scientist, that focuses on more specific science issues. There will also be individual telephone conferences and site visits and an annual meeting of all members of the ASM that rotates among relevant NOAA facilities and partnering institution facilities.

The annual meeting will be planned and organized through a group effort of PIs from all partnering institutions with the committee chair and co-chair being the Institutional lead of the host institution and one other co-PI. The annual meetings will provide a venue for all members of the ASM to attend, share lessons learned, and review progress towards goals. The meeting will also be a venue to provide common experience of professional development to students from across the entire Center. Finally, the external advisory board (EAB) will hold a joint meeting at the same time and location to engage all partners in their review process.

A Post-Secondary Education, Training and Strategic Recruitment Working Group will be formed from the Education Expert, the Lead investigators or their designees from each institutional partner (including affiliates), and an EPP participant. This working group will provide an additional element of the Center-approach to the education and training function and administrative functions of the ASM. This group will review and address issues associated with student training, the educational programming of ASM students, and broader impacts on institutional student populations. This group will also work to ensure that the metrics for the post-secondary student education, training and strategic recruitment for yearly cohort to meet the 50% direct student support requirement are met or exceeded. This group is referred below as the ERR.

The ASM will explore and evaluate the utility of a science management team (SMT) over the first year of tenure of the Distinguished Scientist. Initially, this group will be led by the Distinguished Scientist and comprised of the Director (ex officio), the Assistant Director, the three thematic leads, two of the lead investigators from non-HU institutions on a one-year rotation, and the NOAA technical monitors. This group will meet to assess progress against the scientific research metrics and provide recommendations on new projects, de-scoping (if necessary), resource allocation, and new collaborations.

Table 5 lists the Program elements and the contributing decision-making teams associated with them. Please note that each element has a Center-approach in that they all include representation from partnering institutions.

Program Element(s)	Contributing Decision-Making Elements
Post-Secondary Education, Retention, Strategic Recruitment	ERR (NOAA EPP)
Research	SMT (NOAA Technical Monitors), project teams, and EAB
Administration	EMT, FMT, and EAB
Postdoctoral Fellows Program	SMT, NOAA Technical Monitors
Evaluations	EAB, External Evaluator, NOAA EPP

Table 5: Center Decision-making Teams and Participants

Post-Secondary Education, Retention and Strategic Recruitment

The Education, Retention and strategic Recruitment Working Group (ERR) will implement the programmatic aspects of this strategic plan with the goal of broadening the diversity and capacity of the nation's STEM workforce (with emphasis on increasing engagement of African Americans, Hispanics, and other underserved populations). The activities of this working group will be integrated with the three research themes. ASM research, observations and data collection, data distribution and analyses, and evaluation, will be used as teaching tools by the education, outreach, and workforce development components. Several partnerships with several private sector companies and the other NOAA Cooperative Institutes have been forged over the past five years. These partners will continue to play a major role in the ASM activities including workforce development activities, professional development, and as sponsors of STEM internship programs.

ii. Science and/or Research

The ASM decision making process for each of project team lies in the responsibility of the project lead and their NOAA collaborator. The SMT will review updates and progress reports and provide feedback through the teleconferences or direct contact. Focus area leads will be designated within the first six months of the award based on past experience, the project lead designations can be coordinated by the Distinguished Scientist (DS) efficiently without excessive bureaucratization. Prior to the designation of a DS, we have designated leads for each focus area (Table 6). The leads in each focus area will provide recommendations to the SMT in all key decisions affecting the design of research strategies and approaches for a particular project. In the event that any of the research projects found to be unsatisfactory or unproductive based on findings from ASM regular science teleconferences, annual science reviews, and on further scientific discussions with specific partners, the EMT will investigate causes of the problems and suggest proper strategies for addressing the issue so as to ensure that the overall center research program is successful and meets the NOAA EPP performance and evaluation metrics.

iii. Administrative (including reporting)

As stated above, each of the Partner Institutions will have a lead investigator who assumes responsibility for managing the administrative, education and research training components at their home institution, for integration of the various components, and for serving as the primary point of contact for the EAB and the ASM. The institutional lead investigators are given in Table 6 below. Each institutional co-PI will be responsible for fulfilling the Terms and Conditions of their respective subcontracts.

The CSC handbook mandates a semi-annual report (SAR) for which the Distinguished Research Scientist will take the lead in coordinating with assistance from the Assistant Director and Education Expert. However, decision-making will be driven by ongoing evaluations within the ASM management. These evaluations include the SAR, the External Advisory Board (EAB) assessments, internal assessments by the Executive Management Team (EMT), the Internal Science Management Team (ISMT), an external reviewer (required by OED), and the external CSC Review. Each of these evaluations will be objectively pursued and based on the metrics and deliverables expressed in this implementation plan.

ASM will host two regular teleconferences – a monthly teleconference led by the Director that focuses on administrative, educational, and reporting issues and a bi-monthly teleconference led by the Distinguished Scientist that focuses on science. Each partner institution will provide a quarterly status update to ASM main office through the team DropBox (or GoogleDrive). This status update will be a brief synopsis of the Partner's activities of the past quarter. This will aid in the production of materials such as keeping the ASM Website update and provide information for the ASM Newsletter. It is expected that the PIs at each institution will meet on at least a monthly basis to assure the integrity of the status update.

Project Meetings (for projects within the three themes) will be held on a regular basis to assure that there is sufficient interaction and coordination among the NOAA collaborators and the researchers within each project. A science teleconference (including PI's and Technical monitors) will be held on a bi-monthly basis. The annual meeting of all members of the science team (the Science Team Meeting) will be established in the new cycle. This meeting will be rotated among relevant NOAA facilities and partnering institution facilities. In the past this meeting has been co-located with the annual advisory board meeting. It is anticipated that this cost-effective practice will continue.

ASM Participant	Institution	Principal Role/Responsibility
Vernon Morris	HU	PI and Director
Terri Adams	HU	Assistant Director, Focus Lead 4, EMT, SMT
Kimberly Smith	HU	Program Manager
Jo-Anne Butty	HU	Education Lead, EMT, ERR
Everette Joseph	SUNY	Focus 2 co-Lead, EMT, SMT
Carolyn Stroman	HU	Focus 5 co-Lead
Tia Tyree	HU	Focus 5 co-Lead
Pending appointment	HU	Distinguished Scientist, EMT, SMT
Rosa Fitzgerald	UTEP	Institutional lead investigator, ERR
Roy Armstrong	UPRM	Institutional lead investigator, ERR, SMT
Xin-Zhong Liang	UMCP	Institutional lead investigator, Focus 3 Lead, ERR, SMT
Qilong Min	SUNY	Focus 1 co-Lead, Institutional lead investigator, ERR
Mehri Fadavi	JSU	Institutional lead investigator, ERR
Sen Chiao	SJSU	Focus 2 co-Lead Institutional lead investigator, ERR, SMT
Jose Fuentes	PSU	Institutional lead investigator, ERR
Belay Demoz	UMBC	Focus 1 co-Lead, Institutional lead investigator, ERR, SMT
Souleyman Fall	TU	Institutional lead investigator, ERR

Hari Singh	FVSU	Institutional lead investigator, ERR
Sam Shen	SDSU	Institutional lead investigator, ERR
Juan Arratia	UMET	Institutional lead investigator, ERR
TBD 2017	TBD	External Advisory Board Chair

Table 6: Key ASM Personnel by Institution and Management Role

The external advisory board (EAB) interacts with the leadership of the Center through a face-to-face annual meeting, teleconferences (semi-annual), and email communications (as needed). These meetings will usually be coordinated to coincide with the ASM annual meetings. Prior to the annual meetings, EAB members will be provided with semi-annual reports and other ASM publications and updates. A semi-annual teleconference will also be utilized to keep EAB members up to date on Center activities and needs as well as to exchange information of use to the Director.

The selection of the External Advisory Board (EAB) will be made by the Center Director in consultation with the Distinguished Scientist, Center Partners, NOAA Technical Monitors, and OED Program staff. Care will be taken to avoid conflicts of interest and ensure that an appropriate gender and expertise balance (including Education and SBE proficiencies) are achieved. As in the past, the EAB will have representatives from relevant NOAA Line Offices, NOAA Private sector partners, the academic sector, and other elements of the weather and climate enterprise. An EAB charter was established during past awards and this will be presented to any future EAB for review and revision, if necessary. It is not anticipated that the EAB will be identical to the Advisory Team mentioned in the panel comments. Such a Team, if mandated, would be formed on a separate basis.

External Advisory Board (EAB) Meeting

The EAB advisory board will meet annually (our aim will be to make this at the same time and place as the annual meeting) to critically review Center progress, provide recommendations to the ASM executive administrative team, and to communicate recommendations to the Vice-Provost for Research at HU regarding the Center. ASM will use its advisory board as reviewers of major proposals, professional contacts for establishing collaborations, and for assistance in long-term Center planning. ASM will seek well-balanced representation of the board members from NOAA and the broader atmospheric sciences community.

This group will assess ASM performance based on the strategic plan, implementation plan, and science plan, relevance to NOAA missions, and relevance and productivity with respect to critical issues in atmospheric sciences.

- Written feedback will be delivered to the Vice-Provost for Research and Director and subsequently disseminated to all ASM investigators via DropBox or GoogleDrive.

- The Vice Provost for Research will review the management and fiscal operations of ASM on a semi-annual basis and interact with NOAA on an as-needed basis.

ASM will report to NOAA based on the guidelines of the CSC Handbook (semi-annual performance reports) and per requests of the NOAA EPP program staff.

iv. Postdoctoral Fellows Program

The ASM will support two postdoctoral fellows in the thematic areas at Howard University and anticipates leveraging (identifying non-OED) additional support for postdoctoral researchers on other partner campuses. Postdoctoral fellows working on project teams that involve more than one academic institution may be required to rotate to partner campuses. This would enhance the ASM team collaboration as well as the trans-disciplinary training. The postdoctoral appointments will be awarded on an annual basis with an option for re-appointment based on performance. This program is a continuation of the highly successful postdoctoral program implemented during the first fourteen years at HU, UTEP, and UPRM. In addition to the ASM faculty mentor, each postdoctoral fellow is expected to work in direct collaboration with a NOAA civil servant. The ASM Postdoctoral Fellows will receive support for travel, professional development (technical skills training where relevant), and be included in the strategic planning, project management, and student mentoring.

v. Center-wide Social Science Integration in all Award Objectives

Effective translation of NOAA sciences to the public and private sectors is essential for achieving the vision articulated in the NOAA Strategic plan. The WRN Roadmap states: "End to end social science integration starts with improving the agency's understanding of core partners' weather information needs and of weather information's effects on core partners' decision-making" (National Weather Service, 2013). The ASM will combine SBE and Communication Sciences (SBEC) research in two ways. First, it will sponsor SBEC research and training focused on NOAA needs as it relates to communicating and understanding perceptions and response to forecast and risk information and social and economic risk and resilience. Second, the ASM will support SBEC research that will be integrated into weather, climate, and air quality research to facilitate improvements in products for impact-based decision-making.

The ASM will adopt an interdisciplinary approach to examining societal impacts of severe weather and climate events. The ASM team for SBEC is comprised of faculty from such disciplines as communications, public relations, economics, sociology, and psychology. Faculty will team with atmospheric scientists and meteorologists, where appropriate, to train students on decision-making, human behavioral risk response, risk communications, social and economic impacts of extreme weather, and the diversity dimensions of preparedness, response, and recovery efforts. The ASM members have significant experience engaging NOAA in these areas and co-mentoring students to ensure that they gain the types of perspective that enables a new generation of services that protect the well-being of all communities.

The CapComm Lab is a distinctive feature of the SBEC component of the ASM. CapComm is a Capstone course at Howard University School of Communications where students gain practical experience by planning, developing, implementing and evaluating strategic communications campaigns for for-profit, nonprofit and government entities. NOAA has received assistance seven times with campaigns, including the "Beat the Heat" campaign of NWS and the "Voyage to Discovery" initiative of NOS. This activity engages a unique population of students who would not otherwise be knowledgeable or aware of

NOAA messaging and mutually benefits various line offices of NOAA that is timely, relevant, and designed to reach the evolving demographics of the Nation. CapComm also provides a unique bridge to engage NOAA through in research exploring the impact of self-identity and place attachment on community resilience after major weather related disasters, and assessing the impact of risk perceptions on preparedness and mitigation activities during a severe weather event. CapComm has demonstrated the ability to generate easily sharable "bite-sized" information that can be quickly provided to NOAA officials and to the public via social media, which will allow for faster transfer of information and ideas.

The social and behavioral scientists within ASM will engage NOAA personnel in ongoing discussion of service needs in order to design collaborative research training. For example, recent discussions between the NWS Science and Technology Integration Office and HU SBE faculty resulted in the development and implementation of a study examining the perceptions of and responses to the risks associated with extreme heat in the Washington, DC metropolitan region. The results were provided to NOAA in a briefing and the work also served as the basis for an MS thesis. The ASM proposes to continue these lines of engagement with NWS.

d) Center Financial Management

Center financial management will be executed via a team approach between the ASM Program Manager, ASM Administrative Coordinator, University Account Analyst, Research Administrative Services Team Lead (Thomas Joy) and Director of Research Financial Control (Guillaume Mbappe). The Center staff (Program Manager) will maintain an internal ledger of expenditures to track the award budgetary processes. The Center staff will meet monthly with the University Account Analyst (Yasmin Smith) to reconcile the internal ledger. The University Account Analyst (Yasmin Smith) will meet regularly with the Research Administrative Services Team Lead (Thomas Joy) and Director of Research Financial Control (Guillaume Mbappe) to ensure accurate financial reports are being submitted to NOAA. Additionally, the entire team will meet quarterly to ensure efficient financial management of the award. The invoices from each institutional partner will be reviewed by the PI of the institution before submission to the lead institution. The institutional invoices are submitted directly to Research Administrative Services – Team Lead (Thomas Joy). The team lead will initiate the approval process of the invoices by sending them to the Center Director and/or Assistant Director for approval before final submission to the University office of the Chief Financial Officer (accounts payable) for payment. The Center Financial Lead will be the Director of Research Financial Control (Guillaume Mbappe). He will be available to address any financial concerns as it relates to the management of the Center award. His contact information is located in Appendix I.

e) Key Success Criteria

There are a host of methodologies that organizations use to bring structure to the process of identifying and acting upon opportunities for improvement. At the heart of each of them is the continuous improvement model. The continuous improvement model that the ASM will

adopt will reflect the idea that organizations should undertake incremental improvements to services, products, and processes. It will be guided by the following core principles:

a) Improvements are based on small changes; not major paradigm shifts or new modalities.
b) The continuous improvement model relies on employees, not top management, to identify opportunities for improvement. Thus, the ASM will lean heavily upon the feedback from faculty and students to make the Center effective.
c) Focus incremental improvements are typically inexpensive to implement. The ASM will look for ways to eliminate redundant and unnecessary processes, rather than adding them. This is an excellent way to be sure that each administrative activity adds some value to the ASM and reduces wasted effort.
d) The ASM will encourage each participant (Staff, Faculty, Student, Postdoc) to take ownership and are accountable for improvement. Focus groups, surveys and feedbacks are among the elements in the evaluation plan, which is our primary instrument for accountability.
e) Improvement will be reflective, measureable, and repeatable. The ASM will engage its membership in constant and open communications to ensure that all partners have a voice in the Center. To support real improvement, the results must be measured. The ASM logic models and evaluation plan have been specifically designed to integrate measureable improvements to administrative processes.

f) Plan for Center communication with stakeholders and engagement with NOAA

The ASM approach to ensuring that NOAA is aware of expertise and talent across the Center will build upon successful strategies based on recommendations from NOAA leadership and past experience. These include but are not limited to:

- Annual Briefings of Line Office Directors and Deputy Directors
- Annual Briefings of Branch Heads including EEO and Diversity Officers
- Annual Briefings to the NOAA Science Advisory Board
- Annual Briefings to the NOAA Executive Council
- The ASM will aim to have monthly engagements with NOAA Personnel to visit various campuses, to participate in summer programs, participate in site visits, annual meetings, etc.
- Visiting NOAA labs and facilities (often in coordination with NOAA EPP and other CSCs) on a quarterly basis – or at least four times per year. A proposed schedule is below but is subject to change based on scheduling availability with specific personnel at the various NOAA facilities. We also note that ASM visits are not limited to these facilities but initial contacts have been made in the locations in Table 7.

NOAA Facility	Anticipated Coordination	Year
NCWCP, MD	ASM, CSC Alliance	1-5
ESRL, CO	ASM, CSC Alliance	1-5
NSSL, OK	ASM	1-5
Ronald H. Brown or other NOAA vessels	ASM, NOAA EPP	1, 3, 5
PMEL, WA	NOAA EPP, CSC Alliance	1-3
GFDL, NJ	ASM	2
AETD, TN	ASM, CSC Alliance	2-5
NWC, AL	NOAA EPP	3
Scripps, CA	NOAA EPP	4
AOML, FL	ASM, NOAA EPP	3-4
Various NWS WFOs	ASM	1-5

Table 7: NOAA Facility Visit Schedule

- ASM Days (Events sponsored at NOAA facilities that showcase student talent through poster sessions, brown-bag seminars, and impromptu peer interactions)

V. Center Post-Secondary Education and Training Function

a) Overview

The Cooperative Science Center for Atmospheric Sciences and Meteorology (ASM) will support undergraduate and graduate student fellowships to increase the participation of students from traditionally underrepresented communities in NOAA mission-related scientific, management, and policy professional workforce and advance the educational achievement of all Americans.

The combined undergraduate and graduate NOAA mission-field degree level support for education and training toward a postsecondary degree will support approximately 25 ASM student fellows annually.

ASM activities will include professional development, mentoring, and STEM engagement with local communities (e.g., AMS Weatherfest, AGU Exploration Station, and USA Science and Engineering Festival). Student fellow support and duration will be limited to: 1) US citizens, 2) full-time post-secondary students, and 3) students maintaining a minimum 3.0 grade point average (GPA) per semester.

ASM students will matriculate through the program as cohorts. An ASM cohort is defined as appointments up to two years for bachelor and master's, and doctoral students. For example, Year 1 cohort funding will be allocated to all Year 1 students for their specified appointments (up to two (2) years). New students recruited in Year 2 will be Cohort 2 and will be allocated funding for their specified appointments. As a result, there will be five (5) cohorts of students for the five years of funding.

ASM student education and training will be funded at fifty percent (50%) of the total annual funding for direct student support for a cohort of approximately 25 student fellows annually. ASM fellows in the cohort will be appointed within nine (9) months of the initial award start date for Year 1. For subsequent annual award funding periods, the ASM cohort will be appointed within 90 days of acceptance of annual award amendments. ASM student fellow appointments will conform to ASM education and training requirements (see Table 8).

ASM Baccalaureate Fellows (BF)
As shown in Table 8, during the academic year, ASM baccalaureate fellows (BF) successfully completing their coursework, participate in ASM orientations, work actively with a professor to be mentored, select and work on a research project, attend group meetings, attend relevant NOAA-mission activities, and collaborate with each other professionally.

Additionally, BF students will be required to: a) participate in at least one summer NOAA mission-relevant research and training, b) complete an individualized student development (SDP) plan four (4) times a year in collaboration with their advisor (i.e., planning forms, mid-year progress report, end-of-year progress report, summer progress report), c) participate in activities aimed at success in their career paths (i.e., through participation in center-wide education and research webinars, professional meetings, and institutional research events), and d) participate in center-wide trainings (i.e., mock interviews, sessions on professionalism, completing resumes, and professional online profiles) (see Table 8). Center-wide activities would take place through documentation, electronic communication, and face-to-face engagement.

ASM Graduate Fellows (GF) (Master's and Doctoral)
ASM GF will also be required to engage in activities that require inter- and intra-institution collaboration and teaming to: a) participate in NOAA Experiential Research and Training Opportunities (NERTO) or mission-relevant experiential training, b) complete an individualized student development plans four (4) times a year, in collaboration with their advisor/NOAA mentor (i.e., planning forms, mid-year progress report, end-of-year progress report, summer progress report), c) participate in activities aimed at success in their career paths (i.e., through participation in education and research webinars, professional meetings, and institutional research events), and d) participate in center-wide trainings (i.e., leadership development, presenting at conferences, writing for publications, competencies required to work at NOAA, applying to graduate school, and integrating social sciences in ASM research) (see Table 8).

The NERTO experience is expected to help fellows obtain top-tier practical training experiences in a NOAA mission-relevant field. During their two-year appointments, GF will also participate in ASM group meetings and seminars, work actively on a research project with their academic advisor and NOAA mentor, attend activities at NOAA, present their

research, attend leadership trainings, participate in courses and seminars offered at ASM centers, collaborate with each other professionally.

The expectation is that through a center-wide student-centered collaborative approach, that includes all-hands meetings and opportunities for group interactions, fellows will develop teamwork experience and professional preparedness to be successful in NOAA mission-related scientific, management, and policy professional workforce that will advance their educational and research achievements.

ASM Postdoctoral Fellows (PF) Program

The goal of the ASM postdoctoral fellows (PF) program is to support advanced training in NOAA-related sciences. ASM will support two PF in the thematic areas of atmospheric sciences and meteorology. PF must be US citizens appointed within the first nine months of the award start date. The PF will work on project teams that involve multiple academic institution and will co-locate at a NOAA facility for a minimum duration of six (6) consecutive months and not to exceed one (1) year (see Table 6). This would engage and expand the ASM collaboration with NOAA in atmospheric sciences and meteorology. PF will complete an Individual Postdoctoral Development Plan (IPDDP) three (3) times a year (planning form, mid-year progress report, and end-of-year progress report). In addition to the ASM faculty mentor, each PF is expected to be collaborative with other ASM and CSC PF, CSC scientists, and NOAA scientists. The PF will receive support for travel, professional development (technical skills training where relevant), and be included in the strategic planning, project management, and student mentoring (see Table 8).

b) Goals and Outcomes

ASM will subscribe to **Goal 4: Future Workforce** of the NOAA Education Strategic Plan 2015 -2035 which states that NOAA relies on a world-class workforce with the scientific and technical skills needed to address the environmental challenges conforming our Nation and the planet (NOAA, 2015).

The tenets of Goal 4 are to: a) inspire students to consider career disciplines that support NOAA's mission early in their education, b) maintain continuity in workforce development so that inspired youth have opportunities to build research skills and real-world applications over time, and c) maintain a pipeline of innovative talent that reflects the diversity of the Nation.

ASM outcomes will fully support the objectives and strategies for NOAA Education Strategic Plan - Goal 4: Future Workforce as follows:

> **ASM Outcome 1**: ***Increased number, annually, of CSC post-secondary students trained***. This outcome is aligned with Goal 4, Objective 4.1. - Students, particularly from underrepresented groups, consider education and career pathways in disciplines that support NOAA's mission; and Strategy 4.A. - Support local, regional, and national career

exploration programs and education resources that target youth and young adults, particularly those from underrepresented communities.

ASM Outcome 2: ***Increased number of CSC post-secondary students educated and graduated annually.*** This outcome is aligned with Goal 4, Objective 4.1. - Students, particularly from underrepresented groups, consider education and career pathways in disciplines that support NOAA's mission; and Strategy 4.D. - Collaborate with academic partners to align student preparation with NOAA's scientific and workforce needs.

Level	Minimum Rate Per Year ($)	Purpose	Support Time Period	Education and Training Requirements
Baccalaureate	12,000	Scholarship tuition, stipend, student-travel support	Up to 2 years	All UG student fellows are required to: a) apply for one NOAA mission research and training summer internship experience annually b) participate in one ASM Application Workshop Training c) participate in at least two center-wide professional development activities annually d) complete Student Development Plans (SDP) four times a year (planning form, mid-year, end-of-year, and summer) e) have one faculty member advisor
Master's	25,000	Fellowship tuition, stipend, travel	Up to 2 years	All Master's student fellows are required to: a) receive one-time support of up to $10,000 for research-related travel b) participate in one-time NOAA Experiential Research and Training Opportunity (NERTO) ($5,000) c) attend at least one professional meeting a year d) participate in at least three professional development activities per year (i.e., two center-wide professional development trainings and one advanced research/skill training) e) complete SDPs four times a year (planning form, mid-year, end-of-year, and summer) f) have one faculty member advisor **and** one NOAA mentor
Doctoral	30,000		Up to 2 years	All doctoral student fellows are required to: a) receive one time support of up to $20,000 for research-related travel b) participate in one time NERTO experience ($10,000) c) attend at least one professional meeting a year (aim to present) d) participate in at least three professional development activities (i.e., two center-wide professional development trainings and one advanced research/skill training) e) complete SDPs four times a year (planning form, mid-year, end-of-year, and summer) f) have one faculty member advisor **and** one NOAA mentor
Postdoctoral Fellows			2 years	All postdoctoral fellows are required to: a) collaborate with other postdoctoral fellows, ASM scientists, and NOAA scientists b) conduct research that addresses NOAA-mission science priority areas c) co-locate at a NOAA facility for a minimum duration of six (6) consecutive months and not to exceed one (1) year d) complete IPDDP three (3) times a year (planning form, mid-year progress report, and end of year progress report)

Table 8: Education and Training Requirements for ASM Student and Postdoctoral Fellows

ASM Outcome 3: ***Increased CSC capacity to train and graduate students.*** This outcome is aligned with Goal 4, Objective 4.2. - NOAA and partner institutions leverage federally-funded assets to provide students particularly those from underrepresented groups, with experiential learning, research and scholarship activities; and Strategies 4.B. - Provide scholarships, fellowships, internships, and student training opportunities that promote experiential learning, and Strategies 4.C. - Establish and maintain partnerships with MSIs, professional associations, and other organizations to improve graduation rates of underrepresented students.

ASM Outcome 4: ***Reduced attainment gap for URMs in NOAA mission-relevant fields.*** This outcome is aligned with Goal 4, Objective 4.3. - Postsecondary students, particularly from underrepresented groups, pursue and complete degrees in disciplines critical to NOAA's mission, and Goal 4, Objective 4.4 – Graduates completing NOAA-supported student support opportunities continue education, enter the workforces, and advance in careers that support NOAA's mission; and Strategies 4.E. - Strengthen the links between education initiatives and career pathways at NOAA and related organizations with emphasis on high-need career fields and underrepresented groups.

The progress of these outcomes will be evidenced by the achievement of the overall ASM program-level metrics:

- Annually, number of EPP-funded ASM students from underrepresented communities who are trained and graduate in NOAA mission sciences.
- Annually, number of EPP-funded ASM students who are trained and graduate in NOAA-mission fields (relevant to Funding Opportunity Number: NOAA-SEC-OED-2016-2004758).
- Annually, number of EPP-funded ASM graduates who enter the NOAA mission workforce as hires by NOAA, NOAA contractors, NOAA partners, or resource management agencies, or academia or as entrepreneurs.
- Annually, number of EPP-funded ASM graduates who participate in and complete agency mission-related postdoctoral level programs.
- Funds leveraged with NOAA EPP award (including ASM student support).

This will meet NOAA's goal of: a) increased integration of college and career information into education programs, b) increased number of students particularly from underrepresented groups who participate in experiential learning, research, and scholarship opportunities; c) increased proportion of trained students from underrepresented groups pursuing careers in disciplines critical to NOAA's mission, and 4) improved understanding of the trajectories of NOAA-supported students along their education and career pathways.

c) Strategies and Approaches

The major activity associated with education and training is student professional development which is comprised of four ASM activities: 1) summer experiential training summer program (ETSP) for undergraduates, 2) Individualized Student Development Plan (SDP), 3) student preparation for success in the career paths, and 4) center-wide training (see

Table 8). These activities are designed to enhance and develop students' knowledge, values, and skills through teaching, learning, and collaboration. The activities will involve transferring knowledge and skills using standardized instructional methods and techniques (e.g., workshops, trainings) to students for the purpose of developing and enhancing their professional competencies. Two further activities associated with education and training are: a) NOAA mentors for student fellows and b) longitudinal student outcomes tracking.

Experiential Training Summer Program (ETSP)

The Experiential Training Summer Program provides a rising sophomore with summer experiential training in NOAA mission-relevant research and training at a ASM institution. The initial ETSP program is 8 weeks long. During Weeks 1 to 6, student will engage in NOAA mission-relevant research and training at the ASM institution. During Weeks 7 and 8, student will engage in technical writing, presentation, and career/professional development skill development activities (e.g. mock interviews, presenting research) at Howard University. ASM will pay for student travel to Howard University and housing while at Howard University.

Students are required to work with ASM researchers on an approved NOAA mission relevant project during the summer. Researchers will submit and get approval for the proposed NOAA mission-relevant research project. ETSP students will receive a $5,000 stipend ($4,500 during the summer and an additional $500 after proof of application to a NOAA scholarship program).

Student Professional Development

1. ASM Applications Training Workshop (see Table 9)

The implementation steps to train undergraduate students to create successful quality applications for the NOAA undergraduate program and similar opportunities and increase the total number of competitive applications submitted from MSI students will be:

a. All UG ASM students will be required to participate in <u>one</u> ASM Applications Training Workshop annually.
b. ASM Applications Training Workshops will be held regionally** <u>three</u> times a year in the fall at the ASM lead institution (HU) and other MSI ASM institutions to increase the total number of competitive applications submitted from MSIs
c. Workshop training will include invited speakers (i.e., partners from NOAA/EPP and Pathways) [There are six (6) 2017 educational summer internship opportunities available throughout NOAA for undergraduate students (i.e., Chesapeake Bay Summer Internship Program, EPP/MSA Undergraduate (UG) Scholarship Program, Ernest F. Hollings Undergraduate Scholarship Program, NOAA - Northern Gulf Institute Diversity Internship, Pathways, and Woods Hole Partnership Education Program (PEP).Hollings, EPP, Chesapeake, NG, Pathways, Woods Hole].
d. Training topics will include: application completion, writing cover letters, interviewing, resumes/CV, email etiquette, goal setting, visioning.

e. All students receiving ASM Applications Training will be required to apply for NOAA internships.
f. All BF (rising sophomores and rising juniors) will be required to apply for summer internships especially Hollings and EPP/MSI which are both due annually on *January 31*.
g. Application support (e.g., review of resumes and applications) will be provided to students who attend the training workshop and apply for NOAA internships
h. All students attending the training workshop will be tracked to see if they receive scholarship acceptances.
i. Accepted students will no longer be ASM BF so new UG students will be recruited to replace students who received internships – accepted students will be tracked for three (3) years
j. The process will be repeated in Years 2, 3, 4, and 5.

<table>
<tr><th></th><th>Professional Development Activity</th><th>Purpose</th><th>Strategies and Approaches</th></tr>
<tr><td>1</td><td>Experiential training summer program</td><td>1. To provide summer NOAA mission-relevant research and training experience to students at CSC institutions who have completed their freshman year

2. To train students to create successful applications specifically for the NOAA undergraduate scholarship programs and similar opportunities

3. To annually, increase the total number of competitive applications submitted from MSI post-secondary students from traditionally underrepresented communities in NOAA mission fields</td><td>Experiential Training Summer Program

ASM will require all BF to apply and participate in one summer NOAA mission-relevant research and training experience.

Who: 10 students who completed their freshman year at five ASM institutions

Student Stipend: $5,000 ($4,500 during summer and an additional $500 after proof of application to NOAA scholarship programs)

Length of ETSP: 8-week NOAA mission-relevant research and training program (to include professional/career development and technical writing) at five ASM institutions

Date: June 1 to July 28, 2017

Location: ASM institutions, e.g.,

<table>
<tr><th></th><th>ASM Institution</th><th>Number of Students</th></tr>
<tr><td>1</td><td>Fort Valley State University</td><td>2</td></tr>
<tr><td>2</td><td>San Diego State University</td><td>2</td></tr>
<tr><td>3</td><td>Tuskegee University</td><td>2</td></tr>
<tr><td>4</td><td>Universidad Metropolitana</td><td>2</td></tr>
<tr><td>5</td><td>Open</td><td>2</td></tr>
</table>
</td></tr>
</table>

Requirements for ETSP Program:

Student:

- 3.0 GPA
- Official transcript
- US citizen
- Resume
- One letter of recommendation (sponsoring institution can require more)
- Apply to Hollings and EPP in Fall 2017

Faculty:

- Research Proposal (ASM Institution co-PI must submit and get approval for a proposed research project that the two students will engage in over the summer)

ETSP Program Activities Overview:

Week	Activities
1-6	NOAA-mission relevant research and training at five ASM institutions
7	Technical Writing/Presentation Skills Workshop at Howard University
8	Career/Professional Development Activities (e.g. professional development workshop sessions, mock interviews, research colloquium) at Howard University

ASM Undergraduate (UG) Training Workshops will be provided for UG students to enhance skills necessary to create successful applications for NOAA scholarship/internship programs and similar opportunities. The training workshops would involve invited speakers that would engage participants in hands-on opportunities to search for opportunities, complete applications, write cover letters, respond to emails, and enhance their professional skills for success.

ASM will train and coach students to submit quality applications specifically to the NOAA undergraduate scholarship programs (a) Ernest F. Hollings Undergraduate Scholarship Program and b) Educational Partnership Program (EPP) Undergraduate Scholarship Program) and other NOAA mission field programs.

			ASM Training Workshops will take place regionally (e.g., East, West, and South during the fall) and/or virtually by webinar e.g., East: HU, UMD, UMBC, UDC, Trinity (n=50 UG participants) **Eligibility**: Candidates will include undergraduates in the ASM program and others who may come for a broad range of STEM and other fields. Underrepresented racial and ethnic minorities and females will be encouraged to apply. Candidates must be: ASM UG in their freshman, sophomore, junior, and senior year in college and in good academic standing interested in pursuing a degree of atmospheric sciences and meteorology
2	Individualized Student Development Plan	1. To assist post-secondary students to progress effectively through undergraduate and graduate programs to the workforce in NOAA-related STEM disciplines. 2. To enhance academic, professional/ career, and personal/social development of all fellows.	All ASM fellows will be required to complete an Individualized Student Development Plan (SDP). The SDP will focus on three (3) broad areas that are known to influence educational success: academic development, professional/career development, and social/personal development. Students will be required to complete the SDP four (4) times a year in collaboration with their mentor/advisor (i.e., planning form, mid-year progress report, end-of-year progress report, and summer progress report). The SDP will be web-based. Training for this item will take place online.
3	Student preparation for success in the career paths	1. To engage students in activities to prepare them for success in their respective career paths in NOAA-related STEM disciplines. 2. To train students to be effective in communicating significance of their training and research in support of NOAA's mission.	ASM will prepare students for success in their career paths through: a) student-faculty mentoring program, b) NOAA experiential learning and collaborative research through the summer program, and c) advanced research training programs that will address data science and skill development. Student-faculty <u>mentoring will be year-long</u> and will involve: a) conducting and reporting on student and faculty assessments, and b) mentor/mentee training. Additionally, throughout the year, there will be <u>a minimum of two (2) webinars</u> to address advanced research skill development (e.g., GIS training, computer modeling) and

			professional skill development (e.g., submitting to a peer reviewed journal, competencies required to work at NOAA).
4	Center-wide Training	1. To engage students in Center-wide training to develop mechanisms and approaches that will increase post-secondary learning and professional development. 2. To make courses and seminars offered at any ASM Center available to student fellows at other partner institutions.	The Center will conduct two (2) Center-wide webinars (fall and spring semester) that will focus on career/professional development (one webinar and one face-to-face): a) to expose students to NOAA scientists and others who will provide information on NERTO experiences for students, and b) to present information on leadership development, presenting at conferences, writing for publications, competencies required to work at NOAA, applying to graduate school, and integrating social sciences in ASM research. At annual meetings students will present their research and attend leadership trainings. At networking events like the Colour of Weather, students will be involved in networking and mentoring opportunities. Critical professional development elements such as the responsible/ethical conduct of research will be addressed in centerwide fashion at the annual meetings. ASM will also make select courses and seminars offered at ASM Centers available to students at other partner institutions.

Table 9: Strategies and Approaches for ASM Professional Development Activities

**** Regional Trainings Model (Example):** (face-to-face)

East Workshop Training: **HU** (location for training), UMD, UMBC, UDC, Trinity (n=50 UG participants) (Example of departments for targeted recruitment to ASM Applications Training Workshop: Chemistry, Math, Biology, Sociology, Econ, Physics, Communications)

West Workshop Training: UTEP, **SDSU** (location for training), SJSU (n=50 UG participants)

South Workshop Training: JSU, **TU** (training for training), FVSU (n=50 UG participants)

2. Individual Student Development Plan (SDP) (see Table 9)

In order to assist ASM students to progress effectively through undergraduate and graduate programs to the workforce in NOAA mission fields, the implementation steps for the SDP will be:

a. The SPD will be completed four (4) times a year: 1) start of the academic year, 2) mid-year, 3) end-of-year, and 4) summer:
   i. The **Annual Planning Form** should be completed by the student, advisor, and NOAA mentor at the start of the academic year (by October for the fall semester or January for the spring semester) to plan student education and research activities for the upcoming year.
   ii. The **Mid-Year Progress Report** should be completed by the student and approved by the advisor and NOAA mentor at mid-year (or January for fall semester entrants or May for spring semester entrants). This form should document accomplishments, challenges, and needs by the mid-year (or during the previous fall semester).
   iii. The **Year-End Progress Report** should be completed by the student and approved by the advisor and NOAA mentor at the end of the academic year in May. This form should document accomplishments, challenges and needs by the year end (during the previous spring semester).
   iv. The **Summer Progress Report** should be completed by the student, advisor, and NOAA mentor at the end of the summer experience in August. The form should document accomplishments, challenges, and needs.
b. Students should have SDPs within 30 days after start of Center.
c. All fellows must complete SDP online (Blackboard/web-based)
d. The SDP will focus on 3 broad area: academic, professional/career and personal development.
e. Students must collaborate with advisor/NOAA mentor to complete the SDP
f. Items/outcomes must include: research internship at NOAA, core competency attainment, integrative mechanism for social sciences, writing for peer review and non-peer review publications, presentations in varied professional environments.
g. Training PowerPoint will be provided to complete SDP online.

3. Preparation for Success in Career Paths (see Table 9)

In order to engage students in activities to prepare them for success in their respective career paths in NOAA-mission fields and train students to be effective in communicating significance of their training and research in support of NOAA's mission, the implementation steps will be:

a. AMS student orientation
b. AMS faculty orientation
c. Pairing of ASM students with faculty and NOAA mentor/advisor
d. NOAA Experiential Research and Training Opportunity (NERTO) (required one time only for each student) with tangible training and research: (i) for a minimum duration of 4 consecutive weeks, and (ii) resulting in a publication or an oral or poster presentation to experts, peers, and/or other stakeholders.
e. At least one (1) professional meeting (required one time annually for each student)
f. At least one (1) research-related travel (required one time annually for each student) e.g.,
   - GIS Training
   - Statistical Analysis
   - Computer Modeling
   - Algorithm Development
   - Data Assimilation
   - Techniques Workshop (UAS Project, PR)

   Use expertise of ASM faculty and NOAA personnel for advanced skill development training/workshops
g. Other Student Opportunities:
   - Visit to DC for AMS Washington Policy Forum (May 2017)
   - Visit to NOAA Facilities (e.g., PMEL, ESRL, WHOI, NSSL, AOML)
   - ASM Day at NOAA Facility (e.g., NCWCP or NOAA HQ)
h. Students will indicate their choice of required activities in the SDP Planning form and IPDDP Planning Form at the beginning of the academic year.
i. Reporting of education and research activities on the SDP and IPDDP is continuous throughout the academic year

4. Center-Wide Training (see Table 9)

To engage students in center-wide training to increase learning and professional development and make courses and seminars offered at any ASM partner institution available to students the implementation steps will be to offer two center-wide trainings (one webinar and one face-to-face):

a. One center-wide webinar annually will expose students to NOAA scientists and others who will provide information on NERTO experiences for students. Students will be allowed to interact with presenters and ask questions.
b. One face-to-face meeting annually will present information on leadership development, presenting at conferences, writing for publications, competencies

required to work at NOAA, applying to graduate school, and integrating social sciences in ASM research.

NOAA Mentor for ASM Graduate Fellows

In addition to the four (4) professional development activities, ASM will ensure that each GF has a NOAA mentor in addition to their faculty advisor. The NOAA mentor will collaborate with the ASM faculty advisor/mentor to assure NOAA mission-relevance of the student's project and to familiarize the student with NOAA workplace culture and expectations.

NOAA mentors will be full-time NOAA employees solicited from all NOAA line offices. ASM mentors would be trained faculty and scientists at the various ASM institutions depending on the project team membership. The ASM mentoring program will include:

1. **Mentor recruitment, training, and matching** to a) create a work plan with specific recruitment objectives, actions, and timelines to achieve the ASM program goals, b) develop a process and criteria for screening, selecting, and matching NOAA and ASM mentors and mentees based on the mentor's background and experience, and mentee's interests and comfort level, and c) develop and implement an ongoing ASM mentor training program that produces the greatest positive effects on mentees.

2. **Delivery of mentoring services** to a) require ASM and NOAA mentors to commit to meet quarterly with their mentees, and b) provide ASM and NOAA mentors with ongoing support in arranging structured and engaging activities with their mentees to include check-ins to quickly identify and intervene if challenges arise.

3. **Monitoring program effectiveness** to a) monitor and evaluate the effectiveness of the ASM mentoring program on an ongoing basis by establishing measurable outcomes for the mentor/mentee relationship, and b) use key indicators to assess the impact of ASM mentoring by using both process and outcome evaluations.

In addition to formal mentoring opportunities, students will be exposed to informal mentoring opportunities with researchers and scientists at annual professional meetings and other informal ASM events.

ASM Longitudinal Outcomes Student Tracking

Beneficiaries of ASM funding will be tracked longitudinally (or for 3 years) after leaving the program for any reason. The ASM Student Tracker database will be created by NOAA EPP/MSI and maintained at the ASM lead institution (Howard University) in collaboration with partner institutions. The ASM Student Tracker database will track student support and funding (direct and indirect) and student progress while being funded. The ASM Student Tracker database will also track ASM alumni for 3 years after leaving the program and will gather information on post

ASM employment and pursuit of further education. Data entry will be completed by September 30 each year.

Figure 3 presents the approach for student tracking including the longitudinal tracking of ASM-supported students after completion of the period of CSC award support. Figure 2 also includes strategies for tracking ASM students up to three years after completion of the program. The student tracker will gather information to address the following program-level metrics:

1. Annually, number of EPP-funded post-secondary students from underrepresented communities who are trained and graduate in NOAA mission sciences.

2. Annually, number of EPP-funded post-secondary students who are trained and graduate in NOAA-mission fields (relevant to Funding Opportunity Number: NOAA-SEC-OED-2016-2004758).

3. Annually, number of EPP-funded graduates who enter the NOAA mission workforce as hires by NOAA, NOAA contractors, NOAA partners, or resource management agencies, or academia or as entrepreneurs.

4. Annually, number of EPP-funded graduates who participate in a complete agency mission-related postdoctoral level program.

5. Funds leveraged with NOAA EPP award (including post-secondary student support).

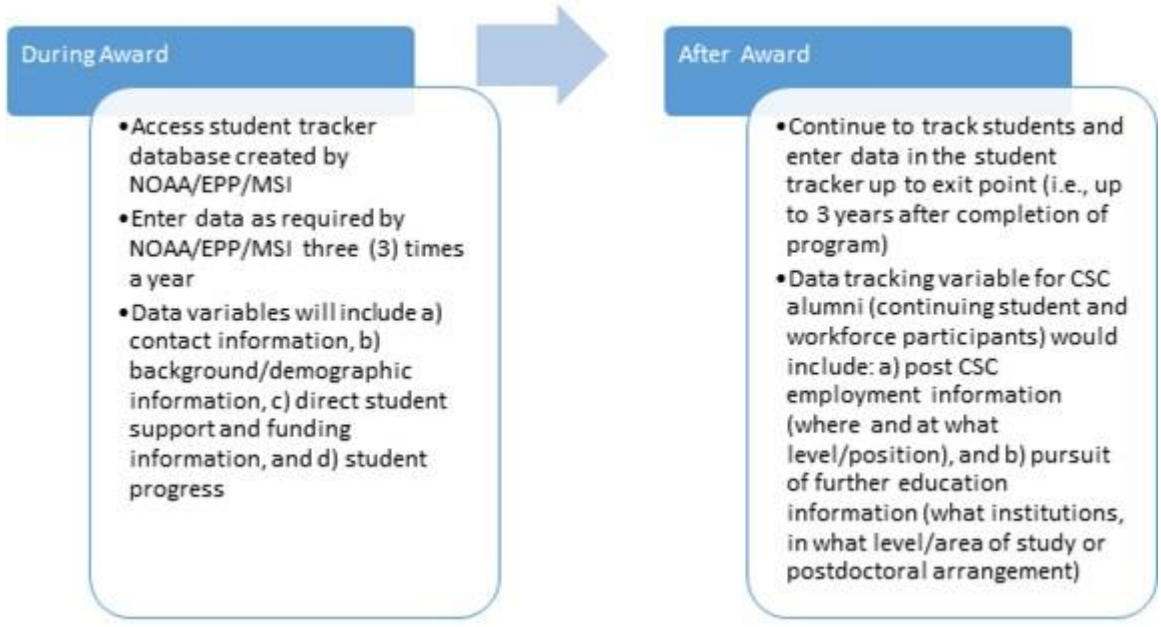


Figure 4: Approach for ASM Student Tracking During and After the Award

d) Performance Metrics with Milestones and Timeline

Table 9 highlights desired program level outcomes and outputs that specifically address ASM strategies and approaches for education and training.

	Program Level Metrics	Program Level Outcomes	Program Level Outputs
Education and Training	1. Annually, number of EPP-funded post-secondary students from underrepresented communities who are trained and graduate in NOAA mission sciences.	Increased number, annually, of ASM underrepresented students, trained and graduate in NOAA mission science.	● The total number of underrepresented ASM degrees earned annually in NOAA mission science. ● The number of URM students who participate in ASM education and training/professional development opportunities, to include at least one on-site experiential research and training opportunity at a NOAA lab, office, or facility with tangible training and research, annually
	2. Annually, number of EPP-funded post-secondary students who are trained and graduate in NOAA-mission fields (relevant to Funding Opportunity Number: NOAA-SEC-OED-2016-2004758).	Increased number of ASM students educated and graduated annually in NOAA-mission fields	● The total number of ASM degrees earned annually in NOAA mission-related disciplines. ● The total number of students who participated in professional development opportunities, to include at least one on-site experiential research and training opportunity at a NOAA lab, office, or facility with tangible training and research, annually
	3. Annually, number of EPP-funded graduates who enter the NOAA mission workforce as hires by NOAA, NOAA contractors, NOAA partners, or resource management agencies, or academia or as entrepreneurs.	Increased number of EPP-funded ASM graduates who enter the NOAA mission workforce as hires by NOAA, NOAA contractors, NOAA partners, resource management agencies, academia, or entrepreneurs.	● The number of ASM graduates who enter the NOAA mission workforce as hires by NOAA, NOAA contractors, NOAA partners, resource management agencies, academia, or entrepreneurs, annually.
	4. Annually, number of EPP-funded graduates who participate in a complete agency mission-related postdoctoral level program.	Increased number of ASM graduates who participate in a complete agency mission-related postdoctoral level program.	● The number of ASM graduates who participate in a complete agency mission-related postdoctoral level program, annually.

	5. Funds leveraged with NOAA EPP award (including ASM student support).	Increased funds leveraged with NOAA EPP award (including ASM student support), annually.	• Amount of funds leveraged with NOAA EPP award (including ASM student support), annually.

Table 10: Education and Training Program Level Metrics, Outcomes, and Outputs

An integrated Milestones and Timeline Chart in Table 11 shows the broad categories of outcomes for Education and Training as stated by NOAA.

NOAA Education and Training Milestone						
	Milestones	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**
1	Increased number, annually, of ASM underrepresented students, trained and graduate in NOAA mission science.		X	X	X	X
2	Increased number of ASM students educated and graduated annually in NOAA-mission fields		X	X	X	X
3	Increased number of EPP-funded ASM graduates who enter the NOAA mission workforce as hires by NOAA, NOAA contractors, NOAA partners, resource management agencies, academia, or entrepreneurs.	X	X	X	X	X
4	Increased number of ASM graduates who participate in a complete agency mission-related postdoctoral level program.		X	X	X	X
5	Increased funds leveraged with NOAA EPP award (including ASM student support), annually.		X	X	X	X

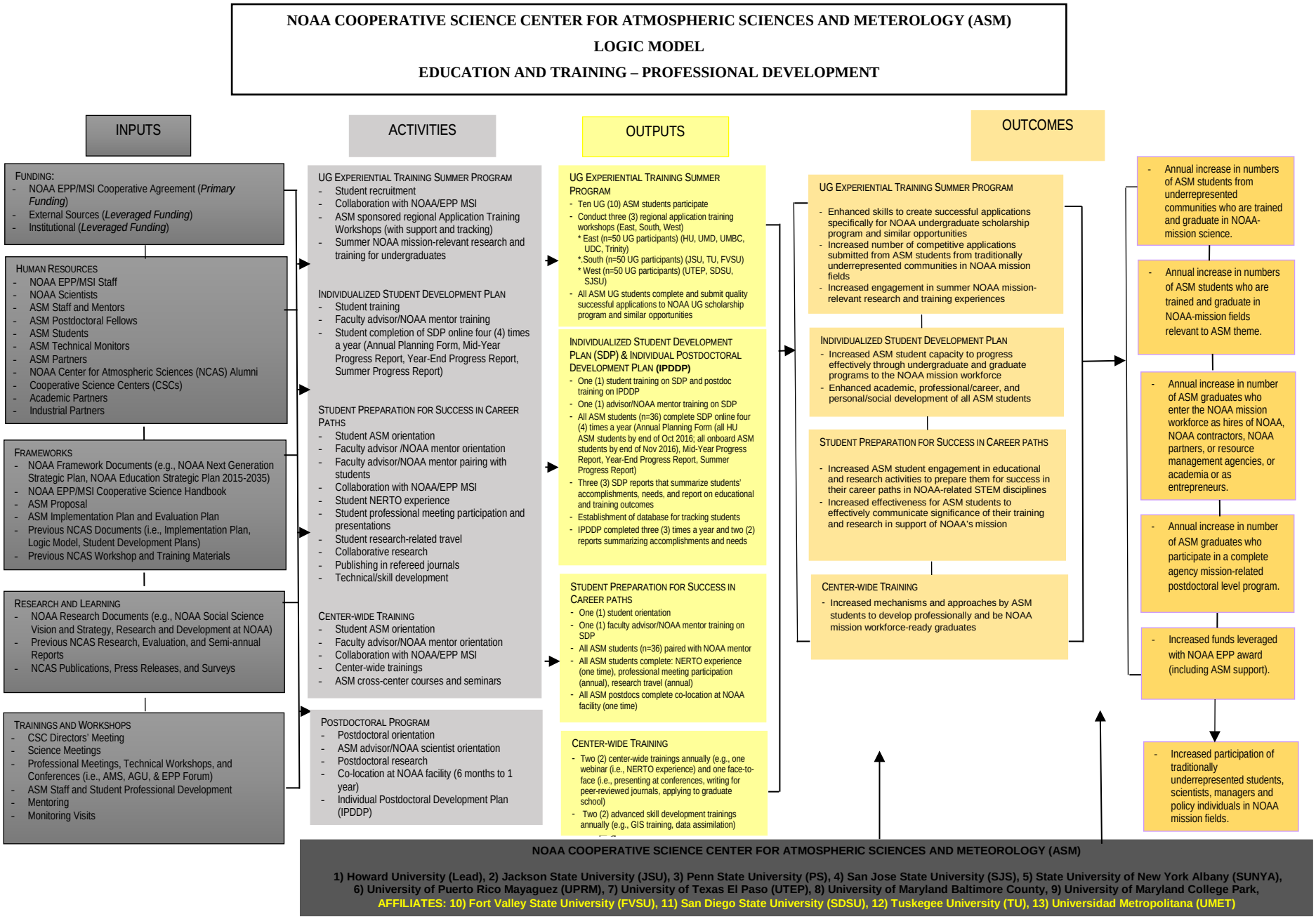
Table 11: Milestones and Timeline Chart for ASM Activities as Related to NOAA Milestones

Table 12 shows specific details concerning annual milestones that address ASM education and training activities, including professional development activities.

e) Key Success Criteria

The Education and Training logic model (see Table 12) shows links among the ASM program inputs (resources), activities, outputs, and outcomes. The model is dynamic and represents the ASM program's theory of change and key success criteria. The logic model includes the overall goal of the ASM program and targets that represent success (outputs and outcomes). The targets include success measures for a) target number of professional development activities, b) target numbers for student participating in professional development activities, and c) number of students successfully receiving undergraduate summer internships and NERTO experiences in NOAA mission-related fields. The targets that represent success can be compared to the national average (see Figure 12 – Logic Models).

Figure 5: ASM Education and Training, Professional Development Logic Model



1.0	Experiential Training Summer Program	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
1.1.	Recruit students for workshop	X	X										
1.2	Collaborate with NOAA EPP/MSI	X	X										
1.3	Conduct Fall ASM sponsored regional application training workshops (with support and tracking) – East, South, West			X									
1.4	Ongoing monitoring, support, and tracking of trainees			X	X	X							
1.4	Scholarship programs due (Jan 31, 2017)					X							
1.5	Prepare and submit semi-annual Year 1 report						X						
1.6	Ongoing monitoring, support, and tracking of trainees								X	X	X	X	X
1.7	Prepare and submit final Year 1 report												X
2.0	**Individualized Student Development Plan**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
2.1	Set up online portal for SDP submission	X											
2.2	Get list of names of all students and upload to online portal	X											
2.3	Train students to complete SDP (online)	X											
2.4	Train faculty and NOAA mentor to complete and review SDP	X											
2.5	Complete and submit SDP Planning Form	X	X										
2.6	Complete and submit Mid-term Progress Report					X							
2.7	Report findings of Mid-term Progress Report						X						
2.8	Complete and submit End-of-Year Progress report									X			
2.9	Report findings of End-of-Year Progress Report										X		
2.10	Prepare and submit semi-annual report						X						
2.11	Prepare and submit final report												X
3.0	**Student Preparation for Success in Career Paths**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
3.1	ASM student orientation	X											
3.2	Faculty advisor /NOAA mentor orientation	X											
3.3	Faculty advisor/NOAA mentor student pairing	X	X										
3.4	Collaborate with NOAA/EPP MSI	X	X										
3.5	Student apply and participate in NERTO experience – one-time experience	X	X	X	X	X	X	X	X	X	X	X	X
3.6	Student register and attend professional meeting – at least one meeting a year	X	X	X	X	X	X	X	X	X	X	X	X
3.7	Student apply and participate in research-related travel – at least one time a year	X	X	X	X	X	X	X	X	X	X	X	X

3.8	Prepare and submit semi-annual report						X						
3.9	Prepare and submit final report												X
4.0	**Center-Wide Training**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
4.1	ASM student orientation	X											
4.2	Faculty advisor/NOAA mentor orientation	X											
4.3	Collaborate with NOAA/EPP MSI	X											
4.4	Two Center-wide trainings			X					X				
4.5	ASM cross center courses and seminars	X	X	X	X	X	X	X	X	X	X	X	X
4.6	Prepare and submit semi-annual report						X						
4.7	Prepare and submit final report												X
5.0	**Postdoctoral Fellowship Program**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
5.1	Postdoctoral orientation	X											
5.2	ASM advisor/NOAA scientist orientation	X											
5.3	Postdoctoral research	X	X	X	X	X	X	X	X	X	X	X	X
5.4	Co-location at NOAA facilitate (6 months to 1 year)	X	X	X	X	X	X	X	X	X	X	X	X
5.5	Complete and submit IPDDP Planning Form	X											
5.6	Complete and submit IPDDP Mid-term Progress Report						X						
5.7	Report findings of IPDDP Mid-term Progress Report							X					
5.8	Complete and submit IPDDP End-of-Year Progress Report												X
	Report findings of End-of-Year Progress Report												X
5.9	Prepare and submit semi-annual report						X						
5.10	Prepare and submit final report												X
6.0	**NOAA Mentor for Graduate Level Student**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
6.1	Recruit mentors (NOAA mentors)	X											
6.2	Conduct assessment of student needs	X	X										
6.3	Conduct assessment of mentor needs	X	X										
6.4	Conduct mentee training	X	X										
6.5	Conduct mentor training	X	X										
6.6	Match mentor/mentees	X	X										
6.7	Monitor and support delivery of mentor services monthly			X	X	X	X	X	X	X	X	X	X
6.8	Monitor mentee/mentor program effectiveness					X				X			
6.9	Prepare and submit semi-annual report						X						
6.10	Prepare and submit final report												X

7.0	Longitudinal Student Tracking	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
7.1	Collaborate with NOAA EPP/MSI re student tracker access	X											
7.2	Enter data as required by NOAA EPP/MSI 3 times a yr.	X			X					X			
7.3	Prepare final annual report for NOAA due Sept 31												X

Table 12: Education and Training Annual Milestones (2016-2021)

	Key Questions	Response
1	How functional integration of all ASM academic partners will be implemented	Functional integration of all ASM academic partners will include: - Application Training Workshop – face-to-face regional trainings (East, West, South), so that all ASM institutions are included - SDP and IPDDP – online management platform (e.g., Blackboard) to collect and disseminate information to all institutions - ASM events at annual professional meetings (e.g., AMS, ASM Annual Meeting, and EPP Forum) - ASM student, faculty, postdoc, NOAA scientist, and other CSC inter- and intra-collaborations (face-to-face and virtually) - Courses/seminars available at partner institutions (cross- institution collaboration) - Cross-institution webinar opportunities - ASM website for information sharing - Cross-institution student opportunities to visit NOAA facilities
2	Key success criteria for ASM Education and Training	Key success criteria for ASM Education and Training can be found in the outputs and outcomes – Education and Training Logic Model, e.g., **Student Preparation for Success in Career Paths** - One (1) student orientation - One (1) faculty advisor/NOAA mentor training on SDP - All ASM graduate students paired with NOAA mentor - All ASM graduate students complete: NERTO experience (one time), professional meeting participation (annual), research travel (annual) - All ASM postdocs complete co-location at NOAA facility (one time) **UG Experiential Training Summer Program** - All ASM undergraduate students participate in the applications training workshop - Conduct three (3) regional application training workshops (East, South, West) during the year - East (n=50 UG participants) (HU, UMD, UMBC, UDC, Trinity) - South (n=50 UG participants) (JSU, TU, FVSU) - West (n=50 UG participants) (UTEP, SDSU, SJSU) - All ASM UG students complete and submit quality successful applications to NOAA UG scholarship program and similar opportunities
3	The role of NOAA science in ASM Education and Training	Science, education, and training are all integrated and NOAA science will play a role in ASM Education and Training: - Each ASM graduate fellow paired with a NOAA scientist - Student skills training will involve NOAA scientists
4	Engagement with Community College faculty and students	The role of the four (4) ASM affiliates and other MSIs to ASM are critical to education and training as there will be: - Collaborations with ASM affiliates, their students and faculty - Outreach to undergraduates from other MSIs for the ASM Applications Training Workshop
5	Engagement with NOAA and the wider academic, public/private sectors, and non-profit communities	ASM will be engaged with NOAA and the wider academic, public/private sectors, and non-profit communities for: - Education and research training and mentoring of fellows - Conducting a variety of field campaigns

6	Data collection, sharing, and management	Data collection, sharing, and management in education and training will allow for the: - Collection of student data in the ASM Longitudinal Student Tracker - Collection of metrics data for education and training/professional development activities to collect outputs/products/deliverables for required reporting to NOAA, external evaluators, and staff for program impact - The data/communications professional will play an important role in data collection, sharing, management, and dissemination
7	Matrix communication to insure information flow to all stakeholders	The matrix communication to insure information flow to all stakeholders will be accomplished through: - PI and Staff meetings - Online platform (Dropbox, Google doc) - Data/Communications Professional - ASM site visits
8	Planned overall impact for the ASM lead and partner institutions on program level-metrics	Planned overall impact for the ASM lead and partner institutions on program level-metrics will be measured by the: - Program-level metrics - Outputs and outcomes of the logic models for each partner institution - Adherence to milestone charts - Findings from external and internal evaluations

Table 13: Summary of Key Items addressed in the Education and Training Implementation Plan

VI. Center Scientific Research Function

a) Overview

The ASM will train postdocs, graduate students, and undergraduate students through collaborative research in a suite of areas targeted to meet NOAA mission goals in weather, water, climate, and their nexus in society. The design is to educate using collaborative research as an educational modality for underrepresented students. Specific research collaborations will be sought that leverage ASM scientific expertise and capabilities that align and directly support WRN roadmap and NGSP goals such as IDSS. The ASM will achieve this by being directly responsive to specific elements of the WRN S&T, and NGSP Science and Technology Enterprise Plans that define NOAA's science and technology needs from academic and other partners. For example, improving convective-scale guidance to increase lead times and reduce false alarm rates for warnings and forecasts is an objective in WRN S&T that is a key scientific requirement for achieving WRN IDSS goals. ASM has designed a number of research activities that are responsive to this S&T objective including acceleration of sensing of the planetary boundary layer and its operational application (HU, UMBC, UAlbany), mesoscale modeling research on convection over urban environments (HU, SJSU, UAlbany), improving cloud and aerosol parameterization in mesoscale models (UMCP, UAlbany, HU), etc. Ultimately, the ASM will determine future projects through ongoing engagement with NOAA line office staff as part of this cooperative agreement and individual memoranda of understanding with NOAA labs and facilities, Cooperative Institutes, and other NOAA stakeholders.

The ASM is principally aligned with the NOAA National Weather Service (NWS) but the ASM will also seek collaborative partners within the NOAA Office of Education (OED), the Office of Oceanic and Atmospheric Research (OAR), and the National Environmental Satellite Data and Information Service (NESDIS) to maximize the numbers of NOAA collaborators and student mentors within the agency. ASM CSC education and research activities will address three thematic areas that directly support WRN and NGSP strategic goals while fulfilling the Education Workforce goal. The three themes are:

i. **Interdisciplinary scientific research for building resilient communities against weather extremes**. Under this theme, ASM faculty and students will collaborate with NOAA staff and stakeholders to perform timely and usable research designed to directly support the following WRN Roadmap objectives: "reduced loss of life, property, and disruption from high-impact events; and improved freshwater resource management." Research under this theme will be interdisciplinary and range from studies to support improvement of convective-scale guidance to increase lead times and reduce false alarm rates for warnings and forecasts to studies by social scientists to understand user decision-making needs and communicating relevant forecast confidence and risk information.

ii. **Innovative observations for advancing climate, weather and air quality analysis and prediction.** Within this theme, the ASM seeks to support research and applications that take greater advantage of novel and traditional environmental

observations particularly those that close observational gaps in NOAA operational network that limit WRN forecast metrics. For example, accelerating techniques for sensing the lowest 5,000 feet of the atmosphere and applying that data into operational forecast systems to help NOAA achieve recommendations from The National Academy of Sciences report, *From the Ground Up* (The National Academies Press, 2009). These recommendations address critical observations needed by NOAA to improve the accuracy of short term severe weather forecasts.

iii. **Interdisciplinary research in support of building healthy communities.** With this theme ASM will pursue collaborative and interdisciplinary research to support the WRN objective on improving air and water quality for healthy communities. This research will focus on aiding NOAA to improve high-resolution ozone, smoke, dust, and other particulate matter forecasts; data on extreme temperatures; and expanded predictive capabilities that include water quality. SBE research will be directed at supporting NOAA to assess and develop effective means of communicating risk of these hazards to vulnerable communities.

The three ASM scientific themes are high-level vision statements that directly connect ASM science goals to WRN and NGSP strategic goals and provide a clear mapping of project level activities into NOAA relevance.

ASM Focus Area	AMS Themes*	ASM Investigators	NOAA Collaborators and Stakeholders	ASM Institutional Involvement **
1. Process-level Understanding and Enhanced Modeling Capabilities	T1, T2, T3	Demoz, Fitzgerald, Fuentes, Gill, Joseph, Li, Min Morris, Sakai, Stockwell	NWS/EMC, NWS/OBS NWS/DSIB NESDIS/STAR OAR/ARL OAR/ESRL	ALL
2. Improved Quantification of Forecast Uncertainty	T1, T2, T3	Armstrong, Chiao, Demoz, Joseph, Liang, Lu, Min, Morris, Reddy, Shen	NWS/EMC NWS/OPC NWS/SPC ESRL/GMD	HU, JSU, SJSU, SDSU, SUNY, UMBC, UMD,UPRM
3. Advancing the Development of High Resolution Models	T1, T2, T3	Chiao, Demoz, Joseph, Li, Liang, Lu, Morris, Singh, White	NWS/EMC ESRL/GMD NWS/CPC NESDIS/STAR	HU, FVSU, JSU, SJSU, SUNY, UMBC, UMD
4. Integrated Social Science	T1 and T3	Adams, Fitzgerald, Joseph, Kurban, Morris, Stroman, Tyree	NWS/STI NWS/CSB NWS/PPI NWS/OPS NSSL	HU, SUNY, UTEP
5. Effective Communication of Climate and Weather Risk	T1 and T3	Adams, Joseph, Fail, Stroman, Tyree	NWS/CSB NWS/OPS NWS/PPI NSSL	HU

Table *14:* Investigator research Affiliations by Theme and Institution

*Theme 1 = Research to Build Resilient Communities Against Weather Extremes, Theme 2 = Innovative Observations for Advancing Climate, Weather, and Air Quality Analysis and Prediction, T3 = Interdisciplinary Research in Support of Building Healthy Communities
**Institutional involvement is students and/or faculty of the institution engaged in the research effort. Students will be involved in every project.

NWS Strategic Goals	Theme 1	Theme 2	Theme 3
Goal 1: Improve weather decision services for events that threaten lives and livelihoods.	✖	✖	✖
Goal 2: Deliver a broad suite of improved water forecasting services to support management of the Nation's water supply.	✖	✖	✖
Goal 3: Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks.	✖	✖	✖
Goal 4: Improve sector-relevant information in support of economic productivity.			✖
Goal 5: Enable integrated environmental forecast services supporting healthy communities and ecosystems.		✖	✖
Goal 6: Sustain highly skilled professional workforce equipped with the training, tools, and infrastructure to meet our mission.	✖	✖	✖
NOAA Next Generation Science Plan Long-Term Goals			
Weather-Ready Nation	✖	✖	✖
Climate Adaptation and Mitigation	✖	✖	✖
Resilient Coastal Communities and Economies			✖
Healthy Oceans		✖	

Table 15: NWS and Next Generation Science Goals, and ASM Themes

Atmospheric sciences and meteorology is inherently interdisciplinary -- typically involving a blend of physical sciences, computer sciences, mathematics, and engineering. However, integrating additional disciplines is essential to building resilience against extreme events and environmental change. Each ASM theme represents a systems approach towards integrated and collaborative interdisciplinary research training effort designed to support the NWS mission. We recognize that there are natural feedbacks between the themes -- for example, an improved understanding of the linkages between climate and health (ASM Theme 1) must be communicated to vulnerable populations and health care providers to support community resilience (ASM Theme 3). Individual projects may involve integrated efforts within the theme or that bridge multiple themes.

For example, the improved use of observed data in operational streams (ASM Theme 2) support and extends NOAA capabilities for impact-based decision-making (ASM Theme 1). All activities, regardless of theme, will be conducted within a framework emphasizing student training and workforce development to which all partners will contribute. The work proposed herein defines the CSC education plan, the workforce development activities, the anticipated research, and management plan for delivering high-impact results to NOAA.

Rather than segregate teams into disciplinary silos, the ASM employs focus areas to organize scientific research efforts into projects that contribute to achieving the goals of one or more of

the broader research themes. Each project team will be comprised of subject matter experts from the academic institutions, NOAA collaborators from the appropriate line offices and/or contractors, and student trainees. Postdoctoral fellows will also be involved in many of these projects. The project teams will operate with the aim of producing basic research that undergirds the science goals, technology transfer and integration, translational research to support applications and impact-based decision support, and applied research designed to improve NOAA operations (models and observing systems) and services (better analyses, predictions, and user-inspired products). WRN Science and Technology Plan (S&T) and NGSP Science and Technology Enterprise (S&TE) spell out scientific goals and objects needed to achieve WRN service goals such as IDSS and COP and NGSP Long-term Goals, Moreover, it identifies NOAA's greatest needs for scientific partnerships with the academic community and other. As a means of ensuring that ASM science is tightly aligned to NOAA science needs ASM activities that fall under the ASM themes are designed to respond to WRN S&T and NGSP S&TE goals and objectives.

The high-level nature of the ASM scientific dictate that more specificity of is required for defining tasks. Thus, five interdisciplinary focus areas are articulated that both imbed within and cut across these thematic areas. These focus areas represent areas of opportunity for collaboration with specific NOAA facilities, NOAA scientists, NOAA assets, and NOAA partners and stakeholders. Finally, projects are defined within each focus area. The projects are the specific collaborative activities that link NOAA to student-faculty teams within the ASM. These collaborative groupings – of NOAA scientists, NOAA stakeholders, ASM faculty, and ASM students comprise the individual project teams. The projects develop from engagement of the ASM with NOAA at multiple levels including but not limited to proposals and white papers to Line Office managers, SSIO opportunities, and strategic discussions between NOAA scientists and stakeholders with ASM leadership and faculty regarding collaborations.

NOAA staff at specific line offices (OED, NWS, OAR, NESDIS) will be engaged to work collaboratively on research projects.

HU has engaged NOAA for the past fifteen years and participated in over 150 individual research-training projects with NWS, NESDIS, and OAR during this time. NOAA scientists will be sought to serve as co-advisors and members on thesis committees for advanced degree students and primarily as summer mentors for undergraduates.

Other modes of engagement will include participation of NOAA staff in annual meetings, research symposia, and professional development activities. HU, UMCP, and UMBC are in close proximity to the Air Resources Laboratory (ARL), National Centers for Environmental Prediction (NCEP), the Sterling Field Support Center (SFSC), and NESDIS (the latter three being primarily located in the National Center for Weather and Climate Prediction (NCWCP). NOAA scientists from these organizations will continue their long record of engagement with these university students and faculty.

In other partner locations, the ASM will leverage existing relationships with personnel in local

weather forecast offices (WFOs) and seek new relationships in regions where partnerships do not yet exist. Current partnerships include student internships and training, shadowing opportunities, and seminars in courses and outreach programs. Table 3 (below) lists the NWS WFOs where members of the proposed partnership have established relationships.

ASM Partner	HU	JSU	JSU	JSU	JSU	UAlbany	UPRM	UTEP
NWS WFO	Albany (Isha Renta)	Memphis (Jonathan Moore)	New Orleans (Patricia Brown)	Slidell (Freddie Zeigler)	Jackson (Parker)	Albany (Ray O'Keefe)	San Juan (Roberto Garcia)	Santa Teresa (Joe Rogash)

Table 16: Anticipated partnerships with NWS WFOs, points of contact (in parenthesis), and ASM institution.

NOAA's hard assets will be employed in the collaborative research as tools, resources, and venues for experiential training of our students and Post-docs. Specific illustrations are provided in the Research Plan.

b) Goals

The ASM defines five research focus areas: **(1) Process-level understanding and enhanced modeling capacities, (2) Improved quantification of forecast uncertainty, long-range forecasting and regional downscaling, storm prediction accuracy (including initiation of convection), precipitation type and start/stop times, (3) Advancing the development of high resolution coupled models within an Earth system framework, and the assimilation and integration of observations (especially for hard-to observe areas), (4) Integrated Social Science, and (5) Effective communication of climate and severe weather risks.** These five areas are defined so as to encompass the skills, interests, and expertise of the ASM faculty that overlap directly with the cross-cutting themes that connect the ASM vision to the NWS and NOAA Science plans. The five focus areas are briefly discussed below with proposed examples of collaborative research that could be conducted within the five areas. These descriptions are followed by a matrix of the primary outputs and products that we anticipate from the scientific research endeavor. We note that the nature and number of projects is expected to evolve as engagement with NOAA continues to develop over the life cycle of this award. We anticipate that as projects are completed, new students are recruited, and more NOAA mentors and stakeholders become aware of the ASM as a resource, additional opportunities for new projects will arise.

(1) Process-level understanding and enhanced modeling capacities

This focus area addresses WRN and NGSP goals for improved scientific understanding that undergirds the development of improved coupled global models. It includes projects that seek to advance the understanding of the weather-climate linkage, cloud and precipitation processes, airborne particulate matter, health sensitivities to weather and climate, planetary boundary layer processes (especially in complex terrain and in coastal oceans), terrestrial hydrology, and vegetation dynamics. This research responds to the NGSP call for a process-level understanding and enhanced modeling capacities of the

elements of the Earth system that relates to the atmosphere and its composition, the oceans, terrestrial tropics, and the cryosphere in order to provide better analyses and predictions.

Improved Forecasting of Airborne Particulate Matter. NOAA/NWS/NCEP uses the Community Multi-scale Air Quality model (CMAQ) with WRF generated meteorology for air quality forecasting. Although the operational CMAQ forecasting model for ozone predictions has been upgraded recently by NCEP/EMC to utilize the CB05 gas-phase chemical mechanism; the CB05 mechanism is not state-of-the-science for ozone or aerosol forecasting. ASM-supported research has produced a new atmospheric chemistry scheme that is now part of the standard CMAQ release (Goliff, Stockwell, & Lawson, 2013). This ASM project lead by faculty and students at HU, UTEP, and JSU addresses the airborne particulate matter, integrated environmental forecasting and climate modeling. Students will be collaboratively trained to further develop RACM2 within the CMAQ-WRF modeling framework to better characterize the formation of aerosols and to develop versions of RACM2 that can be used in global models to provide boundary conditions to regional models such as CMAQ (chemical downscaling). The gas-phase chemistry and chemistry occurring on aerosol surfaces strongly affect the lifetime of many greenhouse gases such as methane. This research will better characterize these key atmospheric physical and chemical processes and could potentially engage NOAA personnel as collaborators at both NWS/EMC and OAR/ESRL.

Aerosol-Cloud Interaction and Land Surface-Atmosphere Interaction
One of the grand challenges for NWS is the development of operational weather and climate models that capture the multi-scale and multi-physics complexity of water cycle processes, including cloud and precipitation processes and land-atmosphere interactions over heterogeneous terrain. Water cycle processes over such complex terrains in mid-latitude climate regime and influenced by a variety of aerosol sources have been poorly studied and under-measured. Faculty and students at UAlbany and HU will conduct process studies of aerosol-cloud interaction and land surface atmosphere interaction to aid NOAA in enhancing its ability to predict the impact of aerosols on weather and climate. ASM will integrate aerosol and cloud observations obtained from ground based HUBC (Howard University Beltsville Campus) and NYS Mesonet, NOAA/ESRL (Environmental Science Research Laboratory (ESRL) and Department of Energy (DOE)/Atmospheric Radiation Measurement (ARM) sites with in-situ cloud and aerosol interactions derived from aircraft (e.g., NOAA/ESRL and DOE/ARM field programs) and remote sensed measurements from satellites. The combined measurements provide much needed and detailed 4D information of atmospheric moisture, wind, and temperature profiles, cloud and aerosol optical properties, precipitation structures, and radiation field. We will first analyze the observations and their space-time variability. The improved data and observational understanding will then be used to constrain and evaluate model parameterizations (e.g., see *Improving the Representations of Cloud Microphysics, Aerosol Processes, and Aerosol Cloud Radiation Interactions in the NCEP Global Models* directly below). Synthesis of these various data streams will allow for an

integrated product revealing a more complete picture of cloud and precipitation microphysical processes in and around the highly sensitive complex terrain and coastal regions. Specifically, we will try to address the question: “How does the thermodynamic and kinematic structure of the atmosphere associated with complex terrain drive microphysical processes and latent heat release, feed back onto airflow dynamics, and ultimately affect the surface precipitation intensity and composition?”

AERosols and Ocean Science Expeditions (AEROSE). Over the past decade the AEROSE program has become a signature research and experiential training vehicle that has yielded unprecedented results in terms of student training and process-level understanding of the long range transport of particulate from West Africa. Lead by HU, UAlbany, and UPRM AEROSE began with a dedicated cruise in 2004 and has been conducted annually since 2006 to generate the most comprehensive data set of complementary atmospheric measurement and oceanographic observations aimed at characterizing the impact and microphysical evolution of atmospheric aerosols of African origin – in particular Saharan dust aerosols, transported across the Atlantic Ocean (Morris et al., 2006; Nalli et al. 2011). AEROSE sounding data have been used to provide independent correlative data necessary for pre-launch phase validation of environmental data records (EDRs) derived from the NOAA Joint Polar Satellite System (JPSS) and Preparatory Project (NPP), Infrared Microwave Sounding Suite (CrIMSS) and the NOAA Geostationary Operational Environmental Satellite R series (GOES-R) Advanced Baseline Imager (ABI).

AEROSE aerosol microphysical measurements will be used to validate Geophysical Fluid Dynamics Laboratory (GFDL) global chemistry and transport models and to improve the National Weather Service new operational global aerosol forecast system based on the NOAA Environmental Modeling System Global Forecast System (NEMS/GFS). This research is supported by a variety of cross-cutting efforts within NOAA including the Satellite Operations and Research (STAR) Satellite Meteorology and Climatology Division (SMCD), the GOES-R Algorithm Working Group (M. D. Goldberg, SMCD Division Chief, and A. Powell, Director of STAR), the NOAA Integrated Program Office (2008–10), the Joint Center for Satellite Data Assimilation FY05–06 Science Development and Implementation Task, and the NASA AIRS Science Team (2006–08 The ASM will seek to extend AEROSE-like opportunities for experiential research training of ASM students and postdoctoral fellows in support of model validation and improvement as well as for advancing process-level understanding of airborne particulate matter, their relation to health sensitivities, and to cloud-aerosol interactions.

(2) Improved quantification of forecast uncertainty, long-range forecasting and regional downscaling, storm prediction accuracy (including initiation of convection), precipitation type and start/stop times.

(3) Advancing the development of high resolution coupled models within an Earth

system framework, and the assimilation and integration of observations (especially for hard-to observe areas).
Focus areas 2 and 3 align with NGSP goals for improving NWS climate modeling capabilities through "Assessment and Validation of various operational models" and improving the "Lead time and Accuracy for Weather and Water Warning and Forecasts" through improved use of numerical representation of physical processes, ensemble forecast methodologies, observational resources, observational tools, analytical methodologies, and visualization strategies. The following example of proposed ASM research fall into these two areas.

Improved NowCasting and Short-term Predictability from the New York State Mesonet
UAlbany is leading the development of the New York State Mesonet (NYM) with its 125 stations and 17 profilers (4000 meteorological soundings of the lower atmosphere per day across the state). The system -- the most advanced of its kind -- is designed to improve Nowcasting and short-term predictability of high impact weather events. The NYM is a member of the NOAA National Mesonet Program (NNMP). With data already going directly to NWS forecast offices in New York (and to MADIS in a few months) and UAlbany and NOAA scientists (e,g., NWS/NCEP) working to apply the data in operational NWP NYM is well positioned to have near term impacts on WRN IDSS and COP goals (e.g., real-time boundary layer heights, convective initiation, fog, icing, ensembles, etc). ASM will leverage research and training opportunities of the NYM as another means of directly contributing to WRN goals. ASM students at Albany will gain research experience through internships or thesis research with NYM. Internships at NYM will be open to ASM partners.

Evaluation and verification of the Operational Global Aerosol Forecast
ASM have collaborated with NWS/NCEP in developing the NEMS GFS Aerosol Component (NGAC) that is a global in-line aerosol forecast system run operationally by NWS. Among other things the new system provides global aerosol information needed for atmospheric correction in satellite retrievals, which in turn have been shown to improve sea surface temperature retrieval (e.g., PhD research conducted by NCAS/Howard University student). Additionally, the system accounts for aerosol direct effect in the global short-term forecasts. NGAC represents a unique opportunity for ASM scientists and students to contribute directly to a NOAA operational model. ASM students and faculty will seek collaborations with NCEP and ESRL scientists to define projects associated with the goal of improving NEMS GFS.

Climate impacts on local circulations, severe local storms, and flash floods
To bridge the gap between the coarse spatial resolution of climate model output and the need for weather and climate information at a higher resolution, ASM scientists at SJSU will apply both statistical downscaling and dynamical downscaling models to examine potential changes of low level moisture in relation to hazardous weather. Synoptic, mesoscale, and microscale features of past extreme events (precipitation, severe storms, and tornadoes) in the U.S. Continental Divide will be investigated using a multi-model

approach and apply downscaling approaches to evaluate the events. Long-range forecasts (weeks to seasonal) will be estimated using the Community Climate System Model (CCSM), and Regional Climate Model systems (RegCM). The project deliverables will be increased confidence in assessing and anticipating climate impacts on local severe storms and flash flood lead times in the U.S. Continental Divide. This project supports WRN strategic goal #3, with two primary goals of (1) increasing confidence in assessing and anticipating climate impacts on severe local storms and flash flood lead times from days to weeks; and (2) enhancing NWS services to support development and delivery of NOAA climate services.

Students at both SJSU and JSU will work on this project and collaborations with NOAA will be sought including NWS-Monterey (Warren Blier), NWS-Shreveport (Cindy Palmer), NWS-Las Vegas (Stan Czyzyk), NWS-Melbourne (David Sharp), and NWS Central region (Jeff Craven).

Physics Refinement, Skill Enhancement, and Decision Support. This project has three major objectives, each directly contributing to one of the NGSP goals stated above and will be led by the UMD contributors with anticipated participation from HU and JSU.

(1) Refine representation of key physical processes at regional-local scales, focusing on planetary boundary layer, ocean mixed-layer, convection, and terrestrial hydrology. This supports the NGSP goal to *improve weather decision services*. The UMCP ASM team has spent years developing advanced schemes representing these essential processes and demonstrated their performance in weather and climate forecasts using mesoscale regional models (Ling et al 2015). They are based on the physical principles and generally to the global modeling at mesoscale and finer resolutions. ASM will seek collaboration with NOAA scientists Georg Grell, Yuejian Zhu, and Michael Ek to implement these schemes into the NOAA forecast systems under development and/or in operation (such as NGGPS, GEFS, NLDAS) and demonstrate their performance.

(2) Enhance skill in sub-seasonal and seasonal precipitation forecasts through physics ensemble optimization, data assimilation, and regional downscaling approaches to maximize the utility of the system predictable memory inherent in the terrestrial hydrology, the upper ocean, and other persistent climate processes. This supports the NSP goal to *deliver improved water forecasting services*. Over the past decade, the UMCP team has led the development of these approaches and demonstrated their abilities in improving NOAA operational precipitation forecasts (Liu – a former NCAS postdoc is now a NOAA employee.). This team has also been involved in data assimilation advances that have led to improvements in skill for global numerical weather prediction (e.g., Kleist et al 2009) in addition to contributing to the reanalysis portion of the operational Climate Forecast System version 2 (Saha et al, 2010)].

Additionally, they have provided key input into mapping out a strategy for research over the next decade to advance sub-seasonal prediction capabilities in the United

States (NRC, 2016). The ASM will seek collaboration with NOAA scientist David DeWitt to incorporate these approaches into the NOAA operational products keen to the predictive management of national water supply. In particular, skill enhancement in predicting droughts, floods, soil moisture and streamflow will be evaluated. Furthermore, close collaboration will be sought with the NCEP/EMC acting climate team lead Suranjana Saha, who led the efforts in implementing versions 1 and 2 of the operational Climate Forecast System.

(3) Improve regional climate change projection and impacts assessment that are in direct support of decision-making in management of national resources for climate adaptation and mitigation. This project supports the NSP goal to *enhance climate services*. Over years, the UMCP team has been developing advanced modeling capabilities of regional climate downscaling and impacts evaluation and applied them in the U.S. national and regional assessments (e.g., Liang, X.-Z., Y. Wu, R.G. Chambers, W. Gao, and C. Sun, 2015). ASM will seek collaboration with NOAA scientists Kenneth Kunkel, Julian X.L. Wang and Zoe Johnson to expand the application of these capabilities, focusing on occurrence of extreme events (floods, droughts, heat waves) and their consequences on water supply, food production, and agricultural economy.

D*evelopment and Implementation of a Light Stress Remote Sensing (LSD) Algorithm.* ASM faculty at UPRM will engage in collaborative work with NOAA NOS and NESDIS scientists through both this award and a student scholarship internship opportunity (SSIO) dealing with measurements of light stress on photosynthetic marine organisms, focusing on shallow water coral reefs. This project is an integrated environmental forecast product supporting healthy ecosystems – which is one of the primary goals of NOAA and is stated in the NWS strategic plan. A UPRM graduate student will use a PAM fluorometer to determine photosynthetic parameters in corals and their relation to water quality/water optics, light and temperature. The goal is to conduct these measurements in the field and in the laboratory using mesocosm experiments. The LSD algorithm will be modified to include UV data in addition to PAR and validated for this region.

At-sea experiential opportunities will continue to be a priority for ASM students using our small and medium-size ships in addition to exploration ships (e.g. E/V Nautilus, NOAA Okeanos Explorer), and other NOAA vessels (e.g. Ron Brown, Nancy Foster). ASM students will also be trained in the use of underwater robotics (ROVs, AUVs and surface vehicles) through ASM collaboration with engineers and scientists from the Woods Hole Oceanographic Institution.

GCOS Reference Upper Air Network (GRUAN). Howard University has developed a unique partnership with the NOAA/NWS/SFSC and NOAA/NESDIS/STAR as part of the Global Climate Observation Sites (GCOS) Reference Upper Air Network (GRUAN) project to document and measure well characterized upper air data climatic records. This

collaboration allows for coordinated weekly radiosonde launch at HUBRC coordinated with the Suomi National Polar orbiting Partnership (Suomi NPP) overpass in the Joint Polar Satellite System (JPSS).

Faculty at HU and UMBC will help organize and coordinate radiosonde work with WMO, NOAA/NWS/SFSC and NOAA/NESDIS/STAR scientists as part of the Global Climate Observation Sites (GCOS) Reference Upper Air Network (GRUAN). Students will be trained to conduct and analyze observations collected in support of this effort. NOAA collaborators in GRUAN effort are Tony Reale NOAA/STAR, Howard Diamond NOAA/NCEI, Mike Hicks NOAA/NWS (SFSC), Nick Nalli NOAA/STAR, James Fitzgibbons NOAA/NWS-SFSC.

PBL determination from the ASOS Ceilometer Network: An ASM project team led by faculty at UMBC will work in collaboration with NOAA/NWS, NOAA/NCEP, NOAA/ on a proof of concept study of saving the full data profile of the NOAA/NWS Automatic Surface Observing System's (ASOS) ceilometer network. This transformational activity was initiated as a response to the NRC's recommendation as a result of the report "Observing Weather From the Ground Up: Network of networks" during the NCAS third funding cycle (2011 - 2016). Beyond the proof of concept demonstration, work is required for helping define and design the network and possible science outcomes including helping write requirement documents, testing/design of algorithms for archiving, building demonstration modules and application of data into various scenarios (volcanic and smoke detection, Cloud and sky coverage enhancement, model improvement, etc.). In particular, an extensive effort is spent in retrieval of the Planetary Boundary Layer (PBL) from the regional lidar networks developed at ASM partner sites, UMBC, and the NOAA NCWCP (NOAA/ARL). A fast algorithm that developed at UMBC, Howard University and NOAA/NWS SFSC will be tested and its performance evaluated. Graduate and undergraduate students from HU and UMBC will be recruited and trained to help carry-out most of the day today work in this project.

(4) Integrated Social Science

Focus areas 4 and 5 address NOAA's goal for a Weather Ready Nation where society is prepared for and intelligently responds to weather-related events. Projects within this focus area aim to improve our understanding of the human dimensions associated with the impacts of severe weather and climate and it conducts research that is relevant to each of the ASM research themes. Within these areas the ASM will emphasize understanding decision-making practices of first responder and citizens, with a special focus on improving communications to vulnerable communities and populations.

Building Extreme Weather Resiliency through Improved Weather and Climate Prediction and Public Response Strategies and Testing and Refinement of Communication Strategies for Convective Hazard Information to Key Decision Makers. This project illustrates the intersectionality of atmospheric sciences with SBEC. It addresses NOAA's Weather Ready Nation's goal of improving forecasts, warnings, and decision support for high-

impact events, and is aligned with NOAA's Forecasting a Continuum of Environmental Threats (FACETs) paradigm. This project lead by faculty at UAlbany, HU, and includes international partners examines the challenges associated with extreme weather resiliency with a particular focus on reducing the impacts of flooding through the enhancement of weather and climate prediction models and better understanding of decision-making risk and response during extreme weather events. Ultimately, this project seeks to improve the ability of climate models to quantify extreme weather events through innovative observations, as well as improve and investigate probabilistic methods and risk perception that impact decision-making during extreme weather in an international context. Potential collaborators and stakeholders within NOAA include NSSL, ESRL, and NWS Climate Services Branch.

Students engaged in this project may be recruited from all partner institutions and will be co-mentored by both social science and atmospheric sciences faculty members and will gain experience with working effectively on international teams.

Testing and Refinement of Communication Strategies. This project is conducted by HU faculty members in collaboration with scholars from Oklahoma University scientists at the National Severe Storm Laboratory in coordination with Randy Peppler at the Cooperative Institute for Mesoscale Meteorological Studies (CIMMS). This project examines the impact of risk aversion and exposure to different forms of communication on the decision-making practices of weather forecasters, emergency managers. Data from this projects will be used to facilitate the development of monitoring and added value products for improved impact-based decision making tools.

Examination of Traffic Patterns during Early Release of Government Employees: The Case of Snowmageddon in Washington, DC.
This project is an example of work that will be conducted to support of resilient communities and the development of impact based decision making tools. It supports Goal 4 of the NWS strategic plan (Sector-relevant information in support of economic productivity). Faculty at HU in coordination with NWS STI scientists will examine the impact of emergency management decisions in the face of severe weather on local economies. The project is by HU faculty and is an example of the type of work that can be conducted to enhance economic and community resilience. The SBE team will model the impact of severe weather on local economies, examining resilient strategies used by business in response to forecasted events, and examining the impact of severe weather events on economic productivity. For example, ASM team members will train students to model the impact of emergency release time on traffic patterns. Team members will use commuting patterns data to forecast the distribution of commuters by socio-economic and demographic characteristics, and modes of transportation simulating traffic patterns along the critical transportation corridors to estimate the impact of various release time schemes.

(5) **Effective communication of climate and severe weather risks**
Communication and Crisis: Cross Cultural Analysis of Media Sources used during Severe Weather Events and CapComm Projects. In an effort to meet the increased need to effectively communicate climate and severe weather risks to communities, HU faculty have engaged in research and training in risk communication in coordination with scientist in NWS Center for Advanced Public Safety and NWS Climate Services Branch. This category of activities includes social science research, media studies, public relations technical assistance, and community outreach work. Research will explore a variety of topics under the risk communication and media studies domain, including media messaging, social media sources and resources, social media usage during severe weather events, and perceptions of media sources and optimal modes of communication. Emphasis is placed on not only conducting research for publication in traditional academic journals, but also transforming data into white papers, survey-based research reports and easily sharable "bite-sized" information that can be quickly provided to NOAA officials and the public via social media, which will allow for faster transfer of information and ideas.

The ASM will seek to utilize strategic partnerships with NOAA, other governmental partners, and private sector through bidirectional scientist exchanges, and experiential opportunities to enhance training in the fields of study above and to facilitate the research and education priorities of NOAA.

Focus Area	Outputs	Goals
Process-level understanding and enhanced modeling capabilities	NOAA Collaborative research Publication-worthy research Peer-reviewed publications Presentations at annual meetings NOAA data sets and research products developed or co-developed Students Trained Experiential opportunities (including but not limited to NERTO) Engagement in NOAA field campaigns	Increased number of NOAA collaborations annually
Improved quantification of forecast uncertainty		Increased number of peer-reviewed publications – including student authored and NOAA co-authored – annually
Advancing the development of high resolution models		Increased number of students trained
Integrated social science		Increased number of NOAA mentoring interactions
Effective communication of climate and weather risk		Increased leveraged funding

Table 17:ASM Focus Areas with Outputs and Goals

c) Strategies and Approach

The project teams will be coordinated by the ASM management team through synergistic study designs that will utilize direct engagement with NOAA, existing scientific expertise, observational infrastructures and modeling capacities at the partner institutions as well as NOAA facilities (NOAA vessels, research platforms, and laboratories).

Various mechanisms for project design will be used but the three essential requirements for any project are:

a. NOAA Relevance and ASM thematic alignment,
b. NOAA collaborators, and
c. Student and/or Postdoc engagement

Integration of Social, Behavioral, and Economic Sciences Research and Training
Effective translation of NOAA sciences to the public and private sectors is essential for achieving the vision articulated in the NOAA Strategic plan. The WRN Roadmap states: "End to end social science integration starts with improving the agency's understanding of core partners' weather information needs and of weather information's effects on core partners' decision-making" (National Weather Service, 2013). The ASM will combine SBE and Communication Sciences (SBEC) research in the following two ways. First, it will sponsor SBEC research and training focused on NOAA needs as it relates to communicating and understanding perceptions and response to forecast and risk information and social and economic risk and resilience. Second, the ASM will support SBEC research that will be integrated into weather, climate, and air quality research to facilitate improvements in products for impact-based decision-making.

The ASM will adopt an interdisciplinary approach to examining societal impacts of severe weather and climate events. The ASM team for SBEC is comprised of faculty from such disciplines as communications, public relations, economics, sociology, and psychology. These faculty members will team with atmospheric scientists and meteorologists, where appropriate, to train students on decision-making, human behavioral risk response, risk communications, social and economic impacts of extreme weather, and the diversity dimensions of preparedness, response, and recovery efforts.

The ASM members have significant experience engaging NOAA in these areas and co-mentoring students to ensure that they gain the types of perspective that enables a new generation of services that protect the well-being of all communities. The social and behavioral scientists within ASM will engage NOAA personnel in ongoing discussion of service needs in order to design collaborative research training. We anticipate discussions between the NWS Science and Technology Integration Office and ASM SBE faculty that will lead to the development and implementation of a study examining the perceptions of and responses to the risks associated with extreme heat in Washington, DC and possibly other susceptible regions. The results will be provided to NOAA in briefings and this work may serve as the basis for student theses as well as useful decision tools for NWS. The ASM proposes to continue these lines of engagement with NWS.

d) Performance Metrics with Milestones and Timeline

Table 18 in appendix a provides a listing of some of the primary performance metrics and projections across the five years. The ASM EMT will revise and refine these projections based on the projects defined after the first year and continue to update the projections based on the ongoing developed of NOAA collaborations.

e) Key Success Criteria

Key success criteria for the scientific research function include but are not limited to”

- Peer-reviewed publications
- Citations and other recognitions of peer-reviewed publications
- Development of data sets, products, and applications of utility to NOAA
- Increased numbers of NOAA collaborators and mentors
- Joint publications and presentations
- Student-authored publications
- Inter and intra-institutional collaborations in support of NOAA mission goals

VII. Appendices

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b) 5-Year Products and Outcomes of the Center

Activities	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
Annual Meeting	Nov	Nov	Nov	Nov	Nov
Science Report		1	1	1	1
# NOAA Collaborations	10	15	20	25	30
# NOAA Collaborators	15	20	25	35	40
# Peer-reviewed Publications	5	15	18	20	20
#Student-authored publications	2	5	8	10	10
# Proposals submitted (to other programs)	5	5	5	5	5
# Proposals funded	2	2	2	2	2
# Leveraged dollars	$1.5M	$1.5M	$2M	$2M	$2M
# Scientific Presentations	15	20	25	30	35
# Invited Presentations	2	4	6	8	10
#Field Campaigns (e.g. cruises)	1	0	2	1	2
# Data Products and Applications used by NOAA	0	1	2	2	3
#Inter and Intra-Institutional Collaborations of NOAA Relevance	5	6	6	6	7

Table 18: 5-Year Deliverables/Performance Measures for Scientific Research

c) Master Schedule

Activities	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
Submission, Collection, Review of Invoices	Monthly	Monthly	Monthly	Monthly	Monthly
Site Visits	Bi-monthly	Bi-monthly	Bi-monthly	Bi-monthly	Bi-monthly
Successful execution of sub-awards	Within 90-days of award	Within 60-days of award	Within 60-days of award	Within 60-days of award	Within 60-days of award
Submission of semi-annual reports	Semi-annually	Semi-annually	Semi-annually	Semi-annually	Semi-annually
Staff Meetings	Weekly	Weekly	Weekly	Weekly	Weekly
Executive Team meetings	Weekly	Weekly	Weekly	Weekly	Weekly
IMT Meetings	Monthly	Monthly	Monthly	Monthly	Monthly
Science Telecons	BI-Monthly	Bi-Monthly	Bi-Monthly	Bi-Monthly	Bi-Monthly
PI Telecons	Monthly	Monthly	Monthly	Monthly	Monthly
EPP Forum	X	X	Nov	X	TBD
Annual Meeting	May	Nov	May	May	May
Submission of reports and plans to EAB	Semi-annually	Semi-annually	Semi-annually	Semi-annually	Semi-annually
EAB Meeting	Annually	Annually	Annually	Annually	Annually
External Evaluation		Summer		Summer	
Submission of Student Tracker Data	Semi-annually	Semi-annually	Semi-annually	Semi-annually	Semi-annually

Table 19: ASM Master Schedule

e) Acronyms and Abbreviations

3DVAR	Three-Dimensional Variation
AAAR	American Association for Aerosol Research
ACARS	Aircraft Communications Addressing and Reporting System
ACS	American Chemical Society
ADP	Automated Data Processing
AERADNET	AErosols and RADiation Observing NETwork
AEROSE	AERosols and Oceanographic Science Expedition
AFWA	Air Force Weather Agency
AG	Access Grid
AGL	Above Ground Level
AGU	American Geophysical Union
AHPCRC	Army High Performance Computing Research Center
AIRS	Atmospheric Infrared Sounder
AL	Alabama
AMMA	African Monsoon Multidisciplinary Analysis
AMS	American Meteorological Society
AMSU	Advanced Microwave Sounding Unit
AOML	Atlantic Oceanographic and Meteorological Laboratory
AOT	Aerosol Optical Thickness
ARL	Air Resources Laboratory
ARM	Atmospheric Radiation Measurement
ARW	Advanced Research WRF
AQS	Air Quality System
ASM	Atmospheric Sciences and Meteorology
ASL	Atmospheric Surface Layer
ASLO	American Society of Limnology and Oceanography
ASOS	Automated Surface Observing System
AUV	Autonomous Underwater Vehicle
AVHRR	Advanced Very High Resolution Radiometer
AWIPS	Advanced Weather Interactive Prediction System
AWOS	Automated Weather Observing System
BAMP	Howard University Beltsville Atmospheric Measurement Program
BBSS	Balloon Borne Sounding System
BLH	Boundary Layer Heights
BSRN	Baseline Surface Radiation Network
CAFAS	Careers in Fisheries, Aquatics, and Atmospheric Sciences
CAMx	Comprehensive Air Quality Model with Extensions
CAREERS	Channeling Atmospheric Research into Educational Experiences Reaching Students
CAPE	Convective Available Potential Energy

CASTNET	Clean Air Status and Trends Network
CB4	Carbon Bond IV model
CBIV	Carbon Bond 4 mechanism
CB05	Carbon Bond 2005 mechanism
CBL	Convective Boundary Layer
CCBay	Corpus Christi Bay
CCN	Cloud Condensation Nuclei
CE-CERT	Center for Environmental Research and Technology (University of California Riverside)
CFH	Cryogenic Frostpoint Hygrometer
CGD	Climate and Global Dynamics
CGU	Canadian Geophysical Union
CICS	Cooperative Institute for Climate and Satellites
CIMMS	Cooperative Institute for Mesoscale Meteorological Studies
CISM	Center for Integrated Space Weather Modeling
CLM	Common Land Model
CM3	Coordinated Mesoscale Measurements in Mississippi
CMAQ	Community Multi-scale Air Quality model
CMM5	Climate MM5 Model
CMP	Conference Mentorship Program
COAMPS	Coupled Ocean-Atmosphere Mesoscale Prediction System
COASTB	Coastal Monitoring and Assessment Group B Reefs
CONFRRM	Cooperative Network for Renewable Resource Measurements
CoZOBs	Coastal Marine Zone Observations
CPAS	Cooperative Program in Atmospheric Sciences (UPRM)
CPC	Climate Prediction Center
CPS	Cumulous Parameterization Schemes
CPU	Central Processing Unit
CREST	Cooperative Remote Sensing Science and Technology Centers
CREWS	Coral Reef Early Warning System
CRTM	Community Radiative Transfer Model
CSC	Cooperative Science Center
CSWR	Center for Severe Weather Research
CTD	Conductivity/Temperature/Depth Instrument
CUNY	City University of New York
CV	Curriculum Vitae
CVS	Concurrent Version Systems

CRW	Coral Reef Watch
CWRF	Climate WRF
D	Democrat
DC	District of Columbia
DCPS	District of Columbia Public Schools
DDR	Direct to Diffuse Irradiance Ratio
DEQ	Department of Environmental Quality
DISORT	Discrete Ordinate Radiative Transfer
DCRM	Detailed Cloud Resolving Model
DIAR-BAR	Differential O2 Absorption Barometric Pressure Radar
DMR	Division of Marine Resources
DOD SMART	Department of Defense Science Mathematics & Research for Transformation Scholarship
DOE	Department of Energy
DOW	Doppler-on-Wheels
DRI	Desert Research Institute
DS	Distinguished Scientist
EAB	External Advisory Board
ECSU	Elizabeth City State University
EF	Enhanced Fujita scale
EMC	Environmental Modeling Group
EMT	Executive Management Team
ENSO	El Nino/Southern Oscillation
EOC	Expanding Opportunities Conference
EOS	Earth Observing System
EPA	Environmental Protection Agency
EPIC	Equatorial Processes including the Coupling
EPP	Educational Partnership Program (NOAA)
EPPMSI	Educational Partnership Program (NOAA) with Minority Serving Institutions
EPIRM	Environmental Physics Inverse Reconstruction Model
EQB	Environmental Quality Board
ERDC	Engineering Research and Development Center
ESA	European Space Agency
ESE	Environmental Sciences and Engineering
ESRL	Earth System Research Laboratory
ERR	Education, Recruitment and Retention Committee
EWX	Austin/San Antonio Region code for the Weather Forecast Office
FAMU	Florida A & M University
FFO	Federal Funding Opportunity
FGSEE	Future Geoscientists for a Sustainable Earth Environment
FL	Florida

FSOC	Field Systems Operations Center
FRRF	Fast Repetition Rate Fluorometry
FSIRP	Faculty and Student Internship Program
FTE	Full Time Employee
FVSU	Fort Valley State University
GCOS	Global Climate Observing System
GDAS	Global Data Assimilation
GFDL	Geographical Fluid Dynamics Laboratory
GIS	Geographic Information Systems
GLAS	Global Laser Altimeter S
GOCART	Georgia Tech/Goddard Global Ozone Chemistry Aerosol Radiation Transport Model
GOESPO	GOES Program Office
GOES	Geostationary Operational Environmental Satellites
GoHFAS	Goddard Howard University Fellowship in Atmospheric Sciences
GFS	Global Forecasting System
GLOW	Goddard Lidar Observatory for Winds
GMD	Ground-based Midcourse Defense
GPCP	Global Precipitation Climatology Project
GPA	Grade Point Average
GPI	Global Precipitation Index
GPS	Global Positioning System
GRUAN	GCOS Reference Upper-Air Network
GSFC	Goddard Space Flight Center (NASA)
GSM	Global Spectrum Model
GSPD	GOES Program Data
GUFMEX	GUlf of Mexico EXperiment
HBCU	Historically Black Colleges and Universities
HF	High Frequency
HU	Howard University
HUBRF	Howard University Beltsville Research Facility
HU IRB	Howard University Institutional Review Board
HURL	Howard University Roman Lidar
HUPAS	Howard University Program in Atmospheric Sciences
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
IAMA	International Aerosol Modeling Algorithms Conference
IAMAS	International Association of Meteorology and Atmospheric Sciences

ICCM	Canary Institute of Marine Sciences
ICE	Informal Science Education
IC-FAIM	Institutional Change through Faculty Advancement in Instruction and Mentoring
ICodEM	Icod Environmental Model
ICON	Integrated Coral Observing Network
IDAS-RAP	Diversity in Atmospheric Science through Research Application and Partnership
IPDDP	Individual Post-Doctoral Development Plan
IDV	Integrated Data Viewer
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IEO	Spanish Institute of Oceanography
IGARSS	International Geosciences & Remote Sensing Symposium
IGRA	Infrared Gas Analyzer
IHOP	International H_2O Project
IMT	Internal Management Team
INTEX	Intercontinental Chemical Transport Experiment
IOAS-AOLS	Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface
IOPs	Intensive Observational Periods
IR	Infrared
ISCS	International Solar Cycle Studies
ISMT	Internal Science Management Team
ISO	International Standards Organization
ISWS	Illinois State Water Survey
IUGG	International Union of Geodesy and Geophysics
JAN	Jackson, Mississippi - I Region code for the Weather Forecast Office
JCET	Joint Center for Earth Systems Technology
JCSDA	Joint Center for Satellite Data Assimilation
JISAO	Joint Institute for the Study of the Atmosphere and Ocean
JPL	NASA/Jet Propulsion Laboratory
JSU	Jackson State University
JSU-MET	Jackson State University Meteorology Program
JPSS	Joint Polar Satellite System
LA	Louisiana
LA-MS	Louisiana/Mississippi
LAPS	Local Analysis and Prediction System
LEAD	Linked Environment for Atmospheric Discovery
Lidar	Light detection and ranging
LISA-QED	Laboratory for Interdisciplinary Statistical Analysis and Mathematics

	Learning through Quantitative Exploration of Data
LIX	New Orleans/Baton Rouge Region code for the Weather Forecast Office
LSD	Light Stress Damage (algorithm)
LSM	Land Surface Model
LST	Local Solar Time
LPASF	Laboratory of Atmospheric Physics Siméon Fongang
LW	Longwave
LWS	Living With a Star
MADIS	NOAA's Meteorological Assimilation Data Ingest System
MAS	Mississippi Academy of Sciences
MAST	Mississippi Academy for Science Teaching
MCC	Mesoscale Convective Complex
MECB	Marine Ecosystems and Climate Branch
MEMA	Mississippi Emergency Management Agency
Met	Meteorological
MD	Maryland
MDE	Maryland Department of the Environment
MDEQ	Mississippi Department of Environmental Quality
MEA	Malt Extract Agar
MFRSR	Multi-Filter Rotating Shadowband Radiometer
MHD	Magneto Hydro Dynamics
MISR	Multi-angle Imaging Spectro Radiometer
MMB	Office of Management and Budget
MMCR	Millimeter Cloud Radar
MM5	Mesoscale Model 5
MODIS	Moderate Resolution Imaging Spectroradiometer
MODTRAN	Moderate resolution atmospheric Transmission
MP	Micro Physics
MPL	Micro-Pulse Lidar
MS	Mississippi
MS DMR	Mississippi Division of Marine Resources
MSI	Minority Serving Institution
MWR	Microwave Radiometer
NAAPS	Navy Automated Aerosol Prediction System
NAAQS	National Ambient Air Quality Standards
NAM	North American Model

NAME	North America Monsoon Experiment
NAQFS	National Air Quality Forecast System
NARR	North American Regional Reanalysis
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAVO	Naval Oceanographic Office
NCAR	National Center for Atmospheric Research
NCAS	NOAA Center for Atmospheric Sciences
NCCOS	National Centers for Coastal Ocean Science
NCDC	National Climatic Data Center
NCDDC	National Coastal Data Development Center
NCEP	National Center for Environmental Prediction
NCO	NOAA Computing Office
NCUR	National Center on Undergraduate Research
NCWCP	NOAA Centers for Weather & Climate Prediction
NDBC	National Data Buoy Center
NERTO	NOAA Experiential Research Training Opportunity
NESDIS	National Environmental Satellite, Data & Information Service
NGIA	National Geospatial Intelligence Agency
NGSP	Next Generation Science Plan
NHC	National Hurricane Center
NIS	Network Infrastructure & Administrations
NMM	Non-hydrostatic Mesoscale Model
NOAA	National Oceanic and Atmospheric Administration
NOBCChE	National Organization of Black Chemists & Chemical Engineers
NoN	Nationwide Network of Networks
NOS	National Ocean Service
NRCS	National Resources Conservation Service
NREL	National Renewable Energy Lab
NRL	Naval Research Laboratory
NSF	National Science Foundation
NSSL	National Severe Storms Laboratory
NSTA	National Science Teachers Association
NWA	National Weather Association
NWS	National Weather Service
OAR	Office of Atmospheric Research
OCWWS	Office of Climate, Water, and Weather Services
OD	Optical Depth
OES	Oceanic Engineering Society
OED	Office of Education
OGP	Office of Global Programs

OLR	Outgoing Longwave Radiation
OMB	Office of Management and Budget
OOS	Office of Operational Service
OPC	Ocean Prediction Center
OPDB	Operational Products Development Branch
ORA	Howard University Office of Research Administration
ORA	Office of Research & Applications
ORAD	Office of Research Applications and Development
ORISE	Oak Ridge Institute for Science and Education Optical Depth
OSB	Ocean Surface Bundle
OS&T	Office of Science and Technology
PAR	Photosynthetically Active Radiation
PASU	Post-Award Services Unit
PASCoR	Partnership for Spatial and Computational Research
PBL	Planetary Boundary Layer
PCR	Polymerase Chain Reaction
PDAS-RAP	Promoting Diversity in Atmospheric Sciences through Research Applications Partnership
PdN	Paseo del Norte Region
PI	Principal Investigator
PIERS	Progress in Electromagnetics Research Symposium
PM	Particulate Matter
PNE	PIRATA Northeast Extension
PPM	Piecewise Parabolic Method
PRWC	Puerto Rico Weather Camp
PSM	Ponce School of Medicine (Puerto Rico)
PSU	Pennsylvania State University
PPD	Planning and Programming Division
QBO	Quasi-Biennial Oscillation
QEM	Quality Education for Minorities
QPF	Quantitative Precipitation Forecasts
RAC	Research Advisory Council
RAD	Radar
RACM2	Regional Atmospheric Chemistry Mechanism, Version 2
RAS	Research Administration Services
RASS	Radio Acoustic Sounding System
RAAS	Reference Ambient Air Sampler
RAMS	Regional Atmospheric Modeling System
RCC	Riverside Community College
REBS	Radiation and Energy Balance Systems
Rep.	Representative
RFC	River Forecast Center
RHB	Ronald H. Brown

Rn	Net radiation
RMS	Root Mean Square
RS	Remote Sensing
RSM	Regional Spectrum Model
RSMS	University of Miami Rosenstiel School of Marine and Atmospheric Sciences
RSS	Rotating Shadowband Spectrometer
RTMA	Real-Time Mesoscale Analysis
SAR	Semi-Annual Report
SACS	Southern Association of Colleges and Schools
SACNAS	Society of Associated Chicanos, Native Americans in Science
SAHRA	Center for Sustainability of Semiarid Hydrology and Riparian Areas (University of Arizona)
SAL	Saharan Aerosol Layer
SAQM	SARMAP Air Quality Model
SARMAP	SJVAQS/AUSPEX Regional Modeling Adaptation Project
SBE	Social, Behavioral, and Economical Sciences
SBEC	SBE and Communication Sciences
SCDAB	Satellite Calibration and Data Assimilation Branch
SCEP	Student Career Experience Program
SDSU	San Diego State University
SDP	Student Development Plan
SeaWiFS	Sea-viewing Wide Field-of-View Sensor
SEC	Space Environment Center
SGP	Southern Great Plains
SJSU	San Jose State University
SLP	Sea Level Pressure
SMCD	Satellite Meteorology and Climatology Division
SMOKE	Sparse Matrix Operator Kernel Emissions model
SMT	Science Management Team
SOARS	Significant Opportunities in Atmospheric Research & Science
SOSVRT	Successive Order of Scattering Vector Radiative Transfer model
SOW	Statement of Work
SPB	Science Plans Branch
SPC	Storm Prediction Center
SR	Southern Region
SRL	Scanning Raman Lidar
SSM/I	Special Sensor Microwave Imager
SSRB	Solar Surface Radiation Branch
SST	Sea Surface Temperature

STAR	Satellite Applications and Research
STC	Science and Technology Center
STEM	Science, Technology, Engineering and Mathematics
STP-M	Solar-Terrestrial Physics and Meteorology
SUW	Subtropical Underwater
SURFRAD	Surface Radiation Budget Network
SUNYA	State University of New York at Albany
SW	Shortwave
TCEQ	Texas Commission for Environmental Quality
TDL	Techniques Development Laboratory
TNRCC	Texas National Resource Conservation Commission
TOA	Top of the Atmosphere
TPIOP	Television and Infrared Observation Satellite
TRMM	Tropical Rainfall Measuring Mission
TRMM PR	Tropical Rainfall Measuring Mission Precipitation Radar
TU	Tuskegee University
TUV	Tropospheric Ultraviolet and Visible model
TX	Texas
UCAR	University Corporation for Atmospheric Research
UIUC	University of Illinois Urbana-Champaign
UMBC	University of Maryland Baltimore County
UMCP	University of Maryland College Park
UMES	University of Maryland Eastern Shore
UMET	Universidad Metropolitana de San Juan
UND	University of North Dakota
UPRH	University of Puerto Rico Humacao
UPRM	University of Puerto Rico at Mayaguez
URC	University Research Center
US	United States
USA	United States of America
USDA	United States Department of Agriculture
USDA SCAN	United States Department of Agriculture Soil Climate Analysis Network
UTC	Coordinated Universal Time
UTEP	University of Texas at El Paso
UV	Ultraviolet
UW/APL	University of Washington Applied Physics Laboratory
VAMD	Vice Admiral
VALIDAR	Validation LIDAR
Vis5d	Visualization of Large 5-d Grided Data Sheets
VIIRS	Visible Infrared Imaging Radiometer Suite
VOC	Volatile Organic Compounds
VRS	Visible Reflectance Spectroscopy

WBTP	Weather Broadcast Training Program
WFO	Weather Forecast Office
WMO	World Meteorological Organization
WRF	Weather Research and Forecast model
WRN	Weather Ready Nation
WSU	Washington State University
WTA	Western Tropical Atlantic
XBT	Expendable Bathythermographs