

RESPONSE TO SITE VISIT REPORT

Date of Report: May 28, 2013

Date of Response: June 11, 2013

Name of the Center/Award Number:

Center for Multiscale Modeling of Atmospheric Processes (CMMAP)

Award Number: 0425247

Name of the Lead Institution/Principal Investigator:

Colorado State University (CSU)

David A. Randall

We thank the Site Visit Team for the time, energy and thought that they devoted to evaluating CMMAP's progress during year 7. Below, we repeat the Challenges and Opportunities and provide responses for each (in red).

A) Intellectual Merit

1. The SVT found that most of the presentations on the Center's research focused on the development of modeling tools (e.g., unified parameterization, Q3D ...), but did not emphasize how the modeling activities have led to new overarching insights and scientific understanding of the physics and dynamics of multiscale processes. We note that in terms of some specific processes, e.g., the MJO and monsoons, the Center is enabling new science and is leading the field (see strength 5 above). However, seeking to inform the modeling community what are the limits to what sub-grid scale processes are "parameterizable" and what needs to be resolved and represented in terms of first principles would be beneficial.

This year's presentations dealt with a mini-LES for turbulence parameterization, microphysics, multiscale land-surface interactions, and low cloud feedback. This is a small fraction of what the Center's researchers are doing. The unified parameterization work, which was not presented this year, deals very directly with the subject of parameterizability. The turbulence work also deals with parameterizability. We can arrange for presentations on those two topics next year.

The low-cloud feedback work that Peter Blossey presented during this year's Site Visit adds to our scientific understanding of multiscale processes.

2. One important measure of success of the Center will be how well the modeling tools developed will be adopted by the broader research community. The Center is progressing in this regard. Some progress is noted with NCEP, GFDL, ECMWF and IITM. Of particular success is the adoption of SP-CAM in the NCAR family of models. However, ensuring that the super parameterization remains a component in future releases of the NCAR family of models will require a comprehensive strategy that is developed in collaboration with NCAR management, and the SVT recommends vigilance in this regard. The SVT also noted that enabling the development of standardized post-processing and analysis tools for SP-CAM within the NCAR modeling infrastructure will further facilitate the adoption of SP-CAM by the broader research community. Regular training and science workshops that emphasize SP-CAM should also be considered.

We agree that vigilance will be needed to make sure that the SP-CAM continues to be supported by NCAR over time. We are going to conduct a one-day SP-CAM workshop in late July 2013, and will produce documentation as well as post-processing and analysis tools for use at that workshop. Going forward, we intend to conduct the workshop on an annual basis, and will explore the best way to do this.

3. As the Center prepares for the ramp down of NSF support in years 8-10, careful consideration should be given to identifying high impact priorities.

At the August 2013 and January 2014 CMMAP Team Meetings, we will conduct plenary sessions designed to aid in prioritization of our work prior to the end of STC funding.

B) Education

1. As noted in last year SVT report/rebuttal, some post-docs' participation in the education of undergraduate/graduate is evident. Additional involvement of post-docs in educational efforts can further enhance CMMAP education impact as well as furthering the post-doc's professional development

Dr. Ian Baker is a Research Scientist supported by CMMAP who earned his Ph.D. as a CMMAP-sponsored graduate student. He served as a Teaching Intern for our program at Colorado College and has been very active as a mentor of both current CMMAP graduate students and undergraduate interns.

Dr. James Benedict served as a mentor for an undergraduate intern during the summer of 2011, while he was a post-doc. Dr. Grant Firl is a current CMMAP post-doc and will serve as a mentor for an undergraduate intern during the summer of 2013.

2. How can other undergraduate institutions capitalize on CMMAP integration and educational activities? In addition to recruiting and involving of MSI faculty/students, primarily undergraduate programs at under-performing institutions and without an atmospheric science program could be targeted.

We have developed three undergraduate courses on weather, climate, and global change, as well as a huge array of web-based resources which could be used by faculty in other institutions. In year 8, we will increase our efforts to make other institutions aware of these resources.

The ChangingClimates program of cross-disciplinary climate curriculum infusion has been presented to many other institutions including George Mason University, the University of Maine at Orono, the University of Montana, Mesa State University Colorado, the University of Wisconsin at Whitewater, the University of Louisiana at Lafayette, the University of Calgary, and Oregon State University.

The Little Shop of Physics science outreach program is being successfully copied at the University of Texas Pan American, Oglala Lakota College, and the Austin (Texas) Community College, Trinidad (Colorado) Middle School, and Sterling (Colorado) High School.

3. As suggested in previous report, pursue education-related funding to sustain education effort (e.g., NSF TUES). Even as LSOP will receive base funding from CSU, additional

funding pursuit in education would help transition to IMMAP as well as the formation of REACH.

We have aggressively pursued education-related funding to sustain our efforts. In the past two years we have submitted the following proposals:

NSF Climate Change Education Partnerships

NSF Discovery Research in K-12 Education: STEMing Elementary Education: Formal and Informal Resources for Science Teaching

NSF Coastal Sustainability Science,

NOAA Climate Change Education.

The NOAA proposal is still pending. Unfortunately, all of the other proposals were declined.

We will continue to apply for additional funding to support education and diversity work.

C) Diversity

1. Must continue efforts for increasing for diversity outside of CMMAP (no post-docs, research scientists, and faculty of color in the department or at research centers).

We will continue to work with the Department of Atmospheric Science, the College of Engineering, and CSU's Vice President for Diversity to support diversity outside of CMMAP.

2. Should continue efforts to develop collaboration regional colleges such at the Metro college of Denver, which has significant minority population and has a meteorology program for a potential graduate student pipeline and collaborative research/educational efforts.

We visited Metro State University in Denver in both 2011 and 2012 and made presentations on CMMAP research and education opportunities. One of our undergraduate interns was recruited from Metro State in 2012, and we have been in continuing contact with several of their faculty. We will continue to work with Metro State, as we have with other minority-serving undergraduate institutions across the US.

3. Should continue efforts to increase participation from Native Americans.

We have long-standing relationships with schools and colleges on the Pine Ridge Reservation, the Southern Ute Reservation, and the Wind River Reservations. We spend about 2 weeks each year visiting these schools, presenting science content, and learning about tribal culture. We have hosted eight teachers from these schools in residential summer professional development programs, and have worked with tribal schools to enhance their teacher preparedness and resources.

James Carpenter, a CMMAP-supported graduate student who identifies as a Native American, was awarded a Masters of Science degree in Atmospheric Science in 2013 under the supervision of Prof. Sonia Kreidenweis. He was very active in CMMAP education and outreach efforts, and has recently accepted a teaching position in Alabama.

4. Should increase representation of female graduate students.

We continue to recruit female graduate students, and to support them in our programs. Over the past three years, 75% of our undergraduate interns have been women. We also support primary social science research to try to understand the reasons for the historical under-representation of women in our field. CMMAP Director David Randall has taken three new graduate student advisees starting in Fall 2013, two of whom are women.

5. Whenever possible, minority graduate students should be strongly encouraged to participate in the summer schools for atmospheric modeling (like at those NOAA ESRL, GFDL, and NCEP) to further promote the modeling focus of CMMAP.

All of our graduate students, regardless of ethnicity or gender, participate in atmospheric modeling, most at a level far above the “summer schools.” We will work in the future to recruit minority graduate students from CMMAP to assist in the teaching of these courses

D) Partnerships and Knowledge Transfer

1. Although the adoption of the MMF approach in the CESM is an important achievement, it is vital that the MMF approach be included in future versions of NCAR community climate models, if the broadest impacts of the model development achieved under the auspices of the CMMAP are to be realized. This will help build a framework for making the MMF continue to grow. It is highly recommended that the CMMAP take steps through continued close contacts and collaboration, and perhaps establishment of a more formal arrangement to ensure that this takes place.

We agree that vigilance will be needed to make sure that the SP-CAM continues to be supported by NCAR over time. We will work with NCAR management to maximize the probability of success.

2. Transfer of technical knowledge regarding the modeling tools among CMMAP collaborators at different institutions, and from one generation of student to the next, could be improved by better documentation of code, establishment of a repository of FAQs/Blog and better version control of models at a central location (e.g., maintaining close contact and collaboration with CESM in point 1 above). A clear personnel for point of contact for the community is also recommended.

We have an archive for model output and source codes at the San Diego Supercomputer Center. It has been developed and is managed by John Helly. In addition, Marat Khairoutdinov maintains SAM as a community model.

For the past several years Mark Branson of CSU has been serving as the point of contact for users and potential users with questions about the SP-CAM.

We are going to conduct a one-day SP-CAM workshop in late July 2013, and will produce documentation as well as post-processing and analysis tools for use at that workshop. Going forward, we intend to conduct the workshop on an annual basis, and will explore the best way to do this.

3. As part of planned workshops for the remaining years of the CMMAP and with the transition to IMMAP, the SVT recommends that the CMMAP consider holding tutorials on the use of the model to continue to grow the community using MMF (akin to what is offered by WRF). By holding a tutorial in coordination with a workshop, potential users will be better exposed to the enhanced science that can be garnered with the MMF approach. In addition to promoting usage of CMMAP modeling framework, this will also help integrate educational and research activities, and enhance the global modeling workforce while building a user community for growth of the framework.

We are going to conduct a one-day SP-CAM workshop in late July 2013, and will produce documentation as well as post-processing and analysis tools for use at that workshop. Going forward, we intend to conduct the workshop on an annual basis, and will explore the best way to do this.

4. Broader partnerships with NOAA and other national laboratories that extend the current PI-based efforts focused on specific problems should be explored in order to determine the broader, overarching contributions that CMMAP could make to the operational modeling enterprise (including both weather and climate simulations).

A few days after the Site Visit, we learned that our CPT proposal (led by Steve Kruger) will be funded. This is an important step towards stronger interactions with NCEP. As we reported during the Site Visit, we also have an interaction under way with ECMWF.

5. The development of a text on global circulation of the atmosphere could also be a legacy of the CMMAP once it is completed.

David Randall will finish this up as soon as he can.

E) Center value

1. In order to sustain the momentum and plan for the upcoming ramp down, CMMAP will need to sharpen their focus on programs and projects that have been successful. For the

value added by this Center to be long-lasting, CMMAP will need to further build collaborations with relevant institutions to ensure continued support of model and parameterization products (e.g., the SP-CAM).

In parallel with our budget planning for Years 9 and 10, we are identifying current activities that can and should be cut back in order to focus resources on higher-priority work. At the August 2013 and January 2014 CMMAP Team Meetings, we will conduct plenary sessions designed to aid in prioritization of our work prior to the end of STC funding. These same sessions will also forge collaborations, including joint proposals, that will continue beyond the end of STC funding.

F) Organization and Management

1. The ramp up of IMMAP presents new management challenges, and also high-value opportunities to extend the excellent work of CMMAP into the future.

We agree, and we are currently thinking about and discussing what should go into the IMMAP Science Plan and also the IMMAP Business Plan, both of which will be completed over the next few months.

2. Planning to archive large datasets (e.g. CMMAP models simulations) after CMMAP sunset is underway, and will be a challenge given the huge storage requirements of the high-resolution data. Currently, the team envisions an MOU between the new institute (IMMAP) and the University of California San Diego/San Diego Supercomputer Center (UCSD/SDSC). It would be desirable to see progress and priorities for data storage plans as the STC funding ramps down.

The MOU is in progress and will be predicated on the data publishing model already developed based on the CMMAP Digital Library. Of course, we want to store all of the model output and software possible. However, as the panel realizes, this will run into the petabyte range and this may not be affordable, especially since we need to have multiple copies; at least two and preferably three stored redundantly at separate locations. We may be forced to subset or otherwise post-process the datasets into smaller volumes to make long-term storage more affordable. We are not making that decision yet but will have to consider it in the context of the new Giga-LES simulations.

As a data point, the NSF-sponsored Chronopolis project is designed for library resources and prices of long-term storage are \$1500/terabyte-yr. Clearly this is prohibitive as a solution but it provides a point of reference. It would make more sense to procure redundant, dedicated storage devices that could be shipped between locations. We are in the process of conducting a trade-study in association with the MOU development to determine a preferred technical solution that is affordable and maintainable within the scope of IMMAP.

G) Legacy and Sustainability

1. A sustainable funding model for IMMAP depends on support from university leadership and/or ATS. The payment of the 30-year building bond is a particular burden on planning. As of this site review, a business plan and funding model has not yet been agreed upon.

We are working with CSU's senior administration and hope to agree on a suitable plan within the next few months.

2. Multiple visions have been put forward on the future of IMMAP, in terms of its mission, breadth, and role within CSU. As IMMAP planning proceeds, clear communication on vision and scope will be essential to reconcile competing ideas, and to create a high-impact, sustainable organization. Scheduled efforts to develop an IMMAP science plan are viewed as an excellent opportunity to move this discussion forward.

We are drafting both a Business Plan and a Science Plan for IMMAP, and will be discussing those with the CMMAP Team and with CMMAP's Internal Advisory Panel over the next few months.

3. Donor funding would be an excellent source of revenue for IMMAP, and the new building could offer the potential for a naming gift opportunity.

We are working with CSU's Development Office and the Vice President for Research to identify promising opportunities to secure private funding.

4. The IMMAP framework would be appropriate for sustaining the impressive accomplishments of CMMAP in broadening the ethnic diversity of graduate students and undergraduate interns at CSU. In planning process for IMMAP, we recommend a long-term diversity strategy that builds on the proven success of CMMAP.

We will continue to work with the Department of Atmospheric Science through the Graduate Student Coordinator (Prof. Sonia Kreidenweis) as well as the College of Engineering and the CSU Vice President for Diversity (Dr. Mary Ontiveros) to build on the successful efforts of CMMAP to enhance the diversity of graduate students and research staff. We plan to apply to NSF as a *Research Experience for Undergraduates Site* for support to continue recruiting and supporting undergraduate summer research interns.

5. In the final three years of the CMMAP grant, it would be desirable to see additional gender diversity among graduate students (improving beyond national average percentages). Recent CSU research, presented by Dr. Denning on behalf of researchers in the departments of Psychology and Human Development, focused on understanding gender diversity in atmospheric science, may offer concrete strategies to support these initiatives.

When have requested permission from the Department of Psychology to distribute the results of research conducted by Prof Silvia Canetto and her students (scrubbed of identifying

information). Assuming that we receive such permission, we plan to present the information to the rest of the Department of Atmospheric Science at the upcoming Fall Faculty Retreat. In addition, CMMAP faculty will continue to recruit and retain women as graduate students, and to be sure that our undergraduate interns are mostly women.

1. In the final three years of the CMMAP grant and/or planning for IMMAP, it would be valuable to extend diversity efforts to scientists and faculty members from traditionally underrepresented groups.

We will continue to work with the Department of Atmospheric Science, the College of Engineering, and CSU's Vice President for Diversity (Dr. Mary Ontiveros) to promote diverse faculty and scientist hiring at CSU.