The following is a summary of the 2004-2009 research project entitled

Integration of Climate Variability and Forecasts into Risk-Based Management Tools for Agricultural Production and Resource Conservation

PROJECT TEAM: Jurgen Garbrecht, Jean Steiner, Xunchang Zhang, Jeanne Schneider, John Daniel

PROJECT SUMMARY

In the Southern Great Plains, climatic variations are pronounced and often result in environmental impacts and annual agricultural production losses exceeding $1 billion. Recent advances in our knowledge of climate variability and predictability have the potential to provide critical planning support for farmers, ranchers, agribusiness and natural resource managers. This project proposes to: (a) develop risk-based decision tools that take into consideration climate variations and forecasts in practical decision applications in agriculture and natural resource management; and (b) demonstrate climate-related decision and application opportunities for a livestock grazing enterprise, and a reservoir water-level management plan. The guiding principle underlying this project is the bridging of the gap between emerging climate-science knowledge and application-specific climate information and decision tools that are related to real-life applications and acceptable to producers and resource managers. This interdisciplinary project relies on direct customer involvement in all phases of the project, and success will be measured in terms of user adoption of climate-related decision information. Customer endorsed measures of climate variations and forecast performance will be made available to producers, resource managers, extension specialists, and the public via the world-wide-web. Anticipated benefits from this project include climate-optimized management decisions and reduction of risk, as well as risk-based decision-making approaches, and case demonstrations. This research also addresses priority questions in the Strategic Plan for the U.S. Climate Change Science Program and will provide a science foundation for decision-making and policy development.

OBJECTIVES

The overriding goal of this project is to develop new tools and demonstrate applications of climate variability and seasonal forecast information in agricultural production and resource conservation to benefit ranchers, farmers, and resource managers. The specific objectives are organized in two categories: 1) development of application-relevant indices and decision tools that consider climate variations and seasonal forecasts; and 2) development of case applications that demonstrate the use of decision tools and decision impacts of climate variations and seasonal forecast information.

Objective 1: Characterize and quantify multi-year regional climate variations and NOAA's seasonal climate forecasts at scales relevant for impact assessment and decision making in agricultural and conservation management, specifically:

Sub-objective 1a: quantify patterns and trends in multi-year regional precipitation and air temperature variations in the Southern Great Plains, and develop related decision support information.

Sub-objective 1b: develop application-relevant indices of forecast utility for the contiguous U.S., spatially downscale and temporally disaggregate forecasts to application scales, and develop probabilistic decision support tools.

Objective 2: Integrate multi-year climate variation and seasonal forecast information into planning and management of agricultural enterprises and natural resources, specifically:

Sub-objective 2a: evaluate management options for central Oklahoma farm enterprises under a range of climate forecast scenarios, including those related to winter wheat establishment, fall grazing opportunities, optimal forage utilization and risks.

Sub-objective 2b: demonstrate the contribution and use of multi-year climate variations and seasonal forecasts for management of water levels in a large, multiple-purpose reservoir in southern Oklahoma.

NEED FOR RESEARCH

Description of problem.

In the Southern Great Plains, seasonal, year-to-year, and persistent multi-year variations in precipitation and air temperature are pronounced and often result in environmental impacts and agricultural production losses on the order of several billion dollars (National Drought Policy Commission, 2000). Losses affect farmers and ranchers, the economic well-being of rural communities, and the natural resource base through soil erosion, nutrient movement, water shortages, and floods. In the past, the unpredictable character of climate and weather limited our ability to optimize agricultural production under favorable climatic conditions, and to mitigate agricultural and environmental impacts under adverse conditions. Farm planning and management decisions generally were reactive and conservative, and opportunities for diversification, greater profits, and enhanced environmental stewardship were missed. Recent advances in our knowledge of climate variability and predictability have the potential to provide critical planning tools for farmers, ranchers, agribusinesses and natural resource managers. Research is needed to establish potential benefits gained from consideration of multi-year regional climate variations and seasonal climate forecasts in agricultural production and natural resource conservation. The recent advances in climatic knowledge provide new opportunities to develop tools that incorporate probabilistic climate information for farm and conservation decisions. This multi-disciplinary research seeks to bridge the gap between emerging climate knowledge, application-specific climate information and decision methodologies that are relevant for real-life applications and accepted by producers and resource managers.

Potential Benefits.
Integration of climate variability and seasonal forecast information into risk-based decision tools will provide agricultural producers and natural resource managers with expanded capabilities to: (1) optimize agricultural profitability under favorable forecasted and multi-year climate variations; (2) reduce risk by proactively mitigating negative impacts of climate variations; and (3) meet resource management and conservation goals under variable climate.

Anticipated Products.
This project will provide proofs of concept and demonstrations of the potential utility of multi-year climate variations and seasonal forecasts in decision making. We will produce a brochure and web-based information for producers and resource managers that contain graphical displays of NOAA's seasonal forecast performance characteristics by regions, seasons, and forecast direction (e.g., wet or dry) to help determine when and where the forecasts have highest potential. Products will include graphical displays of multi-year precipitation and air temperature variations for the sub-humid stocker regions in Oklahoma and Kansas, and will be by year, calendar season, and growing season for winter wheat and relevant periods of water resources operations, as determined by customer input. The project will deliver to the hydrologic modeling community a weather generation computer program that accounts for precipitation and air temperature variations and forecasts, and Artificial Neural Network software for streamflow prediction. The project will provide guidance and produce demonstration applications of how to use probabilistic information of climate variations and forecasts in production management and resource conservation. Brochures, guidelines and demonstrations will be developed with customer participation and disseminated through producer organizations and extension services. Products will also be made available to the general public through the world wide web. Scientific findings will be published in the peer reviewed literature.

Customers and their Involvement.
The primary users of this research are resource managers, producers and service organizations of the agricultural infrastructure, such as crop insurance suppliers, emergency and risk management agencies, and fertilizer, seed and chemical companies, all of which could potentially benefit from forecasts of the next season's demands, production and yields. Models and methodologies developed by this research will also be valuable to scientists in federal, state and private institutions, consultants, and action agencies involved in various aspects of climate impacts on agricultural production and environments. Specifically, the Corps of Engineers, Tulsa District (Hydraulics and Hydrology Branch), the Oklahoma Wheat Growers Association, the Oklahoma Wheat Commission, the Oklahoma Cattlemen Association, the Farm Bureau, Oklahoma State Extension Service, the Oklahoma Mesonet, the Climate Prediction Center of NOAA, and several cooperating farmers will provide input and feedback during workshops, seminars and individual work sessions.