

Appendix V. MEAS – Centers and Partnerships

1. The State Climate Office of North Carolina

The State Climate Office (SCO) is a Public Service Center for Climate-Environment Interactions and the primary source of expertise on weather and climate information for citizens and businesses in North Carolina. Identified as the official State Climate Office by the US Department of Commerce and the American Association of State Climatologists, the SCO is an extension center at the College of Physical and Mathematical Sciences (PAMS) affiliated with the Department of Marine, Earth, and Atmospheric Sciences. It is located on the Centennial Campus of North Carolina State University. The SCO is continuously involved with monitoring and study of North Carolina's climate. In addition, the SCO operates a network of environmental observing stations located across the state in cooperation with the College of Agriculture and Life Sciences (CALs). The SCO works closely with the faculty at several UNC institutions, the Regional Climate Centers, and several international institutions to ensure the SCO uses the most current science and research in the field.

The State Climate Office has a mission based on extension, research, and educational outreach:

Extension

- Provide the most accurate climate information to the citizens of North Carolina.
- Assist North Carolina state agencies in climate-environment interaction issues and related applications.
- Establish, operate, and maintain an extensive meteorological network across North Carolina and archive and disseminate this data to the public in a timely fashion.
- Assist other extension scientists by integrating climate information into applications such as agricultural and environmental models.
- Increase public awareness of variations in North Carolina climate and environment.

Research

- Study North Carolina's climate and its interaction with the environment.
- Investigate the effects of climatic variations on agriculture, air pollution, and natural resources and develop forecasts that assist in resource management.

Education

- Interact with K-12, community colleges teachers and students, and with other community organizations on different aspects of NC climate.

The SCO aspires to fulfill each of these objectives with emphasis on enhanced information services, establishing the NC Environment and Climate Observing Network (ECONet), development of client-driven environmental applications, and providing an educational resource for students in North Carolina.

As the primary mission of the State Climate Office is extension and outreach to the state, much of its recent effort has been focused on developing partnerships with federal, state, and local

agencies. Collaborations with NC Division of Air Quality, NC Division of Water Resources, NC Division of Forest Resources, and the NC Department of Transportation. Additionally, SCO works with US Geological Survey, the Army Corps of Engineers, the US Environmental Protection Agency, and National Weather Service to meet community needs for environmental applications and services.

The basis of its community applications and services is a comprehensive environmental database, which includes historical and real-time weather and water resource information. The backbone of its environmental monitoring is the NC ECONet, which includes standard weather sensors as well as unique atmospheric and soil measurements. The data collected by the NC ECONet and other high-quality observing systems in North Carolina are archived at the State Climate Office and used to drive decision-support tools for transportation, water resource, air quality, and agricultural needs. The State Climate Office is actively engaging agricultural scientists and extension agents across the state to improve the use of weather and climate information for agricultural and environmental applications.

As needed to support the extension and outreach mission, the SCO conducts research on weather and climate of North Carolina. Recent research efforts has lead to improved understanding of the El Nino – Southern Oscillation, local climate change patterns, evapotranspiration, hurricane frequency, severe weather dynamics, and coastal storm evolution. This research has resulted in improvements to atmospheric modeling capabilities, drought monitoring, and seasonal forecasting.

The State Climate Office supports its educational mission by providing research and training opportunities to undergraduate and graduate students in the Department of MEAS and other departments at NC State University and other UNC system schools. The SCO is also one of the first units at NCSU to collaborate with Centennial Campus Middle School and hosts four students annually from CCMS for scientific internships. The SCO provides direct community education through invited presentations and lectures to K-12 classes and civic organizations.

2. MEAS and the Center for Marine Sciences and Technology (CMAST)

[Present]

MEAS has been a constituent of the CMAST research center and a full partner in its coastal laboratory (the CMAST facility) since their inception. The marine-oriented MEAS faculty became affiliated with the Center when it was formed. MEAS faculty were also intimately involved with the conception of the coastal laboratory facility. We wrote the vision statement, planned PAMS/MEAS programs, defined the faculty expertise we hoped to put in place, and helped design of the building to optimally support these goals. As soon as the building was completed MEAS put into place resident faculty and graduate students to get research programs underway.

The CMAST laboratory is shared with the NCSU Colleges of Agriculture and Life Sciences (CALS) and of Veterinary Medicine (CVM). The county Cooperative Extension Service also occupies some space in the facility, as does Carteret Community College. Facilities used by MEAS/PAMS in the CMAST building include spaces that are dedicated to our use, ones in which we are “primary users”, and shared spaces. Dedicated spaces include 2 faculty offices,

grad student/postdoc offices, a general-purpose research lab, and an electronics lab. Spaces in which MEAS is the primary user include a machine shop, wet and dry staging rooms, and the instrumentation platform on the roof. Shared spaces include a teaching lab and videoconference facilities.

MEAS has invested substantially in the CMAST facility and its programs. We have put in place a full-time electronics technician and fully-equipped electronics laboratory. We installed major machine tools for the machine shop. MEAS initially assigned 2 resident faculty to the facility, although after 2 years budget shortfalls required their presence back in Raleigh when new positions were not forthcoming to fill the voids in campus programs. The MEAS plan remains, though, to have 3 positions for faculty resident at CMAST. A first step has been to hire a physical oceanographer who, although stationed on campus, is expected to do research out of the coastal facility.

MEAS has participated in CMAST programs in all the traditional academic areas: research, teaching, and outreach. Both resident and campus faculty have maintained funded research programs at CMAST on reproductive biology of blue crabs, benthic and fisheries ecology, and instrumentation development (remote data stations for the “instrumented estuary”; robotic drifters for studying red tides and larval transport; biotelemetry). Numerous graduate students have devoted full time to research at CMAST after completing coursework on campus. Teaching at the undergraduate level has included full courses, short courses and field trips. Coastal processes (MEA459), a multi-disciplinary, 5-week summer “immersion” course is team-taught by campus and CMAST faculty during the summers. Natural Resources discussion sections on campus have been taught by CMAST resident faculty, using the videoconference network. The oceanography student training cruises (MEA461 for undergraduates, MEA615 for graduate students) use CMAST as their base and the *R/V Cape Hatteras* as the seagoing platform. Field trips for campus courses (e.g., MEA220 Marine Biology) have been conducted regularly from CMAST.

At the graduate level, courses taught by resident faculty have included Biotelemetry and Instrumentation Techniques (MEA591), which attracted students from MEAS, NCSU Zoology, CVM, Duke, UNC-CH/IMS, and UNC main campus. Other courses (e.g. fishery science) were taught between campus and CMAST, one way or both ways, using the videoconference facilities.

In outreach, CMAST resident faculty helped convey the importance of marine sciences to the NCSU community by making presentations to the "Connecting with NC" bus tour hosted by the Chancellor, and to the public by providing tours of the facility to visitors and consulting with members of the fishing industry. They joined campus faculty in participating as moderators and science judges in the National Ocean Science Bowl, and included runner-up teams and their teachers in the oceanography training cruises. They also became active, involved citizens in their Carteret County communities. Campus-based faculty affiliated with the Center have also frequently advised state agencies on issues of fishery management, coastal water supply, and storm surge/disaster planning.

[FUTURE]

MEAS has a vision for coastal programs it wishes to develop using the options provided by the CMAST facility. Since the idea of a coastal laboratory was broached we have dreamed of a “Semester at the Sea” for our best and brightest marine science students. We look forward to providing, in a cooperative program with the Duke Marine Lab and UNC’s Institute of Marine

Science, a broad spectrum of field-oriented courses supplemented by electives taught over the videoconference network. This would allow our undergraduates to experience marine science in the most immediate and compelling way, while carrying a full course load that would allow normal progress toward their degrees. To prepare for this, we have taken a leading role in seeking means to provide housing near the laboratory. We envision a facility that would accommodate faculty and graduate students undertaking short-term projects, undergraduates taking courses, and visiting scientists--one that would foster contact and interactions among different disciplines and levels of experience.

An essential part of this vision is faculty in residence at the CMAST facility; a minimum of 3 has long been our goal, but has not been attained because new positions have not become available. Potential areas of expertise, chosen in consultation with members of the coastal science community already in place, include coastal/estuarine oceanography, instrumentation development, marine education and outreach, and other areas that would gain disproportionate benefit from having immediate access to the field environments. One of these positions may be filled by a permanent CMAST director, who will serve as a scientific leader and communications conduit to national bodies and funding agencies.

MEAS expects to continue building its physical presence at the coast. We already are partners in bringing high-speed Internet to Carteret County, to which Carteret Community College and the UNC, Duke, and NOAA labs have now been connected. We have a fully-equipped and staffed electronics laboratory, and the basics for a machine shop. When the latter is completed and staffed with a machinist, CMAST will represent a center for development of new technology in support of fisheries, oceanography, marine animal medicine, and many other disciplines.

Research of the planned resident MEAS faculty, in concert with that of their multidisciplinary MEAS colleagues who may collaborate, visit, or even rotate to CMAST for limited periods, will address a multitude of questions central to the well-being of the local ecology and economy. Examples include modeling of storm surges, ensuring sustainability of fisheries, predicting harmful algal blooms, and assessing suitability of habitats for aquaculture.

Resident faculty and graduate students will continue outreach in the tradition of the Land Grant University, providing new information that applies to real-world problems. They (especially a Marine Education specialist) would contribute breadth and depth to the local K-12 instruction in marine sciences. Presentations by resident and visiting scientists would increase public awareness of the importance of marine sciences, and foster inter-institutional collaborations.

Growing numbers of MEAS scientists resident at CMAST, increasing research activities, and larger groups of undergraduate and graduate students attracted to CMAST programs, all will increase the already substantial portion of the local economic activity attributable to marine sciences and higher education.

3. Partnership between the North Carolina Museum of Natural Science and MEAS.

The Museum mission statement focuses on enhancing the public's understanding and appreciation of the natural environment in ways that emphasize the biodiversity of North Carolina and the southeastern United States and relate the region to the natural world as a whole. One way the museum accomplishes this is by capitalizing on the most current research in various

fields, and eliciting input from academics in various disciplines to collaborate on exhibits and programs.

With respect to paleontological research and specimens that form a large part of Museum displays and focus, an “unofficial” partnership between the North Carolina Museum of Natural Science (NCMN) and the Department of Marine, Earth and Atmospheric Sciences has existed for some time. This probably could be marked by the donation of a Tyrannosaur skull cast to the Museum by the Department, but the date of this donation has not been recorded. The partnership was formalized with the negotiation between the Museum’s Dr Betsy Bennett and Jerry Whitton, Dean of College of Physical and Mathematical Sciences, to secure the employment of Dr. Dale Russell in late 1994. After negotiations were finalized, Dr. Russell began his contract in August of 1995, under the headship of Len Pietrafesa, who accepted Dr. Russell into MEAS as faculty.

Students from Duke or Chapel Hill have worked with the Museum on an occasional basis, preparing and describing Museum specimens, but the primary research done on Museum fossil specimens has been conducted with NCSU graduate students under the direction of Dr. Russell and Dr. Reese Barrick, who was with the Department as faculty until 2003. This collaboration resulted in some student-lead publications, including those of Paul Fisher, who carried out X-ray imaging of Willo's pericardial area (published in Science) as an NCSU graduate student, James Lamb, who examined Cretaceous vertebrates in Museum collections in his graduate research (not published), and Dr. Bill Straight's research on isotopes on Cretaceous vertebrates, published as an abstract.

The collaboration between the Museum and the Department will continue into the future, and now involves both Dr. Julia Clarke, who is supervising two graduate students working on Museum specimens, and Dr. Mary Schweitzer, who has one student currently conducting his dissertation research on a new specimen of dicynodont housed at the Museum that has resulted in two published abstracts.

The future of the collaboration between the Museum and the department will rest upon continued input from cross-appointed academics, and student involvement resulting from this. The Museum’s focus on public interest and outreach forms a natural outlet for such involvement. Dr. Clarke is one of the leading young scientists in the field of paleosystematics, and she utilizes modern computer-driven approaches to elucidate the process of evolution in dinosaurs and birds, her area of expertise. In addition, she is involved in international exploration, and has been able to secure for the Museum opportunities to research and temporarily house rare, or understudied fossils from China, a wonderful opportunity to enhance the vision and public awareness of Museum programs. Schweitzer’s research is rather more non-traditional, and a bit more difficult to portray in a public setting, but extending those methods to Museum specimens through student research will play a greater role in the future. In addition, Schweitzer has, with the help of University negotiators, been able to secure a long term contract with North Carolina landowners who have extensive holdings in prime fossil-bearing regions in Montana. This contract will result in field opportunities to NCSU students, and will provide the opportunity to build Museum collections by returning fossils discovered there to the Museum for curation, housing and preparation. Both NCSU faculty members offer a "balanced" research expertise to the Museum, and hopefully portray the diversity and excitement of discovery in natural history.

The collaboration between the Museum and the University was recently extended by the opening of a preparatory position, housed in the Department but funded by the Museum. This position, when filled, will greatly enhance research opportunities for students, by hastening the preparation of many of the world-class fossils housed at the Museum that have not been able to be described because of the time intensive nature of preparation, currently undertaken by volunteers and Museum staff with a multitude of other responsibilities.

A formal collaboration between the University and Museum strengthens the research and public profile of the Museum. Accordingly, it will continue to be very important to the Museum that the Museum's role in the collaboration be given equal footing with that of the University. The Museum's high-profile program of outreach provides access to the North Carolina general public from which the major North Carolina universities are relatively isolated, but from which the majority of NCSU students are drawn. Problems in the NCSU-Museum relationship arise from divergent priorities - e.g. emphasis on student degree and tenure track matters in the former, and pre-university education and high-profile public displays in the latter. Although both institutions find it easy to agree on the benefits of collaboration, institutional priorities tend to dominate day-to-day considerations in both. Cross-appointments provide living links between the two institutions.

4. Partnership with the National Weather Service

Partnership with the National Weather Service has been very strong over the years, and has become stronger since the NWS relocated in the Centennial campus. It is the oldest ongoing NWS–University Collaborative Program in the U.S. It included several initiatives as described below:

- Collaborative Coastal flooding modeling 1986
- GALE Project 1986
- National Winter Weather Workshop 1988
- Sixteen consecutive years of NOAA funded research
 - Southeast Severe Storms Consortium
 - 3 COMET Cooperative Programs
 - 2 CSTAR Projects
- Organized and hosted the first ever NWS – University – AMS sponsored training symposium for operational forecasters, 1995
- Recognized by NWS Scientific Services for developing an effective protocol for successful NWS – University Collaborations – The “Five Step Process”
- Science and training program consistently rated 5 Star (excellent) by NWS’s Scientific Services Division of the NWS.
- AMS Charles L Mitchell Award (1997) for leadership in forging strong collaborative applied research relationships between forecasters and university professors and students.
- NWS Isaac Cline Award (2004) for leadership for infusing scientific principals into operational meteorology.
- NOAA Unit Citation (1997) for outstanding applied research leading to operational improvements.

- Pioneered Joint Severe Weather Operations where highly selected faculty and students work with forecasters during severe weather outbreaks.(BAMS, 1997)
- Collaboration promotes professional and career development for students
 - Since 2004, the NWS internship course for credit has provided 27 NCSU students with operational experience in meteorology
 - Since NWS RAH collocated with NCSU on campus, 16 NCSU students who were participated in the collaboration have gained employment with the NWS.
 - NCSU-NWS Intern Course, which was featured in an article in BAMS in October 2005
- The collaboration's research produced a number of valuable forecast tools for the region's most critical forecast problems including:
 - Coastal flooding
 - Intensification of coastal storms
 - Cold air damming and its erosion
 - Winter storm precipitation types
 - Precipitation amounts
 - Inland flooding induced by tropical cyclones
 - Enhanced rainfall due to the interaction of tropical systems with mid latitude disturbances
 - Severe weather associated with gravity waves and cold fronts aloft
 - The initiation of convection by low level boundaries and the effects of boundary interactions on convection
 - A technique for detecting lightning strikes
 - Tornado outbreaks

5. Other Partnerships:

- Partnership with the City of Raleigh, DENR Division of Aquifer Protection, and USGS Raleigh Office in the development and operation of the Piedmont Hydrological Observatory (Bill Showers and John Fountain)
- Collaborations with Ocean University of China, East China Normal University, National Taiwan University, and Vietnamese Academy of Science and Technology (Paul Liu)
- Memorandum of Understanding between NCSU/MEAS and the Submerged Aquatic Vegetation Working Group, which is coordinated by the Albemarle-Pamlico Estuarine System, National Estuary program and NC DNR (David Eggleston)
- Member of the Blue Crab Advanced Research Consortium (BCARC), which is funded by NOAA @ \$5million/yr. and made up of NC State University, University of MD, Smithsonian Environmental Research Center, College of William and Mary, University of Southern Mississippi, and the Maryland Watermen's Association (<http://www.umbi.umd.edu/~comb/programs/aquaculture/bcarc.html>), David Eggleston
- Collaborative research and MOU with Indian institute of Technology, New Delhi, National Institute of Oceanography, Goa, India, and Indian Institute of science, Bangalore, and

National Institute of Ocean Technology, and India Meteorological Department, Chennai,
India (Sethu Raman)