

RELATED ACTIVITIES

In addition to the Climate Outlook Fora held in Africa, Latin America, the Caribbean, and Southeast Asia, and activities of the Pilot Program for Application of Climate Forecasts, NOAA-OGP was involved in several activities related to the use of climate information during 1997-98, including:

- The ENSO Rapid Response Project (RRP);
- The ENSO Signal Newsletter;
- The California Pilot Project on the Use of Climate Information;
- Regional Assessments of Climate Variability, Social Vulnerability, and Public Policy Program;
- The Economics and Human Dimensions Program; and
- The Pacific ENSO Applications Center (PEAC).

The primary aim of these various activities was similar to that of the Outlook Fora and Pilot Applications Projects; to better understand the capacity of society to utilize climate forecast information. Some activities encouraged and coordinated the use of climate forecasts, and were initiated as a response to the 1997-98 El Nino-event, while others monitored and analyzed the actual and potential use of forecasts in a research mode, and have been on-going programs for several years. All have the ultimate purpose of aiding the mitigation of socio-economic impacts associated with climate variability. These activities helped build linkages between research and user communities, consolidate knowledge about the applications of climate forecasts, or serve as an effective means of distributing information, helping to support NOAA-OGP's response to the 1997-98 El Niño event. The RRP, ENSO Signal, the California Pilot Project, and the PEAC acted as a direct response, providing decision makers in the United States government and worldwide with quick access to information as the event unfolded. Following is a summary of each project, along with lessons-learned.

ENSO RAPID RESPONSE PROJECT

In order to provide the best available climate information for regions worldwide during the 1997-98 El Niño, NOAA-OGP, in cooperation with IRI, implemented the ENSO Rapid Response Project (RRP). The ENSO RRP serves as an interface between the producers and users of climate information by providing monthly updates and other periodic updates of the ENSO RRP products to officials in the United States and abroad and by eliciting their feedback on the usefulness of these climate products. The ENSO RRP distributes a suite of climate products, including:

- Pacific Ocean sea-surface temperature (SST) observation maps and forecasts, precipitation and temperature observations for regions worldwide and on multiple timescales from NOAA's Climate Prediction Center (NOAA-CPC);
- Net assessment seasonal precipitation and temperature forecasts for regions worldwide and a comparison of the 1997/98 El Niño SSTs to other El Niño events from IRI;
- A multivariate ENSO Index comparison of recent El Niño events from NOAA's Climate Diagnostic Center (NOAA-CDC);
- Global seasonal precipitation and temperature forecasts from the Center for Ocean Land Atmosphere Studies (COLA); and
- Interpretative material for these products provided by NOAA-OGP, when necessary.

Initially, NOAA-OGP provided monthly updates of climate information through the ENSO RRP for IRI Core group members,⁴¹ officials at NOAA, the Department of Commerce, and other United States government agencies. In April 1998, the IRI began to provide climate forecast and observational information to its Core Group members. NOAA-OGP continues to provide United States officials, who are either stationed abroad or require climate information for regions outside of the United States, with ENSO RRP products.

Through the ENSO RRP, NOAA-OGP responded to several requests for information regarding the 1997-98 El Niño and its impacts worldwide, including:

- Officials from United States Embassies in Indonesia, Singapore, Malaysia, the Philippines, and Brazil requested information regarding fires burning in their respective regions. They requested satellite information to constrain the spatial extent of the fires and climate information to determine when rainfall was likely to return to normal, and therefore provide relief from the impacts of the fires.
- World Bank officials informally requested forecast information to assist in their decision to issue a loan to the Government of Peru for \$150 million in preparation for the 1997-98 El Niño. The loan was part of an estimated \$500 million El Niño Emergency Assistance

⁴¹The IRI Core Group was a select group of individuals from countries and institutions interested in financial sponsorship and management of the IRI Core that met during 1997-98, with the goal of transitioning the IRI from a unilateral activity to a fully multilateral entity.

Project, funded by both the World Bank and the Inter-American Development Bank.

- Officials at USAID-OFDA requested climate forecast information to assist them in targeting areas for disaster preparedness and response activities during the El Niño event. Since September 1997, the ENSO RRP has provided USAID-OFDA monthly updates of IRI net assessment precipitation forecasts (3 month) for several regions of the world such as Central America and Mexico, South America, Africa, and Asia, as well as percent of normal precipitation forecasts for three-month time intervals covering the same regions. In addition, during a disaster period, the ENSO RRP assists USAID-OFDA in obtaining from the IRI and NOAA-CPC more specific regional climate information.
- Officials at the United States Initiative on Joint Implementation of the United States Country Studies Program requested ENSO RRP products to be sent to government officials in environmental ministries and national meteorological services.
- In September 1997, officials from the Department of State requested climate information on the impacts of El Niño in North Korea and central China, because these regions were in the midst of a drought. The IRI provided this information, which indicated that the 1997-98 El Niño event may have amplified pre-existing drought conditions by causing below-normal precipitation.

THE ENSO SIGNAL NEWSLETTER

The “ENSO Signal” newsletter is a quarterly publication originally created as an outreach tool during the planning of the November 1995 International Forum on Forecasting El Niño: Launching an International Research Institute. It provided update information on the Forum planning process and featured articles from climate scientists and international experts involved in ENSO Research or the use of forecast information. The Forum was convened in response to a request by various nations and organizations to address how best to apply early-warning forecasting capability that could be used for, and incorporated into decision-making practices. This came in the form of an initiative to establish the International Research Institute for Climate Prediction (IRI) for the purpose of El Niño forecasting.

Over the past three years, the IRI has progressed toward fully-operational status, while at the same time, the “ENSO Signal” has evolved into a more substantive product that has captured the attention of a wider and more diverse audience. The focus of the newsletter has shifted to highlight advances in forecast application activities, new ENSO research techniques or scientific conclusions, and socio-economic issues affected by ENSO. There are currently eleven issues of the Signal, and the readership includes close to 950 national and international individuals and organizations. It is recognized as an educational and informative tool to university students, private organizations and other government organizations interested in ENSO research and related issues.

The ENSO Signal contributed to OGP’s response during the 1997-98 El Niño events in several important ways. It served as a medium for worldwide organizations to highlight updates on their preparations and response to the event; provided website information to readers who wished to access up-to-date information on the unfolding El Niño; and provided summaries of Climate Outlook Fora in several countries which assessed implications for specific sector-planning activities (water management, food security, etc.) affected by the El Niño event.

CALIFORNIA PILOT PROJECT ON THE USE OF CLIMATE INFORMATION

Background and goals

Beginning in late Spring 1997, Californians were warned that a strong El Niño was well underway, and many in the state began to take measures to prepare for El Niño driven storms that cause severe flooding, landslides, hill slides, and mud flows. In the midst of these activities, NOAA-OGP in collaboration with the University of California, Santa Barbara (and other state and federal contributors) proposed to conduct a small-scale research pilot project on the use of El Niño-related climate information, and invited decision makers from several climate-sensitive sectors in California to participate. The project began in December 1997, and will continue through the duration of the 1998-99 La Niña event. It includes approximately 25 decision-makers and several climate scientists from government and university based institutions.

The goal of the California Pilot Project has been to learn if and how decision-makers in climate sensitive sectors can use climate information in order to better prepare for and respond to the impacts of climate variability. Working to achieve this goal, NOAA-OGP provided climate forecasts and observational data on the impacts of this El Niño in easily understandable language. This allowed decision makers to determine if and how climate information could be incorporated into their emergency and regular operations. In addition, NOAA-OGP received detailed feedback on the value of this information from the decision-makers.

The primary source of the climate information was NOAA-CPC, whose scientists provided 6-10 day, monthly, and seasonal precipitation and temperature forecasts as well as observational information such as soil moisture indices. IRI net assessment seasonal precipitation and temperature forecasts for North America were also included. The IRI forecasts, which were less detailed and presented in a format different than those of NOAA-CPC, were included to determine what types of information were best suited to user needs. The United States Geological Survey (USGS) with NOAA's Climate Diagnostics Center (CDC) and Scripps Institution of Oceanography provided an experimental streamflow forecast for the Merced River. NOAA-OGP provided interpretive information for these climate products when necessary. Based in part on the results of this research project, NOAA hopes to lay the groundwork for participants and other domestic users to regularly receive and incorporate climate information into their decision making.

Methodology

To identify participants of the pilot project, NOAA-OGP concentrated on attracting a small but diverse group from climate-sensitive sectors such as agriculture, water management, ranching, forestry, health, port authorities, energy, banking, tourism, emergency services, communications, transportation, and local and state planning agencies. NOAA-OGP identified potential participants by directly contacting state agencies as well as by contacting individuals who were quoted in the news media. Originally, about 30 individuals were identified, and about 20-25 of these have been consistent participants in the pilot project.

The methodology used for this pilot project was developed using several sources. Through the experience of NOAA-OGP's Regional Assessments Program (see Regional Assessments of Climate Variability section) the California Pilot Project was able to draw on the experience of other groups who have been working with decision-makers to use climate forecast and observational information. In addition, it was necessary to use the expertise of participants of the pilot project in developing the methodology. Therefore, an initial meeting of participants (decision-makers, climate scientists, and NOAA-OGP staff) was held in December 1997. This meeting provided participants with an opportunity to discuss how climate can impact their respective sectors, and to agree on how the pilot project would be conducted.

At the December 1997 meeting, it was agreed that NOAA-OGP would send decision makers in California a monthly packet of climate forecast and observational information. This information was provided by NOAA-CPC and the IRI and later included information from the USGS with NOAA-CDC and Scripps. NOAA-OGP staff produced interpretive information to accompany the graphics so that decision makers could more quickly understand and identify the types of information that most suited their needs. Through the course of the pilot project, the information became more user friendly as comments from decision makers were communicated to the producers of the climate forecasts and incorporated into the production of the packets. In addition, NOAA-CPC maintained a website at which decision-makers, both those participating in the pilot project and others working closely with NOAA-CPC, could access updated information that was sent to them in the packets, and this website was updated on a weekly basis.

Another important part of the methodology was to obtain feedback from decision makers on the climate information that they were receiving from NOAA-OGP and other sources (e.g.

private sector climate services, local news media). The type of feedback requested from decision makers included documentation and verbal reports for questions such as the following:

- Did you use it to prepare for and/or respond to the impacts of the 1997/98 El Niño?
- How did you use the climate information?
- Was the information useful?
- Can you incorporate climate information into your decision-making process?
- Did you change your institution's operations based on the climate information you received?

Feedback was received through phone and face-to-face interviews and e-mail exchanges and was then shared with the producers of the climate information. This feedback process allowed for improvements in presentation of weekly and monthly climate updates and increased awareness of how and to what extent climate information could be used in decision-making processes.

Postmortem meeting and on-going activities

A 1997-98 El Niño postmortem meeting for the California Pilot Project was held in July 1998. It provided an opportunity for both the users and producers of climate information to share their experiences during the 1997-98 El Niño and to identify ways to improve the preparation for and response to the impacts of climate variability. Another purpose of this meeting was to explore the potential for future collaborative activities to research the use of climate information within certain climate-sensitive sectors and the institutional capacity for using this information.

At the 1997-98 El Niño postmortem meeting, participants indicated that they were interested in continuing to use climate information in their decision making. They offered several suggestions on how to improve presentation of the climate information. For example, it was noted that officials at different levels of management require different levels of detail regarding the climate information. Mid-management is interested in a short written summary of a 6-10 day precipitation and temperature forecasts while officials in field operations are interested in receiving graphics to further explain the written summary. Several participants requested that 6 month forecasts be made available a few months prior to the time at which budgetary decisions are made for the next fiscal year.

Based on the points listed above and other discussions at the postmortem meeting, participants agreed to consider the following suggestions as a continuation of the California Pilot Project:

- A La Niña project that would include the distribution of climate information during September-April 1998-99 in anticipation of La Nina's impacts on California and monthly documentation of how decision makers use climate information;
- Research projects in which institutions within a climate sensitive sector work with producers of climate information to develop sector-specific forecast products;
- Research projects on the institutional structure and decision making processes of climate sensitive organizations;
- A breakfast meeting of media professionals and climate scientists to discuss how to best present climate information to the public;
- A breakfast meeting for chief executive officers of climate sensitive organizations and climate scientists to discuss the potential for use of climate information within these organizations; and
- A project to coordinate the many web sites that provide climate information for the state of California.

REGIONAL ASSESSMENTS OF CLIMATE VARIABILITY, SOCIAL VULNERABILITY, AND PUBLIC POLICY PROGRAM

The motivation behind NOAA-OGP's investment in a regional assessments effort is continual improvement in our understanding of how global-scale climate variations manifest themselves regionally and how the dynamics of decision-making in climate sensitive sectors could be affected by the introduction of new analytical and predictive information. Equally interesting is the manner in which production and dissemination of climate information is influenced by the reactions of "users." The research objective is focused on both the process of assessment as well as on the products. That is, we believe this to be a long term endeavor with eventual implications for both science planning and for regional institution-building. Central to each project in this early stage is stakeholder involvement, research teams resident in the region, and a research design that looks at climate variations across the range of timescales.

Pacific Northwest and Southwest

Since 1995, a multidisciplinary team of researchers at the University of Washington has been undertaking an integrated assessment of the interaction between climate and society for the purpose of identifying feasible adjustment measures for the Pacific Northwest (PNW) using the evolving technology of regionally refined global-scale climate forecasts. The following are the component studies of this regional assessment:

- The instrumental record of climate variability in the PNW;
- Impacts of climate variability on water resource use, including agricultural production, dams, transportation, recreation and Hanford operations in the Columbia River Basin;
- Evaluating policy/management systems for water resources;
- Determining sensitivity and vulnerability of salmon, sturgeon, municipal water supply, and waste disposal practices to climate change;
- Relationship between Columbia River annual flow and El Niño Southern Oscillation;
- Relationship between the ENSO and the Pacific Decadal Oscillation and PNW regional temperatures, precipitation, snowpack, and stream flow;
- Incorporating climate information into reservoir operation;
- Impacts of climate variability on forests;
- History of impacts of climate variability over the past century on marine ecosystems; and
- Impacts of climate variability on coastal activities.

In January 1998, a regional assessment pilot activity centered at the University of Arizona was launched. This particular assessment was proposed by a group of investigators nationally recognized in interdisciplinary studies. This team hosted the United States Global Change Research Program Office of Science and Technology Policy (USGCRP-OSTP) Regional Workshop on Climate Impacts and through that process had already launched a dialogue with stakeholders in the region focused on the use of scientific research for decision-making in climate-sensitive sectors. The project begins with analysis of stakeholder needs in the region and to provide a sound basis for an assessment of climate impacts and response options. The research team will analyze the state of climate and hydrologic forecasting for the Southwest including analysis of quantitative precipitation forecasts, ensemble weather predictions, 30-90-day temperature and precipitation Outlooks, seasonal precipitation and water supply forecasts, and peak-flow snowmelt-runoff forecasts. The team will conduct an early workshop to ensure that key personnel from agencies within the region are included to help identify physical science-based needs for improved climate information products. Social scientists within the team will conduct in-depth analyses of vulnerability to climate variations experienced by ranchers and urban water users.

Southeast

A multidisciplinary team of investigators from a consortium of Florida Universities that have been focused on the development of methodologies to assess possible impacts of climate variability for agriculture and identify improved management of agricultural systems for given climate forecasts. In their second year of funding they began studies to characterize the historical influence of ENSO on crop production to identify areas and crops most likely to benefit from application of ENSO-based climate forecasts. Analysis of winter precipitation in Florida has revealed important spatial patterns of ENSO influence, and differences in response to strong versus weak events. As they enter into their third year, this group will expand their regional analysis of the impacts of climate and increase substantially their interaction with regional stakeholders and determine how best to develop a climate service for the region.

ECONOMICS AND HUMAN DIMENSIONS OF CLIMATE FLUCTUATIONS PROGRAM

In the early 1990s, NOAA-OGP introduced a social science-based research element with the goal of providing a more comprehensive understanding of how humans interact with the climate system, including both human drivers of change and human responses to climate variability and change. With the advancement in climate forecasting capabilities based on the prediction of the ENSO phenomena and the need to more fully understand societal adjustment to short-term variations in climate, the program is currently focusing its efforts on analyses of how society could potentially make use of the new forecasting technology and how socioeconomic factors impede or encourage its adoption. To achieve this goal, the program is aimed at bringing social science research methodologies to bear on the application of forecast information to short-term adjustment issues, fostering new connections between social, physical, and natural science research, and identifying through research projects the needs of decision makers in climate-sensitive sectors. In particular, the Economics and Human Dimensions of Climate Fluctuations Program sponsors university- and government laboratory-based research projects to address the following questions:

- How does society currently adjust to climatic variability?
- Where will climate forecasts have the highest payoff for human welfare (which may not correspond to area of highest forecast skill)?
- What are the economic, institutional, and cultural factors that influence how decisions are made in the face of climate variability and how do these factors constrain the use of forecasts?
- What are the distributional effects of the adoption of the forecasts (who gains and who loses)?
- What can we learn from how scientific information flows from government entities to the public to ensure adequate dissemination of forecast information?
- What are the risks involved in issuing and acting upon false positive or false negative forecasts?
- What is the value of the forecasts to a specific sector or industry?
- How should forecasts be presented, which variables are most significant, to ensure highest value to society?

Because NOAA-OGP has been investing for the past several years in research on the societal implications of climate forecasts, research provided some foundation for the potential

application of forecast information during the 1997-98 El Niño event. For instance, the potential economic value of ENSO-based forecasts to the United States agricultural sector as a whole has been shown to be substantial (Texas A&M project, Yale University Project). Research has also demonstrated that the agricultural impacts of climate and the value of forecasts differ across regions, thus highlighting the importance of the distributional effects of climate variability and the need to more fully understand these effects. Moreover, the strength of an El Niño event and how the event is classified (e.g., the classification of the Southern Oscillation Index⁴²) appears to be more important than just knowing if an event is occurring (Texas A&M project).

Because of ongoing projects, researchers were able to take advantage of their planned field work to monitor individual, institutional, and governmental response to this El Niño event and determine if and how forecast information was used or why in certain contexts it is not being used. Human dimensions researchers also provided insight from their field work and analysis at several of the Climate Outlook Fora in Africa and Latin America this past year.

Although field work and analysis is continuing into the fall and winter of 1998 to gather data on the responses to the 1997-98 El Niño, some preliminary findings are illuminating both the needs of society as well as the current impediments to the use of these forecasts. For instance, through survey research approaches, researchers are finding the following issues and variables to be important to certain users of climate information: total seasonal rainfall, increased spatial and temporal forecast resolution, consensus-based forecasts, forecast updates throughout the rainy season, adding national boundaries to forecast maps, presenting in Geographical Information System format, and translation into native languages (Tufts/University of Georgia project).

Survey research in developing countries is beginning to illuminate the significant impediments to the use of forecasts at the local level. While the 1997-98 El Niño event caused the worst drought in decades in parts of Latin America and Africa, small-scale farmers, especially those without irrigation, were unable to alter their practices based on forecast information because of resource and technology constraints and limited availability of land. In addition to lacking the means to benefit from the forecasts, farmers are often skeptical of the forecasts and are more likely to rely on their own methods of coping with climate variability. However, the area of planning for

⁴²The Southern Oscillation Index (SOI) is calculated based on the differences in air pressure anomaly between Tahiti and Darwin, Australia. Negative SOI values generally correspond to El Niño episodes, while positive SOI values coincide with La Niña episodes. In general, the larger the SOI (positive or negative), the larger the ENSO event.

relief aid to local communities is a promising area for the application of climate forecasts (Tufts/University of Georgia project and University of Arizona project).

CURRENT HUMAN DIMENSIONS PROGRAM RESEARCH PROJECTS

PROJECT TITLE	INSTITUTION(S)
An Integrated Assessment of the Social and Economic Effects of Extreme Climatic Fluctuations on Forests in the Northeast United States	Rand, NCAR, USFS, Resources For the Future
Responses to Climate Variability and Utility of Climate Forecast Information for the Livestock Sector in the Arid & Semi-Arid Zone, South Africa	Colorado State Univ., Univ. Witwatersrand
Social & Policy Implications of Seasonal Forecasting: A Case Study of Ceara, Northeast Brazil	Univ. Of Arizona
Climate Variations and the International Management of the North American Pacific Salmon Fishery: A Game Theoretic Perspective	NCAR, Univ. Montana
Effects of Seasonal Climate Forecasts on the Competitiveness in the Grain Market	Texas A&M Univ.
The Use of Probabilistic Climate Forecasting Information in Water Resource Decision Making	Battelle PNNL, Oregon State Univ., George Mason Univ.
A Case Study of Burkina Faso; Opportunities and Constraints to Using Seasonal Precipitation Forecasting to Improve Rainfed Food Production Systems at the Village Level in the Sahel-Sudano Region	Tufts Univ., Univ. of Georgia
Climate Prediction, Information & Policy Response: A Retrospective Assessment of Drought Management in Oklahoma	Univ. of Oklahoma
Human Health and Economic Dimensions of Climate Fluctuations	Harvard
Improvements to Water Resources Management Due to Climate Forecasts	Hydrologic Research Center
Early Warning of ENSO Events for Regional Agriculture	Battelle PNNL
Optimal Use of the Climate Prediction Center's Long-Lead Outlooks: Improved Interpretability and Decision-Analytic Case Studies	Cornell Univ.
Improved Climate Forecasts and Pacific Rim Grain Supply and Markets	Univ. California-Davis