External Review
of the
Cooperative Institute for Climate and Satellites
University of Maryland (CICS-MD)
College Park, Maryland

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Contents

SUMMARY

An external review of the research, education, and outreach programs of the Cooperative Institute for Climate and Satellites (CICS) at the University of Maryland (UMD) was conducted on November 6-7, 2012 in Asheville, North Carolina and November 8-9 in College Park, Maryland. Guidelines for conducting the review were provided by the National Environmental Satellite, Data and Information Service (NESDIS) within the National Oceanic and Atmospheric Administration (NOAA). The review was conducted under the auspices of the NOAA Science Advisory Board (SAB) and, therefore, is subject to the requirements of the Federal Advisory Committee Act (FACA). A list of review panel members is provided in Appendix I. The review panel's on-site agenda is provided in Appendix II.

The committee found that CICS is well-aligned with the eight overarching themes of NOAA science as well as NOAA strategic needs in climate and satellites. In most cases there is a clear path from research into operations. CICS-NC was remarkably well-aligned with NCDC needs. CICS-MD collocation supports broad connectivity between the University of Maryland, NOAA and NASA that is particularly important to support current and emerging satellite-related research and workforce planning. The research being conducted at CICS is excellent and internationally-recognized in several areas. Data Assimilation is well-positioned to make broad impacts given the excellent research work at CICS and the recent collocation with the Joint Center for Satellite Data Assimilation (JCSDA) and the National Centers for Environmental Prediction (NCEP) at the NOAA Center for Weather and Climate Prediction (NCWCP). Climate studies and the work being done associated with the National Climate Assessment will have wide impact and inform national and international decisions and policies.

The review panel was extremely impressed with the progress made by CICS-NC in such a short amount of time. The staff, logistics, information technology, computing infrastructure and scientific progress has been amazing. In addition to the hard work of the CICS-NC staff, this success is in large part due to the enthusiasm of the CICS-NC director and NCDC management.

The matching funds provided by CICS have been very useful in the first 5 years for recruiting and research, and we recommend that CICS work with NOAA to ensure these benefits continue in future years.

The review panel wishes to thank CICS for the highly informative review including the presentations, background materials, and the chance to personally interact with scientists, managers and sponsors. In addition, the panel wishes to recognize Ingrid Guch, the Director of Cooperative Research Programs at NESDIS, for providing her background knowledge with the CI and her significant coordination and documentation support efforts.

The specific findings and recommendations are listed below and discussed in more detail in later sections of this report.

Findings

CICS

1. Both CICS-MD and CICS-NC have enthusiastic early career scientists making important contributions related to CICS science themes and outreach to the public. Examples include CycloneCenter, which allows the general public to study historical cyclone imagery from NCDC, and linkages to the Capital Weather Gang that provide outreach related to lightning research and public safety.

2. Metrics other than publications do not appear to be mature or well documented to communicate the progress of activities at CICS.

3. CICS does not have significant funding set aside for “new starts”; however they leverage NCDC and STAR end-of-year funds as well as some matching funds. CICS-NC also encourages their employees to spend 1 day a week writing up results or otherwise focusing on research. Several “new starts” such as CycloneCenter started because of this dedicated day.

4. CICS scientists are not regularly trained in ITAR (International Traffic in Arms Regulations) that control the import/export of defense related data. ITAR dictates that covered material may only be shared with US persons. Because CICS deals with both ITAR and open source material, for example, Suomi-NPP calibration/validation work in particular may involve ITAR-related information, and employs US and foreign national personnel, the opportunity might exist for inadvertent disclosure if CICS personnel are not aware of the regulations.

5. CICS-MD and CICS-NC relationships and collaborations could grow and become mutually beneficial in many areas, including precipitation and land surface temperature.

6. The administrative structure of CICS, with a single cooperative agreement for the entire consortium, appears to be working from a scientific point of view. The relationship between the managers at CICS, CICS-MD and CICS-NC is very good and all are committed to CICS success.

7. CUNY/CREST (City University of NY – Center of Excellence in Remote Sensing Science and Technology Center), a consortium member, is bringing needed diversity to CICS and the larger atmospheric and weather scientific community with its advanced degree programs that incorporate CICS research topics.

8. The current cost-share (matching funds) by CICS is highly beneficial to the institute's success. The consortium is meeting its commitments to support multiple CI activities. To fully maximize activities in a renewal period, NOAA must evaluate CICS intentions and commitments for a future 5-year period.

9. The CICS consortium is large in response to the NOAA FFO for CICS and the needs anticipated for a National Climate Service. Even without the National Climate Service, the CICS structure serves as an effective facilitating mechanism – the majority of consortium members are actively receiving or pursuing funds through CICS. There is no significant cost to CICS for running this large consortium and there are clearly some benefits to NOAA. In the future such a large group could potentially become unwieldy, but at this time it is not. The UMD business office is well-staffed to accommodate the current structure.

10. The University of Maryland management is notably flexible and supportive of CICS-like organizations (government contracting and support). This is a clear benefit for CICS.

11. CICS is well positioned to see gaps that may exist between the work being conducted by multiple NOAA offices, and thus make informed recommendations and help facilitate filling those gaps for NOAA.

12. CICS is playing an important role preparing for GOES-R and JPSS satellites. Team members are involved in retrieval algorithm development, NPP calibration/validation activities, and conducting evaluations of the potential impacts of GOES-R and JPSS data on forecast operations.

13. In the future, NOAA will be required to better track CI expenditures against specific funding sources. STAR should work with CICS to determine requirements and address how to respond. The administrative review is addressing this finding.

CICS-NC

1. There is an excellent badgeless environment at CICS-NC contributing to the success of the institute as well as high-priority NOAA activities. The collaboration and collocation of

government employees (approximately 100) and academia (approximately 35) provide unique approaches to problem definition and solution. The avoidance of silos is positive.

2. RISA (Regional Integrated Sciences and Assessments) and National Climate Assessment coordination work is outstanding and a major undertaking that is well-suited to CICS capabilities.

3. Very high quality research is being conducted related to the global surface temperature databank at CICS-NC. This should provide an excellent, transparent basis for future evaluation of climate change.

4. CICS-NC has done a tremendous job spinning up a CI from scratch in 3.5 years, due in large part to the enthusiasm and commitment of the director, the UNC system and NCDC sponsors.

5. The number of employees at CICS-NC is reaching critical mass; several have been at CICS-NC for 2 or more years now and have promotion potential. There is appreciation for the CICS-NC director and the business manager/administrator providing a sense of community, but there are many questions about how they can advance in their careers in the University system at a location that is remote from education sources that offer advanced degrees. In addition, when assessing employee performance, CICS management should ensure that they understand specific employee achievements via informal discussions with NCDC collaborators and project leads.

6. CICS-NC has an enthusiastic and knowledgeable staff that will greatly help CICS and NOAA achieve their mission goals.

7. Outreach and education at CICS-NC is just getting started, but looks very promising with a focus on the private sector and complementing efforts at CREST (another CICS node).

8. CICS-NC has accomplished much in the 3.5 years since inception, standing up an organization and processes, staffing from one original employee to ~35, and achieving research and R2O products. The organization is reaching a transition point in maturity. The Administrative review identified critical “one deep” positions where there is no back-up for key personnel. Two positions they did not highlight are Otis Brown (Director CICS-NC) and Jenny Dissen (who is leading the Education/Literacy/Outreach efforts). To ensure continued, future stability and performance from CICS-NC, succession planning will be required.

CICS-MD

1. CICS-MD is uniquely able to bring UMD, NOAA and NASA together to conduct high-quality science for the benefit of both agencies and the nation. Examples include precipitation and Suomi-NPP land surface studies.

2. Important work related to change in arctic sea-ice volume is being conducted at CICS that has the potential to change the national conversation about diminishing sea ice from one associated with surface area to one associated with volume, which would be a positive development.

3. Impressive work is being performed related to precipitation climatologies (combining NOAA and NASA interests) as well as techniques to obtain important information about precipitation rates by looking at lightning data in concert with thermal emission, in anticipation of upcoming GOES-R development.

4. Work related to Suomi-NPP land surface algorithms utilizing VIIRS data is progressing well at CICS; however it is clear the scientists would like to move faster than NOAA and NASA structures will allow (IDPS upgrades as well as direction from sponsors).

5. CICS-MD does not have a person dedicated to outreach so many related activities are ad-hoc.

6. CICS is informing the UMD AOSC undergraduate and professional masters programs and vice versa which is unique and to the benefit of both.

7. Partnerships are already forming after just a few months resulting from the new NCWCP building collocation between CICS, NOAA, ESSIC and NASA personnel and more partnerships are expected.

8. It was not clear if personnel at UMD receiving funds from both NOAA and NASA for research related to CICS are considered members of CICS or only members of the Earth System Science and Interdisciplinary Center (ESSIC).

9. Impressive scientific presentations were provided by CICS-MD early career scientists related to cryosphere and lightning.

10. Impressive scientific work and partnerships are being undertaken in data assimilation that will benefit both UMD and NOAA.

11. CICS-MD work on data records is impacting both the archive in NCDC and operations that are closely associated with the STAR mission.

12. CICS is training a well-prepared workforce that will serve NOAA well in the future.

13. The CICS proving ground assists in collaborations between other CIs and NOAA forecasting offices and serves an important integration role.

Recommendations

1. CICS should increase their use of the metrics they have identified in order to better monitor and communicate performance. CICS should consider defining additional metrics to monitor and communicate performance related to education and outreach. While difficult to define, these metrics will help them make a larger positive impact on NOAA, particularly with respect to identifying and filling gaps in capabilities/capacities.

2. CICS should increase interactions and collaboration between CICS-NC and CICS-MD, particularly where the scientific expertise and projects are similar such as in the precipitation and land surface temperature areas.

3. CICS should require an introduction to ITAR training for scientific employees. Online coursework is available from both university and industry organizations.

4. There are both positives and negatives to both the administration of CICS as a single cooperative agreement and two CAs (MD and NC). A single CA is attractive to NOAA with respect to administrative duties that are supported by CICS-MD. A single CA is also consistent with the preliminary NOAA SAB look at CI's, which recommends reducing the number of CI's. There is currently no issue impacting the science but it is clear there are concerns on the part of some of the CICS personnel and funders. This has been studied in more detail by the administrative reviewers. The CICS administrative review team has recommended that this issue be addressed by collecting and analyzing data on purported delays with funneling all tasking and funding through CICS-MD. The science panel supports this recommendation.

5. The directors of ESSIC and CICS should work together to clarify who is considered part of CICS-MD, particularly when scientists are receiving funding from both NOAA and NASA, and communicate this throughout the organization so that CICS is appropriately credited for research done under the umbrella of CICS.

6. CICS-NC would benefit from additional support for the director such as a part-time deputy director, as well as for the outreach coordinator. CICS-MD would benefit from an outreach coordinator. Some of these personnel changes are already in the planning stages.

7. Personnel at CICS-NC should be better informed on the career ladder associated with their positions. They also need to better understand how they are evaluated (academic criteria only or additional credit for operational support? Is there a formal or informal connection with their NCDC task collaborators?).

8. CICS-NC may benefit from undergraduate summer internships to strengthen ties with the North Carolina State University.

9. If CICS-NC is able to streamline administrative processes or identify efficiencies in other areas, they should put savings into the reserve fund so that there are more funds for new starts and exploratory research.

10. CICS must determine, with NOAA, what commitments to matching funds can be made so that NOAA may consider this prior to evaluating the 5 year renewal.

11. There is an issue related to limited space for CICS-MD growth. The current on site facility is reaching capacity. It will be important to solve this issue for future growth.

I. Overview of CICS

The Cooperative Institute for Climate and Satellites (CICS) was formed in 2009 as a consortium of academic, non-profit and community organizations with leadership from the University of Maryland, College Park (UMCP) and the University of North Carolina (UNC) System through North Carolina State University (NCSU). CICS provides foci for collaborative research and associated activities in support of NOAA mission goals related to meteorological satellite and climate data and information research and development.

II. Science plan

A. What is the scientific (not programmatic) vision for the institute?

The CICS scientific vision is to enhance interdisciplinary understanding of the state and evolution of the Earth System and to improve the communication of that understanding to interested communities.

B. How is it related to the NOAA Strategic Plan?

CICS' vision is closely aligned with NOAA's vision and goals, and CICS activities in the first 3.5 years of the Institute bear this out. CICS tasks contribute to all four of the NOAA Long-Term Goals, and in addition contribute significantly to NOAA's Enterprise activities.

CICS strongly emphasizes the longer time scale aspects of NOAA's responsibilities, beginning approximately at the weather - climate interface and extending to centennial scales. CICS provides NOAA with mechanisms that enable the agency to conceive, plan and implement activities that span these aspects of its Mission.

C. What are the goals and objectives?

CICS performs collaborative research aimed at enhancing NOAA's ability to use in situ and satellite observations and Earth System models to achieve its long-term goals, including monitoring, understanding, predicting, and particularly communicating information on climate variability and change.

Goals

- Develop innovative applications of in situ networks and satellite observations, and assist in the transfer of such applications to NOAA operational activities;

- Investigate observing systems and design information products and applications to detect, monitor, and understand the impact of climate variability and change on coastal and oceanic ecosystems;

- Identify and, where appropriate, fulfill the in situ and satellite climate needs of users of NOAA climate information products;

- Improve regional and global climate forecasts through the use of satellite-derived information products, particularly through participation in the NOAA/NWS/ NCEP Climate Test Bed;

- Develop and advance regional ecosystem models, particularly aimed at the MidAtlantic region, to predict the impact of climate variability and change on such ecosystems; and

- Establish and deliver effective and innovative strategies for articulating, communicating, and evaluating research results and reliable climate change information to targeted public audiences.

Objectives

- Engage in research on the use of in situ and satellite observations to advance the National climate mission, including monitoring, understanding, predicting, and communicating information on climate variability and change in support of NOAA's mission and strategic goals.

- Mentor and train the next generation of researchers through research and education opportunities.

- Provide education and outreach opportunities in research on applications of satellite data and information to climate issues, for both NOAA and the academic community.

- Disseminate and communicate research results for the general public, capitalizing on current advancements in technology, media, and educational methodologies that address the unique nature and complexity of climate change science.

D. What criteria are used to measure progress in accomplishing these goals and objectives?

The progress of CICS is measured by the success of its staff in conducting their research and education activities. The following criteria are used by CICS administrators to evaluate CICS staff members and their contributions to the goals and objectives of CICS:

1. Scholarly Publications (peer reviewed only)
2. External and internal service relationships (national and international committees, meeting organization, etc.)
3. Recent scientific highlights and accomplishments
4. Examples of successful research to operations (R2O) transition
5. Mentoring relationships
6. Extramural research support (if relevant)
7. Graduate students supported through CICS
8. Collaborations with NOAA
9. Outreach and educational activities at K-12, undergraduate, or graduate level, as well as private sector and general public
10. Products, articles, etc. developed through CICS support

Not all of these metrics were presented to the review committee. CICS should increase their use of the metrics they have identified in order to better monitor and communicate performance.

E. What are the major scientific themes?

CICS has three major research themes:

> Theme 1: Climate and Satellite Research and Applications incorporates the development of new observing systems, and new climate observables from current systems.
>
> Theme 2: Climate and Satellite Observations and Monitoring focuses on: (a) development and improvement of climate observables from current systems, and (b) development of all continental and global fields of climate parameters that can be used for climate analysis and climate model initialization.
>
> Theme 3: Climate Research and Modeling is the research component that brings together (a) climate observables, modeling, and validation in a comprehensive integrated whole, and (b) observational products with model development efforts to enable research into the improvement of forecasts of climate system variability on space scales ranging from regional to global, and time scales from a week or two to centuries.

1. How were they identified?

The NOAA Federal Funding Opportunity defined the three research themes.

2. Which themes/sub themes are near completion?

None of the CICS Themes is nearing completion. Some of the topical areas under the themes, such as Future Satellite Programs, have relatively clear life cycles and are evolving from the initial highly developmental stage toward implementation and operation, but ongoing activities related to ensuring quality and working toward improvements are expected to continue.

3. What are the emerging thematic areas? Why?

Within CICS, three additional thematic areas are emerging: (a) Integration of observations and models, (b) Monitoring and predicting at the weather and climate interface, and (c) Climate literacy, education, and outreach. All of these are growing from the existing Themes and associated topical areas, and striving for organized structure and support.

F. Scientific partnerships

1. What is the relationship to NOAA entities?

CICS has extremely strong partnerships with its two NOAA/NESDIS principal sponsors: the Center for Satellite Applications and Research (STAR) and the National Climatic Data Center (NCDC), both of NOAA/NESDIS. CICS has a number of other strong linkages to NOAA laboratories and units in the Washington DC region and in Oak Ridge, TN, and collaborates closely with other NOAA Cooperative Institutes.

The NOAA Center for Weather and Climate Prediction (NCWCP), which has been occupied since August 2012, and ESSIC, which hosts and houses CICS-MD, are located together in College Park at the UMCP's M-Square Research Park. The STAR Satellite Climate Studies Branch (SCSB) is collocated with CICS-MD in ESSIC. CICS-MD scientists collaborate with STAR scientists in the NCWCP, the Climate Prediction Center and the Environmental Modeling Center of the National Centers for Environmental Prediction, the Joint Center for Satellite Data Assimilation and the Satellite Analysis Branch of NESDIS. A strong collaborative effort focused on air quality research joins CICS-MD scientists in the Department of Atmospheric and Oceanic Science with the NOAA Air Resources Lab headquarters unit located in the NCWCP. Elsewhere in the local area, CICS-MD scientists collaborate with the National Oceanographic Data Center and the Climate Program Office.

NESDIS NCDC and CICS-NC are collocated in Asheville in the Veach-Baley Federal Building Complex. CICS-NC scientists work in task teams within the various divisions of NCDC that directly support NCDC mission requirements. This working arrangement leads to strong collaboration between NOAA, CICS, and NCDC contractor staff on a regular basis. These collaborations facilitate project development, initiation, and execution as well as the publication of scientific results.

CICS-NC also has a strong collaboration with the Air Resources Lab Atmospheric Turbulence and Diffusion Division located at Oak Ridge, TN. This effort is focused on the installation, operation and research related to the Climate Reference Network, a major joint research project connecting scientists at ATDD, NCDC, and CICS-NC.

A number of the CICS-NC staff have appointments in the North Carolina State University that facilitate research collaboration, seminars, mentoring of undergraduate and graduate students. These collaborations are leading to development of new curriculum options for graduate programs in Raleigh. Starting in summer 2013, CICS-NC will provide mentoring opportunities for students in the Climate Science and Society Professional Science Masters program, a joint undertaking program by NCSU and UNC Asheville.

2. What, if any, formal procedures does the CI have for cooperative planning?

CICS is involved in cooperative planning activities at a number of levels. Both NOAA and NESDIS coordinate annual meetings of the Cooperative Institute Directors. A broad range of issues are discussed at these meetings, including both events transpiring in the NOAA environment that will impact CI plans as well as inter-CI opportunities and challenges. The NOAA-wide meetings tend to focus, naturally, on issues that involve a majority of the CIs. The meetings of the NESDIS CI Directors are more focused on opportunities and challenges specifically relevant to CICS and those other CIs managed by and working most closely with NESDIS. The NESDIS CI Directors' meetings provide the opportunity to initiate and monitor the detailed, specific planning required to coordinate the broad research and development activities associated with the CIs roles in the GOES-R and JPSS programs.

CICS itself utilizes a number of methodologies for cooperative planning. The Council of Fellows, which consists of approximately 36 CICS and NOAA scientists familiar with CICS research, meets at least annually to consider the CICS research portfolio. Focus groups drawn from the Council, and including NOAA managers where appropriate, are charged with evaluating CICS interaction with its NOAA partners and identifying innovative research opportunities. Three CICS Science Meetings, in 2010, 2011 and 2012, have provided fora for presentation of ongoing research and discussion of opportunities.

The CICS leadership weaves all these activities together, sets priorities, and coordinates interactions. The Executive Director, Phil Arkin, and the Directors of CICS-MD, Hugo Berbery, and CICS-NC, Otis Brown, participate in all of these processes and others, including direct conversation with NOAA scientists and managers, and develop action plans to ensure the successful conduct of the CICS research program. Both CICS-MD and CICS-NC leaders participate in regular staff meetings conducted by their hosting organizations. The weekly ESSIC staff meeting includes the CICS Executive Director and CICS-MD Director, as well as the Chief of the STAR SCSB. The CICS-NC Director participates in a variety of routine meetings; these include NCDC weekly staff meetings, biweekly meetings with the NCDC Deputy Director, monthly center-wide meetings with the NCDC leadership, quarterly meetings with the NCSU leadership, and routine monthly onsite and quarterly off-site meetings with the CICS-NC staff.

There is an excellent badgeless environment at CICS-NC contributing to the success of the institute as well as high-priority NOAA activities. The collaboration and collocation of government employees and academia provides unique approaches to problem definition and solution.

III. SCIENCE MANAGEMENT PLAN

A. How does the Institute identify new intellectual opportunities?

Intellectual opportunities for CICS collaborative research arise from a number of sources with varying degrees of formality. Opportunities often surface from discussions between CICS staff, academic partners, private sector end-users, and government scientists. The venues can be formal, such as the CICS Council of Fellows, Agency Announcements of Opportunity, and the Federal Register. Conversely, collaborations can arise through more informal discussions, such as professional society meetings, weekly seminars at CICS and/or NOAA units, or visits with agency program managers. Co-location of the CICS centers at College Park and Asheville with major NOAA facilities (the NOAA Center for Weather and Climate Prediction and the National Climatic Data Center) facilitates routine meetings and exchanges between CICS and federal and contract staff, as well as the opportunity for informal meetings. Co-location also facilitates interactions between the CICS leadership and NOAA program managers for information exchange, which can also lead to research opportunities.

B. What are some recent examples of intellectual opportunities?

Recent opportunities identified include:

- Research and algorithm development projects associated with JPSS and GOES-R programs,
- Analysis of data from Suomi-NPP instruments,
- Collaborations with the newly established National Calibration Center,
- A new global surface temperature analyses,
- Outreach and Engagement
- Collaboration with UMD Atmospheric Science Department to support undergraduate research projects.

C. What is the strategy for new starts (projects, techniques, campaigns, etc.)?

NOAA-based new starts are typically initiated and supported by new announcements of opportunity and are based upon convincing evidence of exceptional intellectual opportunity. Strategies for non-NOAA originated new starts tend to vary and are developed based on the experience of senior CICS personnel.

There are also informal mechanisms for new research activities – hallway conversations, seminars, agency visits – and proximity (e.g. SCSB at CICS-MD, CICS-NC at NCDC, and collocation of CICS-MD with NCWCP) greatly enhances these informal mechanisms.

D. How much of the Institute resources are reserved for new opportunities or bright ideas?

While the current cost-share by CICS is highly beneficial to the institute's success, CICS does not have significant funding for "new starts". CICS is able, as many CIs, to leverage NCDC and STAR end-of-year funds as well as some matching funds. CICS-NC also encourages their employees to spend 1 day a week writing up results or otherwise focusing on research. Several "new starts" such as CycloneCenter started because of this dedicated day.

Virtually all CICS resources are devoted to specific ongoing projects, education and outreach efforts, or to internal management of the Institute. One of the highest priorities for new Task 1 funding is to provide seed support to foster the development of new concepts. The CICS scientific staff is bright and creative, and frequently generates such new ideas. At the current time, there is a lack of dedicated internal R&D support, and there are significant challenges involved in transitioning startup projects to longer-term support.

E. What is the demographic structure of the Institute employees?

CICS has an enthusiastic and knowledgeable staff that will greatly help CICS and NOAA achieve their mission goals. The institute has enthusiastic early career scientists that are making important contributions to CICS science themes and outreach to the public. During this review period the CICS demographics included:

27 Research Scientists
16 Postdoctoral Fellows
12 Graduate Students
2 Undergraduate Students
14 Research Support Staff
5 Administrative Staff
38 Employees are located at a NOAA facility (NCWCP, Silver Spring, or NCDC)

The number of employees at CICS-NC is reaching a critical mass; several have been at CICS-NC for 2 or more years now and have promotion potential. There is appreciation for the CICS-NC director and the business manager/administrator providing a sense of community, but there are many questions about how they can advance in their careers. Personnel at CICS-NC should be better educated on the career ladder associated with their positions. How they are evaluated (academic criteria only or additional credit for operational support) should also be clear to each employee.

A few months after the new NCWCP building collocation with CICS-MD and partnerships are already forming between CICS, NOAA, ESSIC and NASA personnel and more partnerships are expected. Strong collaborations between CICS-NC and NCDC are also clearly evident during the review. As an example of this collaboration:

62 Employees receive > 50% support from NOAA
10 Employees receive < 50% NOAA funding (not including students)

It was not clear to the science review panel if personnel receiving funding from both NOAA and NASA at UMD for research conducted in the CICS thematic areas are considered part of CICS or only part of ESSIC. This does not impact the science, but the science may not always properly credit CICS, which could be detrimental. The directors of ESSIC and CICS should work together to clarify who is considered part of CICS-MD, particularly when scientists are receiving funding from both NOAA and NASA, and communicate this throughout the organization so that CICS is appropriately credited for research done under its umbrella.

F. What is provided for human resources development (Recruitment, Rewards, and Training)?

In general, recruitment is driven by the needs of the research or outreach project being staffed, in combination with the effort to entrain the best possible candidates. On other occasions, CICS has the opportunity to recruit widely and hire the best candidates as students or postdoctoral researchers. A wide variety of techniques are employed in searching for candidates, including public and focused advertising, individual contacts, and promotion from within, with attention to equity issues. Specific procedures for training and awards are handled according to the processes of the host university, and, at UMCP, by the individual units in which the CICS employees work.

CICS-NC has done a tremendous job spinning up a CI from scratch in 3.5 years, due in large part to the enthusiasm and commitment of the director, the UNC system and NCDC sponsors. The number of employees is reaching a critical mass. Several employees have been at CICS-NC for two or more years and have promotion potential. There is appreciation for the CICS-NC director and the business manager/administrator providing a sense of community, but there are many questions about how they can advance in their careers. The career ladder at CICS-NC, as well as the role NCDC provides in performance evaluations, should be communicated. The enthusiastic and knowledgeable staff is critical to maintain and will greatly help CICS and NOAA achieve their mission goals.

G. What is the state of the financial health of the Institute? (Provide a budget summary and identify imbalances or needed adjustments.)

CICS is in excellent financial health, with exceptional growth in the 3.5 years since its establishment - from ~$10M in the CICS FY10 to ~$25M in the CICS FY12. CICS has received approximately $50M to date from NOAA, and $5M to date from matching funds. The exceptional growth results from three main factors:

- The increase in work related to GOES-R and JPSS satellite systems;

- The expansion in research, research to operations transitions, and outreach related to the Climate Data Record Program, National Climate Assessment, and public/private sector engagement activities; and

- The move of NOAA employees from multiple locations to the new National Center for Weather and Climate Prediction in College Park.

CICS primary financial goal is stability and excellent stewardship to ensure that resources for its activities are available and adequate for its needs.

CICS-NC would benefit from additional support for the director such as a part-time deputy director, as well as for the outreach coordinator. CICS-MD would benefit from an outreach coordinator. Some of these personnel changes are already in the planning stages.

H. How does the Institute intend to work towards accomplishing its financial goals?

CICS poses very significant administrative and infrastructure challenges for its management and host institutions. The large number of individual projects supported under a single award requires a level of fiscal record keeping and oversight at both UMCP and NCSU that is far beyond that of typical research projects, even very large ones. All expenses associated with each individual task must be monitored both from the university perspective and from that of the NOAA sponsor. This level of effort requires significant support from the host university, which is possible because of the cost sharing committed to during the development of the CICS proposal. The rapid growth over the initial 3.5 years of the project has certainly challenged the leadership and supporting staff. With excellent support from UMCP and NCSU, and conscientious attention to best practices, CICS believe that they are in a strong position to achieve their financial objectives.

I. Are there any issues in interacting with NOAA that require attention?

In a broader sense, the balancing of basic and applied research is a continuing challenge, as is execution of plans for workforce development and engagement and outreach. CICS has had several successes in the latter areas with NOAA supporting a number of postdoctoral fellows and providing one-time support for engagement and outreach. Both of these activities would benefit from sustained future support. Enhancement of Task I support levels would assist with seed funding of innovative ideas and CICS looks forward to the NOAA Research Council acting on recommendations to do so.

Similarly, support for student fellowships, vital to the training of the next generation of NOAA scientists and staff, has been difficult to obtain. In the CICS proposal (Appendix B), CICS-MD committed to support two graduate research assistantships each year, one using Task I funds and the other supported through cost sharing. However, the funding sources have not kept pace with costs, placing this vital effort in jeopardy.

CICS scientists are not regularly trained in ITAR. Suomi-NPP calibration/validation work in particular may involve ITAR-related information that scientists should be aware. CICS should consider how to best provide an introduction to ITAR for scientific employees.

The administrative structure of CICS, with a single cooperative agreement for the entire consortium, appears to be working from a scientific point of view. The relationship between the managers at CICS, CICS-MD and CICS-NC is very good and all are committed to CICS success. NOAA and CICS should work together to continue receiving the benefit derived from a sensible cost-share arrangement into the future.

Finally, since Cooperative Agreements are managed similarly to grants by NOAA, there is continuing fiscal pressure to show immediate costing of allocated resources. Unfortunately the late arrival of funding in the federal fiscal year has become the norm, and, thus costing and outcomes almost always lag NOAA's expectations. Moving cooperative agreement funding forward in the fiscal cycle would help the university partners in addressing NOAA's needs and expectations. The administration of CICS (a single cooperative agreement) should be examined to determine if some of the issues related to delays in costing could be minimized. There is currently no issue impacting the science but it is clear there are concerns by the scientists and the funders. This has been studied in more detail by the administrative reviewers.

J. Are there any issues in interacting with the University that require attention?

CICS outstanding challenges derive from stability of support in an era of tight budgets and continuity of resources to address administrative support and innovative ideas. To the present, host university cost share commitments have enabled CICS to manage this difficult situation. However, the same budget pressures that affect NOAA create stress on UMCP and NCSU, and a long-term solution will require creative and collaborative thinking.

CICS-MD has strong ties to the atmospheric science department at the University of Maryland. CICS-NC is located a fair distance for NC-State, making education collaborations a challenge. CICS-NC may benefit from undergraduate internships to strengthen ties with the university. The collaborations with CUNY/CREST are bringing needed diversity to CICS.

CICS and NOAA should work together to ensure continuity of resources, probably through continuation of the host university cost share commitments, to address administrative support and the development of innovative ideas.

IV. SCIENCE REVIEW

A. What are the Institute's most recent scientific highlights and accomplishments?

CICS-MD is uniquely able to bring UMD, NOAA and NASA together to conduct high-quality science for the benefit of both agencies and the nation. The review panel found the following scientific highlights during the on-site visits.

> RISA and National Climate Assessment coordination work is outstanding and a major undertaking that is well-suited to CICS capabilities.

Very high quality research is being conducted related to the global surface temperature databank at CICS-NC. This should provide an excellent, transparent basis for future evaluation of climate change.

Important work related to change in arctic sea-ice volume is being conducted at CICS that has the potential to change the national conversation about diminishing sea ice from one associated with surface area to one associated with volume, which would be a positive development.

Impressive work related to precipitation climatologies (combining NOAA and NASA interests) as well as techniques to obtain important information about precipitation rates by looking at lightning data. This includes the Research to Operations for the Global Historical Climatological Network V3.

There is progress in the development of Climate Data Records (CDRs), including Geosynchronous Surface Albedo, the Carolinas' Test NEXRAD NMQ/Q2 High Resolution Pathfinder, the Global SST CDR and the SSM/I CDR.

Work related to Suomi-NPP land surface algorithms on VIIRS is progressing well at CICS. The NPP/VIIRS Land Product Validation Research and Algorithm Refinement provides early evaluation of the surface reflectance product from VIIRS; however, it is clear the scientists would like to move faster than NOAA and NASA structures will allow (IDPS upgrades as well as direction from sponsors).

There is valuable work in relating lightning to storms, and convective properties observed by new microwave sensors.

Impressive scientific work and partnerships is being undertaken in data assimilation that will benefit both UMD and NOAA. This work includes development of satellite products for use in data assimilation systems, the development of new methodologies, and the collaboration with the Center for Excellence for Data Assimilation research.

The review panel noted particular research areas of potential collaboration between CICS-MD and CICS-NC, such as precipitation and land surface temperature and phenology. CICS should increase interactions between CICS-NC and CICS-MD, particularly where the scientific expertise and projects are similar and appropriate.

V. EDUCATION/OUTREACH

A. What types of educational activities/opportunities (K-12, undergraduate and graduate students) does the institute offer on an ongoing basis?

<u>K-12</u>

CICS-NC collaborates with NCSU Science House as a partner to pilot STEM and climate science education. They are also developing curriculum for high school teachers on applications of climate data.

Each summer since 2009, CREST (a CICS consortium member) has organized a Weather Camp (partially funded by CICS) where 8-10 high school students spend one week on the campus of CCNY and 1 week at the NWS office on Long Island learning about weather concepts, operations, and future college and job careers in STEM fields. CREST also carries out a Summer Outreach program where more than 20 high school students are involved each summer for 8 weeks to work on various research projects.

Undergraduate Education

The two main branches of CICS in Maryland and North Carolina support undergraduate education through mentoring, advising, and teaching students.

CICS-NC supports and enables development of a UNCA / NCSU PSM Climate Change and Society curriculum. They have also developed datasets for use in the courses. There is engagement with NCSU on CICS Seminars.

CICS-MD is closely linked to University of Maryland's undergraduate programs. The Department of Physics offers a BS degree with a concentration in Atmospheric Sciences, while the Department of Geographical Sciences (GEOG) has its own undergraduate program. The Department of Atmospheric and Oceanic Science (AOSC), where many CICS scientists are either members or affiliated researchers, has recently established its own undergraduate program. The program has been designed to teach broad based knowledge in meteorology, oceanography, and climate and air pollution. The degree satisfies the requirements for federal service positions as a meteorologist or oceanographer, and also follows the American Meteorological Society's statement on bachelor's degrees in Atmospheric Science. CICS is informing the UMD AOSC undergraduate and professional masters programs and vice versa which is unique and to the benefit of both.

Graduate and Postdoctoral Education

As part of enhancing and supporting graduate students and postdoctoral students, CICS engages in several activities, including support of postdoctoral fellows in innovative research, mentoring of graduate students and early career staff, support through fellowships, and advancing research efforts through delivering seminars and presentations. CICS scientists offer early career mentoring of students and participate in advisory panels. CICS has an extensive mentoring program for graduate students where they participate in reviews of students' research provide supervisory and mentorship support, and aid in early career development areas. CICS-NC is collaborating with UNC Asheville to modify the professional certification curriculum related to the Masters in Liberal Arts Program in Climate Change and Society.

The National Research Council's 2010 ranking of PhD programs places UMD's AOSC department in the top ten Earth Science programs nationwide and higher than any other institution on the East Coast. Approximately 20% of the graduate students have been employed by NOAA. The UMD's Department of Atmospheric and Oceanic Science has created a Graduate Fast-Track program for accomplished scientists. Graduate students with exceptional scientific achievements may, through written petition to the Graduate Director, replace the written portion of the Comprehensive Exam with a seminar followed by an oral examination. Approximately six NOAA scientists have already taken advantage of this program. About twenty civil servants and contractors have returned for their PhDs following the normal path.

CICS scientists participate in the annual NESDIS Cooperative Research Program Symposium, and CICS helps to support CUNY/CREST graduate students participation as well. CICS also facilitates summer visits by CUNY/CREST students to NESDIS Cooperative Institutes, providing them with hands-on experience with software and techniques relevant to their research projects. This summer exchange program has led to increased visibility and employment opportunities for students and early career scientists, and provides excellent candidates for open positions at NOAA and the CIs.

B. What are the current and planned outreach efforts?

Working collaboratively with other academic and public partners, stakeholders, and the private sector, CICS supports and engages in various educational and outreach-related activities to advance the following areas:

- Increase awareness of climate science and changes in the climate system
- Grow the understanding of how climate data is collected, observed, analyzed, and used in research purposes
- Increase awareness of climate datasets and products, and how educational teachers/professors can make use of climate data products for teaching climate science
- Demonstrate capacity building on the various impacts of climate change across public, private, and academic arenas
- Increase private sector understanding and use of climate data and information for their strategic and operational use

CICS engages in several climate literacy and outreach activities to the private sector as well as the general public. These activities are often in conjunction with CICS partners who have particular areas of expertise. Key highlights of accomplishments in literacy and outreach are framed under these areas:

- Advancing climate literacy for private sector partnerships through interdisciplinary activities, including outreach to energy industry, insurance industry, plant-based sector, and executive roundtable sessions

- Outreach to local and national TV meteorologists and other media interested in climate information

- Providing operational support to activities in NOAA organizations like NCDC in advancing their outreach with the Sectoral Engagement Team, communication with the Communications Officer, and literacy with the Education Lead

- Outreach and literacy activities to the general public

- Developing communication and informational materials on the CICS activities and progress to share with CICS partners, and to inform the general public

Outreach and education at CICS-NC is just getting started, but looks very promising with a focus on the private sector and complementing efforts at CICS-MD and CREST (another CICS node). CICS-MD does not have a person dedicated to outreach so many related activities appear ad-hoc. CICS-NC would benefit from additional support for the director such as a part-time deputy director, as well as support for the outreach coordinator. CICS-MD would benefit from an outreach coordinator. Some of these personnel changes are already in the planning stages.

VI. Summary and Conclusions

In summary, the Review Panel concluded that CICS is a valuable NOAA CI and assigned an overall rating of **Outstanding**. CICS' vision is closely aligned with NOAA's vision and goals, and the superior research, planning, management, outreach and education demonstrated during the first four years of the Institute is commended.

APPENDIX I- LIST OF EXTERNAL REVIEWERS

[1] Mike Keebaugh, Chair of Review Team
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Mike Keebaugh is a retired Raytheon Company vice president and the president of the Intelligence and Information Systems (IIS) business. Headquartered in Garland, Texas, IIS is a leader in intelligence and information technology solutions drawing on capabilities in signals, imaging and geospatial intelligence; air- and space-borne command and control; ground engineering support; and weather and environmental management. IIS is also responsible for the development of Raytheon's information solutions strategy and information assurance/operations business. He was a member of the NOAA Science Advisory Board for two terms, a total of six years. During his time on the SAB, he chaired the ad hoc Working Group to Examine Advisory Options for Improving Communications among NOAA's Partners (the Partnerships Working Group or PWG). The recommendations from this WG ultimately resulted in the formation of the standing Environmental Information Services Working Group (EISWG).

[2] Dr. Michael D. King
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After receiving his Ph.D. from the University of Arizona, Dr. King joined NASA Goddard Space Flight Center in 1978 as a physical scientist, where he served as Project Scientist of the Earth Radiation Budget Experiment from 1983-1992 and Senior Project Scientist of NASA's Earth Observing System from 1992 to 2008. After retiring, he joined LASP as a Senior Research Scientist. Dr. King's research experience includes conceiving, developing, and operating multispectral scanning radiometers from a number of aircraft platforms in field campaigns ranging from arctic stratus clouds to smoke from the Kuwait oil fires and biomass burning in Brazil and Africa. He has also developed inversion algorithms for deriving aerosol size distribution and refractive index. Dr. King is Team Leader of the MODIS science team on the Terra and Aqua satellites. As a team member, he also led the development of 5 science algorithms run routinely to process MODIS data, including the algorithm for determining cloud optical thickness and effective particle radius of both liquid water and ice clouds. He has authored over 95 papers published in refereed scientific journals, in addition to editing 1 Book (Our Changing Planet: The View from

Space), 4 Scientific Documents, and many book chapters. He is a Fellow of the AMS and AGU, recipient of the Verner E. Suomi Award of the AMS, and a member of the National Academy of Engineering.

[3] Dr. Steve Ackerman
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Dr. Ackerman is a Professor at the Department of Atmospheric and Oceanic Sciences and Director of the Cooperative Institute for Meteorological Satellite Studies at the University of Wisconsin. He received a distinguished teaching award from Chancellor David Ward and a Vilas Research award. He is a recipient of the American Meteorological Society's Teaching Excellence Award. His research interests are varied and include analysis methods of clouds from satellite observations, the transport of aerosols (dust, smoke) and the effect of contrails and other clouds on the heat budget of the atmosphere. He received the NASA Exceptional Public Service Medal and is a Fellow of the Wisconsin Academy of Sciences, Arts and Letters. He was recently named UW-Madison Associate Dean for the Physical Sciences.

[4] Dr. Pamela G. Emch
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Pamela Emch is a Senior Staff Engineer/Scientist with Northrop Grumman Aerospace Systems in Redondo Beach, California. She works in Northrop's Space Systems business area on weather, climate, and environmental remote sensing and information technology activities supporting the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, the Department of Defense, and international customers. From 2005 to 2007 she was System Engineering, Integration, and Test Lead on Northrop's GOES-R PDRR Program. Before working on GOES-R, Dr. Emch spent eight years on Northrop's NPOESS Program effort, the last two years of which she relocated to Washington, D.C. to serve as Northrop's system engineering and science interface to the NPOESS government program office in Silver Spring, Maryland. Prior to that Dr. Emch managed development of end-to-end physics/instrument/satellite remote sensing simulations, archives for environmental multimedia data, and led environmental data-collection and application activities for hyperspectral airborne instruments. Dr. Emch holds an M.S. degree in aerospace engineering from the University of

Southern California and a B.A. in mathematics and a Ph.D. in civil and environmental engineering from the University of California, Los Angeles, specializing in water resources with a minor in atmospheric sciences. She served as a member of the National Research Council Committee on the "Assessment of the National Weather Service's Modernization Program". She is the current Past Chair of the American Meteorological Society (AMS) Board on Enterprise Economic Development, a member of the Executive Committee of the AMS Commission on the Weather and Climate Enterprise, and a co-Chair of the Weather Coalition.

APPENDIX II-AGENDA OF SCIENCE REVIEW

Tuesday, November 6, 2012 (Day 1 Science Review)

0800 Welcome to NCSU
Dr. Terri Lomax
Vice Chancellor, Office of Research, Innovation and Economic Development, NCSU

0815 Welcome to NCDC
Mr. Michael Tanner
Deputy Director, NOAA/NCDC

0830 Welcome to CICS-NC
Dr. Otis Brown
Director, CICS-NC

0845 CICS Review: Background and Purpose
Ms. Ingrid Guch
Chief, Cooperative Research Programs, NESDIS/STAR

0900 CICS Science Plan
Dr. Phillip Arkin
Executive Director, CICS

0945 CICS-NC Overview
Dr. Otis Brown

1000 Break

1015 CICS-NC Science Introduction
Dr. Otis Brown

1030 CICS-NC Science Talk – National Climate Assessment
Dr. Ken Kunkel
NCA Lead Scientist, CICS-NC

1100 CICS-NC Science Talk – Climate Data Records
Dr. Pierre Guillevic
CDR Science Supervisor, CICS-NC

1130 CICS-NC Science Talk – CycloneCenter/Madden-Julian Oscillation
Dr. Carl Schreck
Postdoctoral Fellow, CICS-NC

1200 Lunch – Poster Session

1330 Review Committee Executive Session

1400 CICS-NC Science Talk – Geosynchronous Surface Albedo
Dr. Jessica Matthews
Postdoctoral Fellow, CICS-NC

1420 CICS-NC Science Talk – Growing Season
Dr. Jesse Bell
Research Associate, CICS-NC

1440 CICS-NC Science Talk – Global Surface Temperature Databank
Dr. Peter Thorne
Research Associate Professor, CICS-NC

1500 Break

1530 Open Discussion

1600 Review Committee Executive Session

1730 Adjourn

Wednesday, November 7, 2012 (Day 2 Science Review)

0800 Education/Outreach/ Engagement
Ms. Jenny Dissen
Director, Climate Literacy and Outreach, CICS-NC

0845 Research to Operations
Dr. Otis Brown

0915 Science Management Plan
Dr. Phillip Arkin and Dr. Otis Brown

0945 Break

1000 Meet with CICS-NC Science Staff
Executive Session

1130 Meet with NCDC Leadership – Executive Session

1200 Lunch – Executive Session

1330 Out brief to CICS/University Leadership

1400 Concluding Remarks

1415 Adjourn

Thursday, November 8, 2012 (Day 3 Science Review)

0830 Welcome to UMD
Dr. Jayanth Banavar
Dean of the College of Computer, Mathematical, and Natural Sciences, UMCP

0845 Welcome to ESSIC
Dr. Antonio Busalacchi
Director, Earth System Science Interdisciplinary Center, UMCP

0900 Welcome and Review Background
Dr. Hugo Berbery, CICS-MD Director
Ms. Ingrid Guch, Chief, Cooperative Research Programs, NESDIS/STAR

0915 CICS and CICS-MD
Dr. Phillip Arkin
Executive Director, CICS

0930 CICS-MD Science Introduction
Dr. Hugo Berbery
Director, CICS-MD

0945 CICS-MD Science Talk – Precipitation
Dr. Robert Adler, Senior Research Scientist

1000 Break

1030 CICS-MD Science Talk – Cryosphere
Dr. Sinead Farrell
Assistant Research Scientist, CICS-MD

1045 CICS-MD Science Talk – Land Surface
Dr. Chris Justice
Chair, Department of Geographic Sciences, UMCP

1115 CICS-MD Science Talk – Lightning
Dr. Scott Rudlosky
Satellite Climate Studies Branch, STAR

1130 Review Committee Executive Session

1215 Lunch with NOAA Leadership – Executive Session
Tour: National Center for Weather and Climate Prediction

1400 CICS-MD Education and Outreach
Dr. Hugo Berbery

1415 AOSC Undergraduate Program and Professional Masters
Dr. Jeff Stehr, Associate Director and Assistant Research Scientist, Department of Atmospheric and Oceanic Science

1430 Data Assimilation Research and Education
Dr. Kayo Ide, Associate Professor (AOSC)

1445 CUNY CREST: NOAA Workforce Enhancement
Professor Reza Khanbilvardi
Director, Center for Cooperative Remote Sensing Sciences and Technology, CUNY

1515 Break

1530 Discussion

1600 Review Committee Executive Session

1700 Poster Session / Interaction with CICS-MD Scientists

1830 Dinner/ Panel Executive Session

Friday, November 9, 2012 (Day 4 Science Review)

0800 Breakfast Panel Executive Discussion

0900 UMCP Research and CICS
Dr. Patrick O'Shea
Vice President for Research, UMCP

0915 Research to Operations

0915 Satellite Products
Dr. Isaac Moradi
Assistant Research Scientist, CICS-MD

0930 Climate Prediction
Dr. Augustin Vintzileos
Assistant Research Scientist, CICS-MD

0945 Proving Ground
Dr. Michael Folmer
Research Associate, CICS-MD

1000 Break

1015 Science Management Plan
Dr. Phillip Arkin and Dr. Hugo Berbery

1100 Discussion

1200 Lunch Executive Session

1330 Out brief to CICS/University Leadership

1430 Adjourn