J5.3 A CLIMATE SERVICES VISION – A SECOND LOOK

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Nearly six years after publication of *A Climate Services Vision: first steps toward the future* (NRC 2001), some steps toward a more integrated climate services framework have been taken but little or no progress has been made to meet some critical needs. Modernization of the Cooperative Observer Network languishes and Regional Climate Centers still struggle for their base funding each and every year. On the positive side, research programs have improved our understanding of how climate information is interpreted and used and organizations such as the National Weather Service have become active partners in the provision of climate services.

The NRC recommendations were presented in three sections: (1) promoting more effective use of the nation's weather and climate observation systems; (2) improving the capability to serve the climate information needs of the nation; and (3) interdisciplinary studies and capabilities needed to address societal needs. The related recommendations are presented in each of the sections below with a re-examination of each in the context of an additional five years' experience. This essay then concludes with some thoughts on structuring climate services priorities based on today's political, economic, and social environments.

The comments that follow examine the recommendations from the NRC report from the perspective of an individual employed in a state climate office. The essay is not an authoritative review of climate services; rather it is offered as a perspective of someone who has been involved with many climate services organizations as a starting point for further discussion.

1. DEFINING CLIMATE SERVICES

Climate services are continually evolving in response to a growing understanding of climate combined with a growing appreciation of the intersection of climate and human endeavors. "Climate service" is best thought of as a structured portion of a larger applied earth sciences program, much like "weather service" focuses upon short-term events. Like the weather service, which was established with the purpose of collecting observations and progressed to forecasting, climate services has the potential to move beyond analysis of existing records and develop a more prognostic capability.

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The National Research Council first had to come to a consensus on the meaning of climate services before it could address a framework for its provision. In the report, the Board defines climate services as "the timely production and delivery of useful climate data, information, and knowledge to decision makers." Their review noted a shift from the historical climate services, based primarily on statistical analysis of existing weather records, to a more modern service in which understanding of short-term climate fluctuations and improvements in forecasting have opened new doors of opportunity.

The report stated that the societal value of climate information is dependent upon many factors, including:

- The strength and nature of linkages between climate, weather, and human activities;
- The nature of uncertainties associated with forecasts;
- The accessibility of credible and useful climate information by decision makers;
- The ability of users and providers to identify each other's needs and limitations;
- The ability of users to respond to useful information.

Addressing these issues requires research, data stewardship, product development, and training programs.

Given recent upward trends in demand for climate services and the activities in which various federal and non-federal entities are involved, the report concludes that growth in knowledge of climate and human interactions and technological advances, including communication networks, allow for a transformation of climate services. They envision the emergence of a broader, organized, and sustained environment service, bringing in weather, climate, land-use, pollutants, and other factors that address multiple stresses within regions. The parts act together as a more holistic place-based approach to earth sciences. This requires more cohesive management and integration to integrate data from diverse sources, rather than a diverse set of services for different elements of the earth system

The BASC report outlines five "guiding principles" for the development of a new climate services system:

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; and
5. Climate services require active and well-defined participation by government, business, and academe.

First, the user community is diverse, with a wide range of space and time scales needed. Users are becoming increasingly diverse and knowledgeable, with a commensurate increase in specialized needs. In order to address these needs, evaluation, mutual information, and feedback are needed to improve communication and accessibility of information.

Second, research is needed not just on the fundamentals of climate variability and change, but on diffusion of knowledge and information. This requires a mission-oriented research with active mechanisms to transfer knowledge from research to useful products.

Third, information has to go beyond numbers and prediction; it requires context. Information should be presented from the perspective of the historical record to guide understanding of natural variability and climate change. Predictions should be accompanied by analysis of probabilities, limitation, and uncertainties. Access to knowledge on causes and character of natural variability are necessary. Continuous, accurate, and reliable historical climate observations are needed at diverse locales, and products need to be provided for scales from local to global.

Fourth, observations must be reliable and freely exchanged. The BASC report sites Karl et al. (1995; "Critical issues for long-term climate modeling", *Climate Change* 31:185-221) on data characteristics that make for reliable long-term observations. Reliable data is only the first part of it – making the data accessible is essential. This requires open and free exchange of data, combining observations into useful, multi-purpose records, and assuring synergism between observations, theories, and models. All of this should be driven by a "robust and easily accessible delivery system."

Fifth, the government, private sector, and academia each have important roles in providing climate services. The government should be motivated by "public goods and services", which they describe as non-rival and non-exclusive. These are products that are of a general nature, not for individuals or individual commercial operations. Government should also take the lead role in maintaining the official climate records. The private sector should use the data to meet basic and applied research needs of its users. Academic research organizations should focus on their central mission of research, education, and outreach. Sometimes this may include research data and analysis and product development in partnership with industry towards meeting these goals.

2. CLIMATE SERVICES PARTNERS

The climate services framework today is a dynamic system with multiple points-of-entry. Each member of the framework, formal or informal, contributes to the transfer of knowledge about climate to local stakeholders. Climate services can be as simple as a couple of farmers sitting in the coffee shop discussing what the winter will be like or it can be as complex as formal training programs and product development.

For the purposes of this essay, climate services partners will be construed as those organizations who are primary producers or disseminators of climate data, forecasts, and products. Some agencies, such as the United States Geological Survey (USGS) or Bureau of Reclamation collect data that are important to climate services providers, but at present their involvement in a formal partnership has been limited. A look at the members of the formal climate services partnership and some others with substantial historical involvement in providing climate services follows.

A formal partnership has existed between state climate offices, regional climate centers, and the National Climatic Data Center (NCDC), under the auspices of the American Association of State Climatologists (AASC). Within the past five years, two other organizations have joined this partnership: the National Weather Service (NWS) and the Natural Resources Conservation Service (NRCS). Both have historical involvement in climate services and had been involved with the AASC on an informal basis nearly since its inception.

State Climate Offices: Many state climate offices bring years, if not decades, of experience in reaching individuals and local communities. The perspectives and local expertise that such programs deliver, particularly with regard to blending information to meet particular needs, is a tremendous asset to the partnership. Many State Climatologists serve on state boards or task forces, which provides inroads to key decision-makers. Their biggest limitations are resources and time, but through partnerships with their states' NWS Forecast Offices, NCDC and the Regional Climate Centers, and other organizations they are able to make a little bit of funding go a long way.

Regional Climate Centers: The regional climate centers have developed capabilities to manage large climate datasets and tools for query and access to historical archives. In addition, they also provide user services, issue reports and analyses of weather and climate events and trends in their respective regions, and can fill in for states without active state climate programs. They are a key integrator of information through development of the Applied Climate Information System (ACIS).

National Climatic Data Center: NCDC is the national repository for climate and weather information. They, like the regional centers, provide summaries and assessments and tools for extracting information from the archives. Their close collaboration with regional and state offices provides a seamless conduit between national archives and local consumers. Adding forecasts and outlooks to this data stream enhances information reaching local constituencies.

The National Weather Service: The National Weather Service builds upon an existing, robust information dissemination system, represented by the partnership, to reach local constituencies, where information is used and decisions are made. Unlike NCDC and the RCCs, the NWS has a local presence through their Forecast Offices. Each forecast office has a climate focal point to interact with the regional Climate Services Program Managers and other climate service providers and consumers. However, the focal point position is only half-time, at best, and multiple duties limit the ability of many offices to spend much time developing products and services and reaching out to stakeholders. Even so, the forecast office's 24/7 operations provides a highly visible conduit for information to local citizens.

Natural Resources Conservation Service: The NRCS has been a long-time climate services provider through their local offices and through the National Water and Climate Center. The NRCS relies upon high-quality climate data for their assessments of local climate variability and for their streamflow forecasts in the West. They operate networks as well as integrating data from multiple networks and providing advice to local and state officials.

Regional Integrated Science and Assessments Program: The RISA program supports integrated, place-based research across a range of social, natural, and physical science disciplines to expand decision-makers' options in the face of climate change and variability at the regional level. RISA teams are comprised of researchers from the physical, natural, engineering and social sciences who work together and partner with stakeholders in a region to determine how climate impacts key resources and how climate information could aid in decision-making and planning for those stakeholders. It opens new conduits for the flow of information and documents practices for providing services that can lead to improvement across the whole climate services enterprise.

Cooperative Extension Service: The nation's Cooperative Extension Service (CES) has been in the climate services business longer than any provider, but is often overlooked as a key provider. For more than a century, Cooperative Extension has been improving land management practices through the provision of training, fact sheets, and research. Climate is a key consideration in many of these activities.

Private-sector providers: In addition to the federal and state efforts, a growing private sector also is involved in weather and climate services. The American Meteorological Society lists over 550 Certified Consulting Meteorologists and notes more than 250 private weather firms on their website. From constructing storm water runoff lagoons to building skyscrapers to testifying in court cases, consultants provide an important translation of climate information into general practices and offer expert advice.

Together, these partners, both formal and informal, contribute the following in a system of climate services:

- Data collection and stewardship;
- Ability to develop specialized products and services;
- Active outreach programs to climate-sensitive sectors;
- Communications capabilities, including relationships with the media;
- Educating stakeholders regarding climate issues;
- Applied and basic research; and
- Liaison to external decision-makers.

Improving the effectiveness of these partners will enable those who are affected by climate or weather to make better decisions about their risks and activities.

3. NRC RECOMMENDATIONS REVISITED

The National Research Council's report offered recommendations in three broad categories, with several specific recommendations within each:

1. Promote more effective use of the nation's weather and climate observation systems.
   - 1.1 Inventory existing observing systems and data holdings;
   - 1.2 Promote efficiency by seeking out opportunities to combine the efforts of existing observation networks to serve multiple purposes in a more cost-effective manner;
   - 1.3 Create user-centric functions within agencies;
   - 1.4 Perform user-oriented experiments;
   - 1.5 Create incentives to develop and promote observation systems that serve the nation.

2. Improve the capability to serve the climate information needs of the nation
   - 2.1 Ensure a strong and healthy transition of U.S. research accomplishments into predictive capabilities that serve the nation.
   - 2.2 Expand the breadth and quality of climate products through the development of new instrumentation and technology.
   - 2.3 Address climate service product needs derived from long-term projections through an increase in the nation's modeling and analysis capabilities.

2.4 Develop better climate service products based on ensemble climate simulations.

3. Interdisciplinary studies and capabilities are needed to address societal needs.
   - 3.1 Develop regional enterprises designed to expand the nature and scope of climate services.
   - 3.2 Increase support for interdisciplinary climate studies, applications, and education.
   - 3.3 Foster climate policy education.
   - 3.4 Enhance the understanding of climate through public education.

With regards to the first set of recommendations on effective use of observation systems, the most notable development has been creation of the Applied Climate Information System (ACIS). ACIS is essentially a large, linked database that synchronizes data holdings between NCDC, the Regional Climate Centers, and the NWS. A set of query capabilities and products are associated with ACIS, assuring that system users will be using the same information regardless of point-of-entry into the system.

Presently, ACIS concentrates upon NOAA data holdings, although there is development on other federal and non-federal networks. ACIS is far from the integrated system required for easy applications, but it is a strong start toward that goal. Challenges remain in integrating data from networks with different sensor types, biases, precision, and metadata. To be a truly complete archive, ACIS needs the capability to integrate data from any network, apply any adjustments to the observations needed to produce a consistent set between networks, and apply quality-assurance to all observations. ACIS also must move beyond temperature and precipitation products to provide other important climate variables, most notably moisture, winds, solar radiation, and soil moisture.

On most other recommendations within the first group, progress has been minimal at best. There still exists no inventory of data networks and holdings. The Office of the Federal Coordinator for Meteorology (OFCM) was mentioned as “an agent” for the conducting such an inventory, but most OFCM efforts appear targeted toward specific groups, such as space weather or road weather needs. There has been no such comprehensive review of observing systems as envisioned in the NRC report.

Arguably the most detailed assessment came out of the “Goal 2” group associated with the National Drought Policy Commission (2000). One of the Commission’s recommendations was to “maintain, modernize, expand, and coordinate a system of observation networks that meets the needs of the public at large.” Several federal and non-federal agencies participated in the undertaking, producing an analysis of existing networks and identifying needs for improvement. Some efforts continue from this group through the present National Integrated Drought Information System (NIDIS) initiative (2004).

Another initiative is the National Oceanic and Atmospheric Administration (NOAA) created their initiative for a “Global Earth Observation System of Systems” (GEOSS). However, GEOSS’ focus seems to be on satellite-based systems and global exchange of data. It does little to address coordination of existing surface-based networks, which are critical to the supply of climate services.

The National Weather Service (NWS) adopted a formal plan to modernize the Cooperative Observer Network (2004), but its implementation has to date fallen far short of its stated goals. The plan recognized the existence of other networks and called for consideration of those sites when planning for locations for modernized cooperative observer sites, and in some cases this appears to have been done. However, data from the “modernized” coop network consists only of observations obtained directly from the National Weather Service sites.

One cause for the lack of integration is the lack of leadership within agencies. Each network is operated largely autonomously of others. Although managers are cognizant of other applications for the network data, they tend to be driven by the host agencies’ mandates. For example, SNOTEL is designed for water supply forecasting. Even though the information from SNOTEL are quite valuable for a wide range of applications, including research on climate change at high elevations, there is no common, publicly-accessible data archive that brings together SNOTEL observations with historical cooperative observer data, for example.

A major barrier to integration is the funding basis for network operations. Each agency allocates a portion of its budget to operating networks to meet specific needs of their agency. While pooling operations requirements and maintenance costs would increase efficiency, it would also limit the ability for agencies to stipulate requirements for the network. Plus, there may be concerns that a portion of their budget would be going to fund other agency’s operational network. A long-term strategy to address concerns such as these needs to be developed before an integrated network design can emerge.

More success has occurred in some of the other recommendations. Advancements in both the capability to provide climate services and in interdisciplinary research have occurred since 2001. Three major organizational advances in climate services have occurred within the last several years. One is the maturation and expansion of the RISA Program. RISA has contributed to the body of knowledge about how climate information is conveyed, received, and utilized by key stakeholder groups. These findings should be used to construct improvements in the products and

services provided by federal agencies and state climate office services.

A second advancement was the creation of the National Weather Service's Climate Services Division. The new Division concentrates resources on the provision of climate information, from basic observations to advanced knowledge, to local users. The Division successfully engineered the commitment of a Climate Services Focal Point in each of the field Forecast Offices. Although this person is usually tasked with multiple duties, some of the Focal Points have excelled in the creation of new products and services, in particular in downscaling seasonal forecasts produced by the Climate Prediction Center. The Division also created a training program to benefit not just the Focal Points, but other staff at the Forecast Offices as well.

The third advancement was a strengthening of the requirements for State Climate Offices. The American Association of State Climatologists (AASC) established a common set of activities and capabilities required of each state climate office. To become an AASC-Recognized State Climate Office (ARSCO), an office must be housed within an accredited state university, state environmental agency, or other appropriate state agency, and must demonstrate the necessary communication capabilities, information services, research, outreach, and monitoring and impact assessments. Although each state is independent and may select a state climatologist by any means they choose, the requirements have introduced more technology and visibility into many state offices.

Nearly simultaneous to the new ARSCO requirements, the AASC expanded the formal partnership, already in existence between the State Climate Offices, the Regional Climate Centers, and the National Climatic Data Center. The National Weather Service and the Natural Resources Conservation Service (NRCS) are now recognized as formal partners.

Within the NOAA Climate Office, new programs such as Transition of Research Applications to Climate Services (TRACS) as well as continued support of the Sector Applications Research Program (SARP) and the RISA program have contributed to better understanding of how stakeholders use climate information. These studies are often at a regional, state or local level, allowing each study to capitalize upon unique circumstances to the area. For example, the Climate Assessment of the Southwest (CLIMAS) can make use of seasonal predictions when there is a strong El Nino or La Nina signal, whereas other parts of the country may have insufficient skill to reliably make predictions upon which providers may capitalize.

In addition to programs sponsored by the NOAA Climate Office, there have been more education and outreach opportunities related to policy and climate education. The American Meteorological Society launched their Atmospheric Policy Programs' Summer Policy Colloquium in 2001, and demand continues to grow annually. Programs such as this are raising awareness within academic institutions and federal agencies of the intricacies of the policy process and the need for interdisciplinary studies. Several universities have created "clusters" focusing on problem areas which bridge beyond the physical sciences.

The most difficult challenge among this set of recommendations has proven to be limitations of forecast skill. Although seasonal forecast skills have improved, the improvements remain tied to regional signals, most often in association with ENSO events. Thus, even though the climate services community is positioned to provide more forecasts as well as observations, the high uncertainty of the forecasts limits their utility. Even so, new products such as downscaled seasonal forecasts or translating probabilities into odds of actual conditions have expanded the application of seasonal forecast information to end-users.

4. THE NEXT STEPS?

The climate community has made tremendous advancements in its organization, integration, and relevance over the past five years. The increasing opportunities for interaction are an encouraging sign. More National Weather Service employees show up at annual AASC meetings now, creating new awareness of products and services that are available to them. The annual Climate Prediction Applications Science workshops draw people from multiple provider groups into an extended discussion of products, services, and sharing of lessons learned.

As the NRC report offered "first steps toward the future", this essay now offers some next steps along that path. First and foremost along this path, it is necessary that, as a community, we transform our perspective from one of organizations to one of functions. Too often, organizational boundaries interfere with efficient and effective services. Agencies worried about turf and arguments over who should fund activities may lead to paralysis.

While it is difficult to set aside organizational lenses, it is not impossible. Such a perspective was achieved during the drafting of the National Integrated Drought Information System (NIDIS) proposal. NIDIS was able to succeed because it was driven by an organization with no vested interest in the organizational provision of services. The Western Governors' Association acted as a catalyst, picking out the pieces of agency functions that contribute to a robust drought monitoring and management system. Although whether it can successfully surmount those organizational issues during its implementation remains to be seen, a similar process regarding the overall climate services enterprise may be worthwhile.

Some possible integrating functions include:

Data archives and quality-assurance. The heart of climate services has been the ability to access and manipulate data. Many federal agencies collect observations important to climate services. In addition, a proliferation of state-run and private networks provides even more opportunities to assess climate on local or regional scales. Even if these networks remain run independently, the data can be integrated into a common archive. A detailed plan for such integration is required, one that will address proprietary concerns, site and sensor standards, required metadata, adjustments required to provide a common dataset (e.g., maximum and minimum temperature from the Cooperative Observer Network may not correspond precisely with a state-run network with different times of observation), and quality-assurance procedures. ACIS is the prime opportunity to perform these functions, but it must be expanded beyond NOAA networks and include other essential variables.

Forecasts and outlooks. Climate services today is as much about anticipating seasonal and longer-term climate as it is about retrospective assessments of past climate and variability. While climate forecasts have limited skill, there are opportunities to capitalize upon what is available. Thirty-day forecasts can support decision-making, such as when to apply pesticides on crops or scheduling construction projects. Seasonal forecasts may provide clues that can allow agricultural producers to shift market strategies to either lessen risk or increase gains from advantageous conditions. A major barrier to utilization of forecasts on these scales have been their probabilistic nature, but new techniques in downscaling forecasts, such as done by the NWS Climate Services Division, or translating into odds, such as offered by several state climate offices, transform the forecasts into useable information.

Products. Each climate services provider has its own sets of products. This can create unnecessary duplication, but it can also lead to innovation. The key is to convince providers that they do not need to produce a whole suite of products themselves. The AASC should lead an effort to define a common suite of products that could be produced in ACIS. This would free up resources among the state climate offices to provide new products and services, or to tailor information to local clienteles. Furthermore, it reduces the chance of someone obtaining different numbers from different providers for a similar product.

Stakeholder Services. Like products, each provider has an associated set of services. Partnerships between the various providers can utilize an existing infrastructure of services to reach a target audience. For example, partnerships between NCDC, the state climate offices, and Cooperative Extension can enable the delivery of climate assessments to county-level decision-makers. Collaborative development of training materials can improve the effectiveness of services provided at local levels, without federal agencies having to directly undertake new provision of services. Similarly, lessons learned from local and state organizations can be shared to develop or improve national training methodology.

5. REVISITING SOME AASC IDEAS

Several years ago, a group of AASC partners examined climate services from the perspective of their partnership. While no formal document was adopted, many of the concepts conceived in that process provide a nucleus of specific actions that can move from the generalizations of the NRC report to specific and targeted improvement in services.

Successfully meeting today's demands for climate services is hindered by a plethora of data sources and formats, many of which contain data of unknown quality. Although significant funds have been directed to climate research in the past decade, there has not been an equivalent investment in climate services that deliver products to those whose decisions affect the economy and welfare of this country. Each of the climate services providers discussed previously brings different strengths to the table. Combining their expertise and resources, it is possible to move forward quickly on a number of critical issues. The concepts presented below are an updated version of those offered by the AASC group in 2003.

Continue to improve the quality of historical data archives. Climate data archives are essential to understanding past climate, modeling climate change, and assessing ranges of climate variability. At present, some of the most important historical climate archives have not undergone satisfactory scrutiny to assess their validity, contributing to uncertainty in climate understanding and predictions. Specific actions that could improve the archives include:

- Complete the climate data modernization program to digitize climate records and improve access to them;
- Create comprehensive descriptions of both historical and current observations, including instruments, locations, observing procedures, and surroundings;
- Evaluate data sources to identify discrepancies between observing systems and develop data sets that correct for these discrepancies;
- Conduct independent examinations of climate records to assure data quality.

Facilitate access to information. Climate information is stored by a multitude of entities, both federal and state, in a variety of formats. Without standards, comparison between data sets and comparing scientific results becomes problematic. The lack of standards makes it difficult for stakeholders to locate important climate information and combine information from different sources. To create an integrated data system:

- Modernize the cooperative observer network to provide timely, local information, while maintaining

the continuity of the nation's historical climate network;
- Integrate data from other federal, state and cooperator climate networks with existing climate databases;
- Establish a common set of Internet-accessible products (observations, outlooks, and summaries, both text and graphical) and services through the climate services partnership;
- Develop a common computing infrastructure and climate database that will be accessible to each state climate office qualifying as an ARSCO, similar to XM-ACIS provided to local NWS Forecast Offices;
- Create a distributed library for climate information, accessible via the Internet;
- Develop standard procedures for providing climate data.

Enhance local capabilities to provide climate services. Most users of climate information are more familiar with state agencies and county-level facilities than they are with federal organizations. Consequently, these facilities are the primary point of initial contact. However, many state climate offices do not have access to the climate information they need to help these people, or have difficulty handling the increasing number of requests for information. To address these challenges:
- Provide federal matching funds to state climate offices qualifying as an ARSCO for technical staff, a climatologist, and an outreach coordinator to maintain local climate data archives and systems and to improve services provided at the local level;
- Provide federal funding to state climate offices not qualifying as an ARSCO in order to establish the necessary capabilities to serve local clientele. State climate offices would be required to obtain ARSCO certification within two years of initial funding;
- Encourage routine interaction between state climate offices and climate focal points in nearby NWS Forecast Offices to enable seamless provision of services regardless of the point-of-contact for the information request. Cross-training of personnel should be conducted where possible;
- Develop and conduct training workshops for USDA, Cooperative Extension, and other state or federal personnel to help them understand where to find and how to apply climate and weather information and allow climate office personnel to better understand needs of local users.

Integrate diverse data sources. The number and types of observing systems have increased over the past several decades. Each network is developed with a specific purpose or clientele in mind, but the data are useful to a wide variety of applications. To achieve efficiency in using data from multiple sources, standards, formats, and data quality must be consistent:
- Complete installation and operation of the Climate Reference Network;
- Expand the Applied Climate Information System (ACIS) to include all relevant federal and non-federal observation systems. The database should include information about the characteristics of the network and observing sites. All data in the repository should be public;
- Adjust observations to account for sensor and network characteristics and biases to create common fields of important variables while retaining the original observations in the archive;
- Apply common quality-assurance to all variables in the archive and adjusted observations;
- Provide funding for non-federal networks to collect documentation on observation sites and to develop a common data format for inclusion in the archive;
- Create an equipment maintenance fund to support non-federal networks that contribute data to the archive. The fund should include resources for upgrading observation sites to consistent standards and guidelines, replacing defective sensors, and periodic rotation and re-calibration of field sensors.

Expand knowledge of the climate-environment-society interface. Climate is only one, albeit very important, piece of our climate vulnerability puzzle. Climate information must be placed within the context of human and environmental activities. Information must reach decision-makers in a format and framework that integrates well into their activities. Activities should be continued or expanded in the following areas:
- Conduct regional assessments of vulnerability and risk;
- Carry out assessments in all states and perform more detailed analysis in the most critical areas;
- Coordinate with federal, state or local organizations as needed;
- Undertake evaluations of climate services to better understand how climate information is transmitted to and used by stakeholders;
- Continue research programs in decision-making, communication, education, and other social sciences to support transfer of knowledge from the physical sciences community.

The end goal of these recommendations is to create a dynamic climate services system with multiple-points of entry and shared information. A user should be able to find information easily with minimal referrals. Jurisdictional boundaries in providing services must be eliminated.

The system design should recognize the varied expertise of each of the providers and build upon the strengths of each. State climate offices have decades of experience at meeting specific needs; this expertise can be an asset to new Climate Focal Points in the NWS Forecast offices. Similarly, state climatologists should recognize the ability of county-level Cooperative Extension and NRCS offices to reach new beneficiaries in a way that their offices cannot.

All of these things will not happen spontaneously. Some organization needs to take leadership over this process, much the way the Western Governors' Association did for drought. Perhaps the AASC can bring parties to the table to work out jurisdictional issues. Until some organization takes the lead, there will continue to be incremental advances in areas in which consensus can be garnered, but the key issues of network integration and funding inequities will continue to hamper efficient provision of climate services.

ACKNOWLEDGEMENTS

Although the thoughts expressed here are my own, I am grateful to the many conversations I have had with experts in climate services over the years. In particular, I want to thank the wonderful insights of Phil Pasteris, George Taylor, Jim Angel, and Don Jensen. I would also like to recognize the excellent work and ideas that inspire me daily from my colleagues at the Oklahoma Climatological Survey – Ken Crawford, Deke Arndt, Gary McManus, Andrew Reader and Andrea Melvin.

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