Climate Sensitive" Regional Integrated Sciences and Assessments (RISA) Research: Origins, Development and Future

By Harvey Hill, Roger Pulwarty, and Claudia Nierenberg, Abstract: 71184

Introduction:

Since 1991 NOAA's Office of Global Programs (OGP) has supported climate sensitive research activities that advance integrated research methodologies while expanding decision makers' options. A key component of the NOAA/OGP contribution to this approach has been the support of the Regional Integrated Sciences and Assessments Program (RISA). The RISA program funds integrated teams of natural and physical scientists primarily based at academic institutions that work with end users to address complex climate sensitive issues relevant to regional and local decision-makers (Pulwarty, 2001). This paper describes the development of the RISA program and compares and contrasts insights gained by the program with similar integrated research experiences in Australia.

Development of the RISA program

Until the 1980's seasonal forecasts were not accepted as feasible for many parts of the world (Ropelewski and Halpert 1986, 1987, 1989). Though advances in seasonal forecasting showed promise research in the 1980's research and anecdotal evidence indicated that decision makers would not adopt ENSO based seasonal climate forecasts without research to identify what climate information was spatially and temporally relevant to decision makers' management processes (Glantz 1982; Lamb 1981;; Sonka et al. 1982). Prior to the development of ENSO forecasts there was evidence climate information could be linked to decision-making by integrating the efforts of natural and social science (White 1945; Burton and Kates 1964; Glantz 1974). What was innovative as ENSO events became possible was the expectation by research funding agencies that integrated research could be extended beyond being an academic exercise and to be genuinely "useable" or applicable to decision makers' needs.

Based on the desire for useable science the U.S. Congress, in 1990, began funding the United States Global Change Research Program (USGCRP) with the goal of conducting integrated basic and applied science to aid policy makers respond to climate change and variability. Its guidelines were to: *a) integrate science into policy processes, b) maintain a partnership among all participants, and c) focus on interdisciplinary science and interactions* (USGCRP 1991). Over its first 3 years NOAA's Office of Global Programs funded natural and social science research in academic institutions to contribute to the USGRCP goals with a primary focus on seasonal variability. The research evolved to support comparative regional integrated assessments of climate change and seasonal variability interaction with significant regional environmental issues.

Practical reasons for this included a crisis in the U.S. west coast salmon in 1994 (DOC/NOAA) and a workshop on climate variability held in the Pacific Northwest in 1995 that illustrated the demand for seasonal forecasts. There was also an increasing awareness that global coupled models provided only limited utility to decision-makers, there was a growing interest in ENSO forecasting, and mounting evidence that an integrated research effort would need to include ecologically-defined regions relevant to decision makers.

Given the results of the first three years of funded research and the experiences with end users it was decided to increase funding for integrated social and physical science research teams focused on decision support. Plans were made to establish 2-4 integrated impact assessments projects/experiments across the United States. Each team was to be established at academic institutions ideally with cooperative agreements with NOAA to facilitate communication between the federal and academic systems. The academic institutions have been a mixture of grant and non-grant (extension) institutions. Between 1997 and 2003 eight RISA experiments were established: The Pacific Northwest (1997), Southwest (1997), California (1997), Florida/Southeast (1998), Colorado (1998), New Hampshire/New England (2001), The Carolinas (2003), and Hawaii (2003). Each effort was, or is being, treated initially as an experiment to identify effective means of conducting integrated regional climate sensitive research in their region. Each team is expected to assess the region in which they are situated to define the physical and social context in which regional decision-makers work.

Based on the teams' assessments their research has primarily focused, or is expected to focus on integrating knowledge of the climate-society interactions and the development of climate relevant decision support tools. Efforts have tended to concentrate on risk assessment and management in the water resources sector; agriculture, public health, wildfires and fisheries. An in depth description of each teams' activities can be obtained by accessing www.risa.ogp.noaa.gov. Given the reliability of ENSO-related impacts the temporal scale in which the teams have worked on in their early stages has been primarily seasonal. The Pacific Northwest team has pioneered the use of decadal scale information in water and fisheries management. In addition, the teams along the west coast of the United States have been involved in linking global coupled model forecasts of expected long term snow water equivalent availability to water management planning. Paleo-climate research has also been explored as a tool in water and wild fire management planning.

The teams have been involved in the development and implementation of State drought plans, seasonal wildfire forecasting, agricultural threat forecasting, and the development of stream flow forecasting, and information communication and dissemination tools.

The Australian Experience

The Australian climate is primarily arid yet has one of the highest variability in annual precipitation observed due to its location in the southern hemisphere, and its exposure to the El Niño - Southern Oscillation-related impacts. The high climate variability observed in Australia inevitably leads to the regular occurrence of harsh droughts often associated with El Niño events and less frequently high rainfall linked to La Niña events (White, 2000).

In addition to the variable climate Australian agriculture is very sensitive to environmental change and market fluctuations as it is extensive and unsubsidized. Consequently, Australian producers tend to be early adopters of new technologies, including information technologies. They are, however, because of the, low cost, unsubsidized structure of Australian agriculture reluctant to invest in technologies that hold a low probability of being of value (Ibid).

These factors led to the establishment in 1990 of the Agricultural Production Systems Research Unit (APSRU) as a joint research unit of the Queensland Government, the Federal research agency CSIRO, and the University of Queensland (UQ) http://www.longpaddock.qld.gov.au/. The APSRU scientists approach the incorporation of climate information into agricultural management processes as part of a larger system (Meinke and Stone). The APSRU team extracts the benefits of climate information via participatory, cross-disciplinary research linking, disciplines, and individuals (scientist, policy makers and direct beneficiaries) as partners.

Under this approach climate science provides insights into climatic processes, GIS based agricultural systems science then translates those insights into management options that agricultural economists and sociologists identify the feasible options from a socio-economic perspective. Meinke and Stone (2002) conclude the probability of climate forecasting becoming one of a number of risk management tools playing important roles in decision-making increases when delivered within such a framework.

Knowledge gained from the APSRU research approach contributed to Australia's drought response policies. Ratified in 1992 the policy acknowledged drought to be a normal feature of the Australian environment. The policy encourages agricultural producers and other segments of rural Australia adopt self-reliant climatic variability management strategies that maintain and protect the Australian agricultural and environmental resource base during periods of climatic stress. (O'Meagher et al. 1998; 1999).

Comparisons and Contrasts

The two approaches exhibit varying degrees of similarity. However, the complexity of legal and institutional arrangements produces different results. The primary funding for the RISA programs is NOAA the Federal agency responsible for climate research. The academic institutions involved are a mixture of land and non land grant universities. Government and private sector funding provide funding for APSRU. It is shared between a set of the state of Queensland agencies responsible for applying research to expand agricultural producers' options, the country's Federal research entity (CSIRO), and the University of Queensland.

Both systems produce high quality research recognized in peer-reviewed journals. One difference is emphasis on the research focus. In the United States most RISA funding comes from NOAA, and some funding from USDA, State and municipal agencies such as the California Energy Commission, The Florida State Legislature, Idaho Department of Water Resources, Seattle Power and Light and very little from the private sector (Bonneville Power Authority). As a result RISA research focuses on public sector decision makers such as water, endangered species, wild fire, and public health managers. The exception is agriculture where research very similar to the APSRU approach has developed in the Southeast and to a lesser degree in Arizona and Colorado, in part, due to the land grant institutions associated with the research.

The temporal and spatial characteristics are quite different facing the two groups. The research in the United States spans widely varying topographies, regional climate predictability, ecosystems, and resource management sectors particularly in the public sector. The Australian effort is focused on a region with a strong ENSO signal, a single sector (agriculture), a specific region, and a robust decision-maker interaction with the private sector. While there has been some expansion into other parts of Australia the primary focus has remained on Queensland.

The source of funds also differs for the two programs. Traditionally in the U.S. funding has come from NOAA. Certain teams have succeeded in leveraging their NOAA resources with funds from other Federal and State agencies. In Australia research is funded much more by joint producer government research arrangements. A significant source of funds for such entities is commodity check off programs along with the taxpayer-funded programs. Naturally these entities provide very clear feedback to the researchers of the research needs of decision-makers. There is no equivalent type of funding source for the RISA teams in the U.S. with the exception, possibly, of the utility check off funding provided by the California Energy Commission.

The type of climate forecasting techniques also differs. The U.S. RISA teams have explored the use of paleo-climate, seasonal, decadal, and centennial climate information. They have also utilized dynamic seasonal forecasting models in ensemble forecasts along with statistically based forecasting tools. Whereas the APSRU group have focused on the use of statistically based Southern Oscillation Index forecast tools due to the extremely strong ENSO signal observed along Eastern Australia. Both accept the need to move increasingly away from tercile style forecasts to forecasts that provide a clearer statement of the probability distribution of a forecast of the variable relevant to decision makers such as yields, stream flow, etc.

The systems research approach taken by the APSRU group is highly quantitative, systematic, and is highly focused on a specific sector. The RISA teams also follow a similar approach, however, they are developing the methodologies required to advance systematically in some sectors where climate prediction is just now being introduced.

Transferring the research and policy findings into operational contexts also differs. Extension services in Australia are privatized hence some of the products developed are being successfully licensed to private extension agents. Other products such as a precipitation database, Rain Man, have been marketed through the relevant State agency.

The U.S. climate service is still very much embryonic. RISA teams are collaborating with a wide range of operational entities including Regional Climate Centers, State Climatologists, the National Weather Service, the National Climate Data Center, and the River Forecasting Centers. They also work increasingly closely with the Interagency Fire Center to refine national seasonal climate based wildfire forecasts. Extension services in

Florida and Arizona are developing tools and methods to disseminate climate information via state cooperative extension systems in conjunction with the regional RISA teams. These steps though important are not complete. American public and private climate service activities are evolving. The role the RISA teams will ultimately play in facilitating the transfer of climate sensitive decision support tools to operational environments is co-evolving with that process.

Conclusions

Attempts to achieve climate sensitive integrated research/applications are beginning to bear fruit. Examples include work by researchers in Australia and the United States. In Australia efforts have been focused on the link between seasonal climate forecasts and farm level agricultural management (Meinke and Stone, 2002). In the United States much of the effort has focused on water, wild fire suppression, and agriculture management. The research in both countries confirms the validity of integrated research efforts to ensure climate information is of value to end-users.

The U.S. experience is advancing our understanding of how to incorporate climate information into public sector decision-making processes and to some degree the private sector particularly in terms of quantitative agriculture decision support tools and information dissemination. The Australian experience is advancing our knowledge of the systematic use of climate forecast in highly sophisticated quantitative simulation systems that are highly calibrated to the needs of private sector agricultural producers. The Australian experience is also providing insights into innovative private-public partnerships to fund this type of research and disseminate the applications. Both efforts are experiments in understanding how scientific knowledge may be most effectively developed within decision-making frameworks.

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