Vision Statement for Research and Educational Outreach for the ARM CART Southern Great Plains Locale

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Our proposal capitalized on and reflected the considerable collective expertise in the atmospheric sciences (both research and educational) that resides in the "Weather Center" assemblage of organizations on the University of Oklahoma (OU) campus. This "Weather Center" is directed by James F. Kimpel (Dean, College of Geosciences, OU) and has the following components:

- OU School of Meteorology (SOM)
  William H. Beasley, Director
- OU-NSF Center for Analysis and Prediction of Storms (CAPS)
  Douglas K. Lilly, Director
- OU-National Oceanic and Atmospheric Administration (NOAA) Cooperative Institute for Mesoscale Meteorological Studies (CIMMS)
  Peter J. Lamb, Director
- Oklahoma Climatological Survey (OCS)
  Kenneth C. Crawford, Director
- NOAA/Environmental Research Laboratories (ERL) National Severe Storms Laboratory (NSSL)
  Robert A. Maddox, Director
- Operational Support Facility for the Weather Surveillance Radar - 88 Doppler Program of the National Weather Service (OSF WSR-88D)
  Ron A. Alberty, Director
- National Weather Service Forecast Office (NWSFO)
  Dennis H. McCarthy, Director

As the proposal indicates, all of these "Weather Center" entities will make vital contributions to the program of research and education outreach that we propose for the Southern Great Plains locale for the Atmospheric Radiation Measurement (ARM) program's Cloud and Radiation Testbed (CART).

Cooperative Institute for Mesoscale Meteorological Studies (CIMMS)

The research component of our program will be based within CIMMS. OU and NOAA founded CIMMS in 1978 to promote greater cooperation and collaboration among research scientists in the NOAA Environmental Research Laboratories (especially NSSL) and faculty, post-doctoral scientists, and students in the SOM and other academic departments at OU. Dr. Lamb's recent appointment as Director of CIMMS carries with it the responsibility of providing the scientific leadership necessary for the realization of the above broad goal.

The Institute has three current research themes: 1) basic convective and mesoscale research, 2) forecast

improvements, and 3) the climate effects of mesoscale processes. Themes 1 and 3 are highly relevant to the ARM program. The research effort we propose will therefore build on and extend activities that CIMMS has already initiated under those themes.

The previously planned CIMMS programs in these areas will, of course, be substantially enhanced by this involvement in a new and highly important national and international research effort. The potential for this two-way interaction is heightened by the fact that the Southern Great Plains locale involved has been, and will remain, a traditional focus for CIMMS research. Furthermore, our research team also involves faculty and post-doctoral scientists from SOM, CAPS, and OCS, as well as research scientists from NSSL. Their involvement is fully consistent with the mission of CIMMS. In sum, because the "Site Scientist for the Southern Great Plains Locale" contract has been awarded to CIMMS, that activity will be one of the major foci for our institute during the next decade.

Proposed Research Program

In formulating the research component of our program, we were guided by the overall goal of the ARM program (to improve the treatment of cloud radiative forcing and feedbacks in general circulation models [GCMs]) and its associated objectives (to improve the empirical characterization of the cloud and radiative processes in the Earth's atmosphere and the parameterization of these processes in atmospheric models). The dimensions of our program were also influenced by the particular attributes of the highly unique observations that will be made at the ARM CART locale and by the scientific interests and capabilities of the members of our group.

Our envisioned research program is both substantial and broad, in keeping with the apparent length (10 years) and level ($250,000 per year) of the available funding. It will investigate atmospheric radiative transfer and surface radiation, cloud-radiation interactions, convective processes, lower tropospheric phenomena including surface-atmosphere interactions, and patterns of cloudiness and soil moisture. In a methodological sense, the research will involve the modeling of both dynamical and physical processes, the consideration of both deep convective and stratocumulus clouds, and the use of advanced statistical techniques. Furthermore, some of the projects we wish to pursue will require the deployment of additional instrumentation at this ARM locale. Each individual project outline provided information on how it would contribute to the aforementioned goal and objectives of the ARM program.

Inherent in the ARM program is a "scaling up" approach to global change research progress. Specifically, the ARM program will make observations and engage in modeling activities (including development and validation) for the rather small cloud-to-regional scale range, in the belief that the results obtained will improve GCMs and their ability to simulate and predict the global climate.

The fact that our envisioned work is consistent with this approach reflects traditional and emerging strengths of our OU "Weather Center" group. Through the activities of NSSL, CIMMS, and SOM over several decades, our group has long been an international leader in mesoscale research. This strength was recently further enhanced with the addition to the "Weather Center" of CAPS, which is funded for 11 years by the NSF Science and Technology Center Program.

The ultimate goal of CAPS is to numerically predict important weather events in the 10^2 m to 10^3 km scale range with sufficient speed and accuracy to permit timely warnings to be issued by operational centers. The initial geographical focus of the CAPS effort is the Southern Great Plains. Clearly, our ARM research program will benefit enormously from being collocated with the state-of-the-science modeling CAPS will perform over the next decade. Finally, concerning the larger end of the aforementioned cloud-to-regional scale range, the proposal noted that both CIMMS and NSSL are now increasingly emphasizing the climatic effects of mesoscale weather systems. Some aspects of our ARM program will build on that foundation.

Scientific Management Proposal

As already indicated, in response to the demanding personnel requirements contained in the Request for Proposal, we have assembled a team of scientists from the OU "Weather Center" that collectively possesses the necessary experience and qualifications. Our plans for the scientific management of this locale are consistent with that approach. They have also been strongly influenced by the short distance (only 150 km) between our scientific base on the OU campus and the center of this ARM locale. This circumstance means that, in many respects, the Site

Scientist will be essentially located "on site"; certainly he can reach it within 2 or 3 hours when required.

The principal scientific management responsibility of the Site Scientist is to ensure that the most appropriate set of high-quality measurements is made for any given time period and that the capability to make such measurements is continuous. To make the decisions that yield this optimum outcome, the Site Scientist must be cognizant of, and influenced by, a number of factors: the overall goals and objectives of the entire ARM program; the specific observational requirements of individual ARM projects for this locale; and the ever-changing weather and weather patterns that characterize the locale and will determine the "windows of opportunity" for the key measurements.

This situation requires that the Site Scientist have good synoptic support and climatic background knowledge, maintain frequent and effective communications with the Site Operator and Site Manager, and ensure that the crucial instrument systems are maintained in the appropriate states of readiness. The necessary climatic background knowledge will be drawn from the substantial research experiences and accomplishments of the Principal Investigator/Site Scientist (Dr. Lamb), one of the Co-Principal Investigators (Dr. Rabin), and their OU/NOAA "Weather Center" colleagues, particularly those at NSSL. The required synoptic support will emanate from the extensive operational meteorology experience that another Co-Principal Investigator (Dr. Crawford) has had for the Southern Great Plains, and from the presences on the OU campus of the Weather Service Forecast Office (WSFO) and the OSF WSR-88D.

Proposed Educational Support Program

The Educational Support Program will be coordinated by Dr. Crawford. It will build on educational outreach programs in which Dr. Crawford is already involved as Director of OCS and its developing Oklahoma Mesonetwork. The program will span the precollege, undergraduate, and graduate levels and will be developed and implemented by combining resources available to both OU and Oklahoma State University. We will also seek to expand the program to two other university campuses in Oklahoma--Langston University (the state's traditionally black university) and Southwestern Oklahoma State University (a regional school).

The goal of this educational outreach will be to use a multi-disciplinary approach that combines meteorology, climatology, computer graphics, telecommunications, geography, geology, and agriculture in a series of applied environmental projects designed to educate a new generation of precollege and college students about our environment, its impact upon society, and the consequences of a changed climate in the 21st century.

Our objectives will be to 1) tap the Oklahoma Mesonetwork and the ARM environmental data streams to develop an interest in science and problem-solving by both teachers and students, through the application of science to society, technology, and daily problems; 2) develop a series of transportable learning-tools (applied project at the precollege level; new undergraduate courses for non-science majors at the college level); 3) focus on traditionally under-represented groups in the fields of math and science; and 4) create a mentor program for learners in the support program.