11.1 THE STATE CLIMATOLOGIST PROGRAM AND A NATIONAL CLIMATE SERVICES INITIATIVE

Mark A. Shafer
University of Oklahoma, Norman, Oklahoma

1. INTRODUCTION

Recent advances in technology and the gradual accumulation of knowledge have provided tremendous opportunities to lessen the impacts of natural hazards. But technology and knowledge are not solutions in themselves – it is their application that mitigates loss. It is not necessarily that we need more knowledge, although ongoing basic research is a critical component of future opportunities. The critical task before us is to apply what is already known.

Interest is growing in climate services. There have been several initiatives in recent years addressing natural hazard threats and climate services. Most focus upon the national arena – national threats with national solutions. But knowledge is most effective when tailored to particular circumstances. This requires placing information in the context of local hazards. Policies are only as effective as their implementation. Therefore, consideration must be given to how national proposals will be put into practice at the local level.

2. CLIMATE SERVICES INITIATIVES

Within the last two years, several climate services initiatives have emerged that aim to tie generation of climate knowledge and predictions to specific user groups. Three notable initiatives are the National Research Council's (NRC) Board on Atmospheric Sciences and Climate (BASC) Climate Services Vision (NRC, 2001), the National Oceanic and Atmospheric Administration's (NOAA) Climate Observation and Services (NOAA, 2001), and a National Climate Services proposal included as part of the Senate Energy Bill.

The BASC report resulted from several planning meetings during 2000. In the report, the Board defines climate services as "the timely production and delivery of useful climate data, information, and knowledge to decision makers." In the report, they identify five "guiding principles":

1. The activities and elements of a climate service should be user-centric.
2. If a climate service function is to improve and succeed, it should be supported by active research.
3. Advanced information (including predictions) on a variety of space and time scales, in the context of historical experience, is required to serve national needs.
4. The climate services knowledge base requires active stewardship.
5. Climate services require active and well-defined participation by government, business, and academe.

The report is aimed at enhancing rather than reorganizing existing activities, which suggests that present relationships in the provision of information to the public would remain largely unchanged.

In contrast to the BASC report, the NOAA plan creates new organizations to improve provision of climate services. In 2001, NOAA established the Climate Observations and Services Program. The new program is designed to integrate resources from several line offices with interagency, academic, and private sector partners. Their plan is designed for "minimizing risks of unusual climate conditions and maximizing it s potential benefits." An interesting comment in their plan: "climate information only acquires value through use." Therefore, utilization needs to be a key focus of any climate services plan.

The NOAA plan calls for an integrated focus – transforming observations into products and services that are meaningful to user groups. The heart of the proposal is (1) attention to observations, (2) research, modeling, diagnostics and analysis, and (3) products and services. Their plan recognizes that much of the information coming from the meteorological and climatological communities lack sufficient consideration of the needs of external users. They call for a new emphasis reflecting the pull for knowledge from regional users. The NOAA plan calls for a management structure consisting of a program board to establish, review, and assess priorities; a program office for staff support and implementation; and a science advisory group to provide expert advice. This structure, they assert, would complete the cycle from production of knowledge to a user-centered focus.

The third, and perhaps most significant, initiative is one within the U.S. Senate. Senate Bill S.1716 was introduced in the U.S. Senate in November 2001. The plan, the "Global Climate Change Act of 2001" includes a section on Climate Change Science and Information, which calls for establishment of a National Climate Service that would include:

1. A national center for operational climate monitoring and predicting;

* *Corresponding author address*: Mark Shafer, Oklahoma Climatological Survey, 100 E. Boyd, Suite 1210, Norman, OK 73019-1012; e-mail: mshafer@ou.edu

2. Design, deployment, and operation of an adequate national climate observing system;
3. Establishment of a national coordinated modeling strategy;
4. Improvements in modeling and assessment capabilities on regional and local scales;
5. Improved capacity to assess impacts of predicted climate changes and variations;
6. A program for long-term stewardship, quality control, development or relevant climate products, and efficient access to all relevant climate data, products, and critical model simulations; and
7. Mechanisms to coordinate among Federal agencies, State and local government entities and the academic community to ensure timely and full sharing and dissemination of climate information and services.

Appropriations for the plan would rise to more than $75 million per year. The Global Climate Change Act of 2001 was added to the Senate Energy Bill (S.1766) in December 2001. As of March 2001, the National Climate Services portion is still part of the bill (Title XIII, Subtitle D, Part II).

3. THE POLITICAL LANDSCAPE

The climate services initiative is reflective of a larger trend. There is a growing perception among the public and those who represent them in Washington, D.C. and in state legislatures, that we, as a society, are becoming more vulnerable to hazards. This growing awareness has been heightened even further by the events of September 11. From the U.S. Capitol to state houses across the country, the quest for homeland security has led to an analysis and better understanding of risk.

Leaders are looking toward the scientific community to contribute. Representative Sherwood Boehlert (R-NY) stated in a recent address:

> "…academia, as a leading generator, analyzer, repository, and purveyor of human knowledge and insight, will necessarily have an impact on whether and how the world actually changes. I hope and expect that academia … is up to that task, which may require some new undertakings, but mostly will simply require more intensive and better focused attention on existing efforts and greater engagement with the rest of society." (from Anthes, 2001).

Anthes (2001) notes that terrorism is only one area in which science can contribute:

> "Other aspects include stress on economies, health, and agriculture caused by severe weather, climate variability, and long-term change; global warming; and air and water pollution on local, regional, and global scales…over the long run these factors will affect more people and have a greater negative impact on society."

In fact, before the events of September 11, vulnerability to natural hazards was rising on the Congressional agenda. Eighteen Senators are members of a Congressional Natural Hazards Caucus (see Appendix), whose stated goal is "to provide ways the local, state and federal government can better prepare for and help mitigate the costs of natural disasters."

All of these threats tie together in the concept of risk management. Whether from warfare or from natural hazards, large segments of our society are vulnerable. The tools of science may be used to assess the magnitude of the threat, but perception and communication are vital elements in risk management (Morgan, 1981; Slovic et al., 1979; Keeney, 1996). This translation from objective measures to perceived vulnerabilities is a vital component of climate services.

Understanding risk, in the context of individual perceptions and evaluations, is something that state offices are well prepared to do. State offices are designed to provide flexibility to policy responses. They interpret data within the context of specific user needs, whether that be a state agency planning future needs or an individual farmer interested in climate and weather impacts on his crop. Each will assess risk differently. A hot, dry summer could be devastating for the individual farmer, but a state agency does not run the risk of being wiped out. Therefore, the agency looks at the event as a challenge of resource allocation, while the farmer looks at the event as financial survival.

Natural hazards are not static either. As more attention is focused upon climate change and climate vulnerability, it is critical to have local experts who can communicate these scientific projections into operational knowledge. This means assessing the projected impacts of upcoming seasons or even decades, and tailoring the message communicated to different user groups. Furthermore, as Rep. Boehlert stated, this communication involves engaging the rest of society. A single message may not be well received or understood among all regions and user groups, therefore there must be groups engaged that can translate these pronouncements into formats meaningful to these sub-national user groups.

These issues are going on within the context of changing management structures in Washington and the states. Two significant trends affect what research is done and services provided, and by whom: federal program evaluation and "devolution". The Bush Administration has made program evaluation a central piece of their management style. In the Fiscal Year 2003 budget, several programs in the Department of Energy were identified for evaluation with "objective investment criteria for federal R&D projects" (OMB, 2001). The Office of Management and Budget (OMB) report criticizes federal research programs for lacking clear, measurable goals. To remedy this, the OMB will begin attaching evaluation criteria to budget proposals. These criteria, at least for Energy's 2003 budget, focus

upon societal and economic impacts of programs. OMB's intent is to apply similar criteria to all applied R&D programs in the FY2004 budget.

The other hallmark of the political landscape, one which has dominated now for nearly two decades, is a "new federalism". Federalism may be defined as "an organization which unites separate polities within an overarching political system by distributing power between and among constituent governments. (Elazar, 1984)." Over time, the balance of power shifts, usually through political bargaining (Anton, 1989). Recent trends have acted to shift the balance of power more toward the states (Wise, 1998).

The current trend toward resurgent state power began in the late 1970s and was a central theme of the Reagan administration (Conlan, 1988; Shannon, 1994). There is a growing recognition that each arena of government has certain functions for which it is best suited, resulting in a "sorting out" of responsibilities (Rivlin, 1992; Peterson, 1995). Certain program areas, such as health and human services, provide a testament to the ability of local governments to provide services tailored to local clientele. This may serve as a valuable model for climate services. Federal government may excel at providing certain types of knowledge, such as long-lead outlooks and climate models, but local offices (e.g., state climate offices) can best tailor this information to local clientele's needs.

4. THE STATE CLIMATOLOGIST PROGRAM

Prior to 1973, the National Weather Service provided climate services to local constituencies within the states. These services were discontinued in 1973. Concerned members of the climate community formed the American Association of State Climatologists (AASC) in 1976, leading to the creation of the State Climatologist program in 1978. The program designated an entity in each state as the State Climatologist office, and created a memorandum of agreement between that office and the National Climatic Data Center (NCDC) to provide service on the local level.

Since the creation of the State Climatologist program, the climate services landscape has changed significantly. Regional Climate Centers now exist to support provision of climate services and address concerns that cover an area broader than a single state. Climate modeling and seasonal outlooks have improved, providing new opportunities to address evolving issues of concern. Computer technology has enabled state offices to tap resources that once required a tremendous investment in infrastructure.

The State Climatologist Program is poised to take advantage of these new opportunities. Over the last year, the AASC has undertaken a revision of the Memorandum of Agreement between the State Climatologist offices and NCDC. The new agreement is called ARSCO: AASC Recognized State Climate Offices. To receive ARSCO certification, a State Climate office must demonstrate capabilities to provide services to its clientele, including communication capabilities, information services, research, outreach, and monitoring and impact assessment. Obtaining certification provides a formal framework for a relationship between NCDC, the Regional Climate Centers, and State Climatologist offices.

Despite the formal arrangements and new opportunities, State Climatologists remain constrained in the resources they can bring to bear on climate services and issues. Most offices are small, typically consisting of a part-time Director and maybe one or two additional staff members (who may be University students). Because of this, most offices wait until individuals contact them for assistance. This may occur after weather or climate has adversely affected a region in the state. With such limited resources, it is very difficult for State Climatologists to reach other audiences, particularly those who are not aware of the services available to them, and those who could benefit from the services but aren't even aware of the risks they face from weather and climate events. Demand for climate information is growing by leaps and bounds, and even the increased capabilities of the state offices are insufficient to meet these demands.

5. THE OKLAHOMA CLIMATE SURVEY

The Oklahoma Climatological Survey (OCS), home to the State Climate office in Oklahoma, is an example of how climate information can be tailored to specific clienteles. In addition to the "standard" climate databases, OCS operates a statewide network of automated weather stations, called the Oklahoma Mesonet. OCS couples the climatological and meteorological data into tailor-made products, distributed to the public through web sites and through specialized outreach and training programs. The total annual budget for OCS is approximately $3 million, nearly all of it from state sources.

In terms of basic climate data and services, OCS doesn't do things much differently than most other states. OCS maintains an archive of Oklahoma cooperative observer data, severe storm data, national weather service observations for the region, and several publications from the National Climatic Data Center (NCDC). Dissemination relies primarily upon people either browsing web pages or calling up the office requesting data.

What really makes OCS unique is operation of the Oklahoma Mesonet, a statewide network of 115 automated weather stations, with at least one station located in each of the state's 77 counties. The stations, which have 10-meter towers and follow WMO standards, report observations of basic meteorological

variables, plus soil temperatures and soil moisture, every 15 minutes around-the-clock. Data are automatically ingested, quality-assured, and delivered to users via the web and ftp. The core operations for the Mesonet require about $2.1 million per year in operating costs.

One area where OCS has been very successful is in its outreach programs. OCS has three active programs: Earthstorm for K-12 schools; OK-FIRST for state emergency managers, fire, and police; and a program for the state's electric cooperatives. Earthstorm was the first of the three programs, and builds heavily upon Mesonet data. It provides lesson plans for teachers, classroom experiments, data, online resources, and mentors to help school children and their teachers understand basic meteorology and the physics and math behind them (Melvin and Kloesel, 2000). This gives teachers a point-of-contact for questions or assistance, as well as a web site where data can be displayed in formats easily integrated into classroom curricula.

The OK-FIRST program, which provides data, training, and support to state emergency managers, was recognized by Harvard University's Kennedy School of Government as one of the most innovative programs in 2002. OK-FIRST uses Mesonet data and WSR-88D data to provide real-time information to local offices. Numerous success stories have come from the program (Morris et al., 2000; James et al., 2000). Most significantly, on May 3, 1999, OK-FIRST was used to deploy emergency responders and warn people in the path of a deadly tornado outbreak in Central Oklahoma. One emergency manager told of using the system to track a tornado that destroyed a mall and heavily damaged a hospital in the town of Stroud. His warning resulted in evacuation of the mall and removal of people to interior hallways in the hospital before the tornado struck. The successful application of the information in real-time depends upon the training received by the participants, which in turn depends upon the quality of data and communication of knowledge by OCS staff and others.

Other applications have been developed that provide information that does not rely upon the training used by the OCS outreach programs. OCS has become an integral part of the state's drought monitoring activities. Mesonet data are used to provide real-time assessments of rainfall in the state. These data are integrated with historical archives, such as cooperative observer data, to identify regions that are experiencing below-normal precipitation. Data are displayed on web pages that are updated in real-time and monitored closely by officials in state agencies (Johnson et al., 2002). In addition to the precipitation monitoring pages, OCS has recently added access to soil moisture calculations (McManus et al., 2002).

With adequate funding, these activities represent things that can be done in any state. Networks can be installed, outreach programs developed, and products tailored to specific needs of local clienteles can be made. These constitute one aspect of climate services, and can be replicated in any of the other 49 states. It just takes vision, imagination, and a dogged willingness to pursue funding through a variety of venues.

6. A PROPOSAL

As a group, service climatologists have learned to adapt to doing their work with limited funding. But there is an opportunity to think on a grander scale. As John Kingdon (1984) wrote, there come times when the problem, political, and policy streams come together. These "policy windows" open only briefly. Such an instance may be happening now. Issues are being defined in the problem stream: climate variability, human vulnerability, and long-term climate change. Political opportunities are present: renewed federalism, agency reviews, and program evaluation for relevance. But is the policy stream ready? Proposals are already out there, such as the National Climate Service in the Energy Bill, but are they what the service climatology community needs?

As initiatives are defined from within the scientific community, service climatologists need to raise some difficult questions. What is needed, in terms of research and operational products, to close the gap between production of knowledge and its utilization? What are the appropriate roles for each participant – federal agencies, state climatologists, academic researchers, and others? What timeline do we, as a community, need to implement these policies? How much funding will it take to 'do the job the right way'?

One thing that emerges from this discussion is that state offices may play an important role in the future of climate services in this nation, but that awareness is largely absent from federal proposals. As federal agencies seek to become re-engaged in climate services, state climatologists must make sure decision-makers in all arenas are aware of what they do and how they can contribute to the issues before them. Even though the community has existed on shoestring budgets in the past, our history need not confine us. We need to imagine the possibilities, and then pursue those vigorously. A few people were largely responsible for passage of the Global Change Research Act in 1990, bringing billions of dollars annually to the understanding of climate change. Few people thought that would be possible. Given the awareness of climate issues and the political climate in Washington, the time may be right for a similar initiative focused on mitigating societal impacts. And states – and their climate offices – can be a critical part of a successful strategy.

In any proposal that involves State Climatologists, one thing is certain: attention must be paid to their infrastructure. In order to complete the

cycle from knowledge generation to application, the resources available to State Climatologists must be improved. Most State Climatologists rely upon state funding sources, but few have been successful in convincing their state legislatures to provide sufficient funding for climate services. However, states often respond to opportunities for federal match. As a climate services plan is developed, federal matching funds could promote a renewed interest in climate services at the state level. Federal funds, if distributed as a 1:1 matching block grant, would allow state offices to hire additional staff, upgrade communication technology, and undertake outreach efforts to at-risk groups. The matching requirement would also draw state agencies and local private-sector companies into real partnerships to deal with climate and weather risks.

Such a proposal does not require an extensive administrative structure. The existing ARSCO Memoranda of Agreement provide a vehicle for administration of the funds, assuring that funds are spent only in states that have a proven capability to deliver services. Unclaimed funds could be allocated to the Regional Climate Centers to provide services in those states unable to make the commitment.

In order to develop new techniques for packaging information and developing prototypes for information dissemination, additional revenues could be provided to NCDC, to be distributed on a competitive grant basis. This would encourage collaborative projects between State Climate offices, Regional Climate Centers, and NCDC to develop systems that move information from data collection to application. Grants could be awarded using a process similar to that used by the National Science Foundation or other Federal granting agencies.

These resources will help to bridge the gap between knowledge and application. Furthermore, it does so efficiently, using existing formal relationships between federal and state governments. It holds the promise of connecting the local knowledge residing in state offices with the capabilities for seasonal and climate predictions provided by federal agencies. And best of all, it relies upon those who know local needs and have access to local constituencies to translate information into action.

ACKNOWLEDGEMENTS

I would like to recognize Jim Angel, Kelly Redmond, and Josh Foster for their stimulating discussions on climate services. I would also like to recognize Howard Johnson, Derek Arndt, and Gary McManus at the Oklahoma Climatological Survey for their efforts in meeting the needs of Oklahomans for specialized climate services. These ideas grew out of my studies in Political Science, and for that I would like to thank Tom James, my committee chair, and David Morgan, who taught me all I know about federalism.

APPENDIX

Members of the Congressional Natural Hazards Caucus:

Senator Stevens (AK) and Senator Edwards (NC), co-chairs

Senator Akaka of Hawaii
Senator Boxer of California
Senator Breaux of Louisiana
Senator Byrd of West Virginia
Senator Cleland of Georgia
Senator Cochran of Mississippi
Senator Conrad of North Dakota
Senator Dorgan of North Dakota
Senator Feinstien of California
Senator Graham of Florida
Senator Inouye of Hawaii
Senator Murkowski of Alaska
Senator Robb of Virginia
Senator Schumer of New York
Senator Torricelli of New Jersey
Senator Wyden of Oregon

http://www.senate.gov/~edwards/cnhc/index.html

REFERENCES:

Anthes, Rick, 2001: "How can the science community respond to 11 September?" *UCAR Quarterly,* Winter 2001.

Anton, Thomas J., 1989: *American Federalism and Public Policy: How the System Works*. New York: Random House.

Conlan, Timothy, 1988: *New Federalism: Intergovernmental Reform from Nixon to Reagan*. Washington, D.C.: The Brookings Institution.

Crawford, Kenneth C. and Renee A. McPherson, 2002: "The Oklahoma Mesonetwork: Ten Years Later," *18th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology.* American Meteorological Society: Orlando, FL: 310-312.

Elazar, Daniel, 1984: *American Federalism*, 3rd ed. New York: Harper and Row.

James, Thomas E., Paula O. Long, and Mark A. Shafer, 2000: "An Independent Evaluation of the OK-FIRST Decision-Support System," *2nd Symposium on Environmental Applications.* American Meteorological Society: Long Beach, CA, 40-47.

Johnson, Howard L., Derek S. Arndt, Gary D. McManus, and Mark A. Shafer, 2002: "The Oklahoma Mesonet: A Mesoscale Tool for Drought Recognition and Monitoring," *18th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology.* American Meteorological Society: Orlando, FL: J70-J72.

Keeney, Ralph L., 1996: "The Role of Values in Risk *Annals AAPSS,* **545**: 126-134.

Kingdon, John W., 1984: *Agendas, Alternatives, and Public Policies.* New York: HarperCollins Publishers.

McManus, Gary D. Jessica M. Thomale, and Kenneth C. Crawford, 2002: "The Quality Assurance and Dissemination of Soil Moisture Data from the Oklahoma Mesonet," *18th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology.* American Meteorological Society: Orlando, FL: J289-J290.

Melvin, Andrea D. and Kevin A. Kloesel, 2000: "EarthStorm U: Encouraging The Use of Oklahoma Mesonet and ARM Data in Undergraduate Education and Non-Science Major Courses," *Preprints, 9th Symposium on Education.* American Meteorological Society: Long Beach, CA, 139-141.

Morgan, M. Granger, 1981: "Choosing and Managing Technology-Induced Risk," *EIII Spectrum*, **18(12)**: 53-60.

Morris, Dale A., John Lewis, Mike Honigsberg, and Ben Springfield, 2000: "Collaborations Between Meteorologists and Emergency Managers: The Oklahoma Tornado of 3 May 1999. Part 2: Rural Applications of Modern Weather Information during a Disaster," *2nd Symposium on Environmental Applications*, American Meteorological Society: Long Beach, CA, 25-31.

National Oceanic and Atmospheric Administration, 2001: *NOAA's Climate Observations and Services*. Washington, D.C.: U.S. Department of Commerce.

National Research Council, 2001: *A Climate Services Vision: first steps toward the future*. Washington, D.C.: National Academy Press.

Office of Management and Budget, 2001: "The President's Management Agenda". Washington, D.C.: Executive Office of the President.

Peterson, Paul E., 1995: *The Price of Federalism*. Washington, D.C.: The Brookings Institution.

Rivlin, Alice M., 1992: *Reviving the American Dream: The Economy, the States, and the Federal Government*. Washington, D.C.: The Brookings Institution.

Shannon, John, 1994: *Reflections on the Fourth Stage of Federalism*. Washington, D.C.: State Policy Center, Urban Institute.

Slovic, Paul, Baruch Fischhoff, and Sarah Lichtenstein, 1979: "Rating the Risks," *Environment*, **21(3)**: 14-39.

Wise, Charles, 1998: "Judicial Federalism: The Resurgence of the Supreme Court's Role in the Practice of State Sovereignty," *Public Administration Review*, **(58)**: 95-100.