CLIMAS Update

News from the Climate Assessment for the Southwest Project

Integrating science, policy, and community

THE UNIVERSITY OF ARIZONA.

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Announcements

- "Fire & Climate 2001," a CLIMAS co-sponsored workshop by invitation, will be held February 14-16, 2001 at the Four Points by Sheraton Tucson University Plaza in Tucson, AZ. For information, contact Gregg Garfin at gmgarfin@u.arizona.edu.
- A multidisciplinary gathering, entitled "Predicting hydrologic, geologic, and biologic responses to a drier and warmer climate in the desert Southwest" will be held April 23-25, 2001 at the United States Geological Survey office on the UA campus in Tucson, AZ.
- The "Third Annual Meeting on the Border Environment" will be held April 26-28, 2001 in Tijuana, Baja California, Mexico. The meeting brings together hundreds of NGOs, academics, and other stakeholders to discuss US-Mexico border issues, including water and climate. For information, see http://www.encuentrofronterizo.org or email Evelyn Alvarez at bordenv@u.arizona.edu.

CLIMAS Mission

CLIMAS was established to assess the impacts of climate variability and longer-term climate change on human and natural systems in the Southwest. Our mission is to improve the ability of the region to respond sufficiently and appropriately to climatic events and climate changes.

What We've Been Up To...

Climate & Health CLIMAS researchers Korine Kolivras and Andrew Comrie presented results of their work on climate variability and valley fever (a fungal disease endemic to parts of the Southwest) at the Valley Fever Center for Excellence in Tucson, AZ; their recent paper on this topic has been accepted by the journal *Aerobiologia* for its March 2001 issue.

Climate & Society Barbara Morehouse presented a paper on institutional and political implications of climate impacts for water management in transboundary regions at a climatic change workshop in Switzerland. Diana Liverman gave a talk at the University of Georgia on environmental change in Mexico, and an invited paper on institutions for collaborative environmental research in the Americas, at the START / CIRA Workshop on Integrated Regional Assessment.

Climate Prediction & Variation CLIMAS researchers presented papers at the Second Southwest Weather Symposium in Tucson, AZ. Roger Bales, Dave Brown, Tereza Cavazos, Andrew Comrie, Holly Hartmann, Korine Kolivras, Thomas Pagano, and Soroosh Sorooshian presented on topics ranging from evaluation of seasonal climate outlooks to spatial modeling of winter climate variability in the Southwest.

Fire & Climate Diane Austin and Barbara Wolf of the University of Arizona's Bureau of Applied Research in Anthropology (BARA) are working with the Fort Mohave Tribe and Kaibab Band of Paiute Indians. They are seeking to reduce the negative impacts of fire and improve resource management by exploring whether and how climate information can be incorporated into natural resource planning and decision making by tribes and federal agencies with trust responsibilities in Indian Country.

Finally... Kudos to CLIMAS team members Colin West and Thomas Pagano who won awards for their presentations at the annual University of Arizona Student Showcase.

Winter 2000-2001 Climate Outlook

NOAA's Climate Prediction Center (CPC) Climate Outlooks suggest a greater than average likelihood of above-average temperatures (based on the 1961-1990 mean) for Arizona and western New Mexico this winter. The highest confidence in above-average temperatures is centered on the Arizona-California border, which has been warmer than average this fall.

The CPC has reserved judgement about precipitation in the Southwest in their extended forecasts for much of 2001. It would be prudent for decision makers to prepare for the full range of possibilities, since there is no indication that any situation is more likely than any other (wet / normal / dry).

NOAA CPC climate models and other forecasts indicate a weakening in ENSO conditions, suggesting ENSO-neutral conditions by spring. Thus, we can expect more variability than usual in the climate during upcoming seasons.

Since 1997, the evolution of many atmospheric and oceanic indices is remarkably similar to that observed during the period 1982-1986, when a strong El Niño was followed by three years of cooler-than-average-conditions in the tropical Pacific. During the last three months, equatorial Pacific ocean temperature, wind, and rainfall features have evolved in a manner consistent with La Niña conditions.

Climate and Water Management

Our extensive interactions with water and wildland fire managers, ranchers, and farmers reveal that prospective users of climate forecasts lack any quantitative basis for evaluating forecast credibility. In response, CLIMAS researchers are developing tools to allow individuals to monitor and evaluate seasonal climate forecasts in terms that are important for their unique decision making situations.

CLIMAS hosted a one-day workshop in November to obtain input from water managers and forecasters about how to improve the communication of climate forecasts and forecast performance. The workshop included invited representatives from local and regional water providers, emergency management agencies, the National Weather Service (NWS) Tucson office, and NWS Colorado Basin River Forecast Center. It was a first-ever attempt to garner detailed insights about technical issues related to probabilistic forecasts, climate forecasts, and forecast evaluation, from the perspective of water management professionals.

A key focus of the workshop was the format and information content of climate forecasts, which affect how users interpret, apply, and judge them. Participants identified key elements of forecast products that will improve the ease, accuracy, and reliability of interpretation by water managers and others. A second area of focus was a review of several tools for evaluating how good the forecasts have been for the Southwest. The review started with simplistic approaches and progressively shifted to more complex analyses that more accurately reflect forecast performance. Some of the evaluation criteria tracked the accuracy of forecasts, others summarized how well the forecast probabilities corresponded with the aggregate distribution of observations.

CLIMAS appreciates the dedication of the workshop participants, who maintained their enthusiasm during extended in-depth discussions of details that were sometimes highly technical. We will continue to work with stakeholders in the Southwest to improve the quality of climate forecasts, forecast evaluations, and the array of future climate services.

Sulphur Springs Valley Community Assessment

Following a successful community climate vulnerability study in the Middle San Pedro River Valley by CLIMAS team members (see CLIMAS Report Series CL3-00), Marcela Vásquez-Léon and Colin West of BARA have expanded their efforts to understand the ways in which residents of the Southwest are vulnerable to climate variability, and how they adjust to climate impacts.

The team is currently engaged in a vulnerability case study of the Sulphur Springs Valley in southeastern Arizona. Their fieldwork has included interviews with a wider range of agriculturalists such as corn and chili farmers, fruit and nut growers, *U-Pick* vegetable producers, and migrant laborers.

Their research reveals that there is a great deal of diversity in terms of people's concerns with climate variability. Some vegetable growers may welcome a summer drought; as one farmer said, "Droughts are good because I can decide when and how much to water. This decreases the incidence of disease and the need for weeding."

Several consecutive years of drought, however, can be devastating. Increased reliance on groundwater irrigation may lead to declining aquifer levels and increased pumping costs. While for many this combination has resulted in bankruptcy and the abandonment of agriculture, for others it has led to the development and adoption of water efficient irrigation systems.

Local farmers have expressed interest, and skepticism, in the use of seasonal climate forecasts to assist them in agricultural decision making. Thus, CLIMAS is planning a spring 2001 climate forecast meeting with stakeholders from southeastern Arizona. CLIMAS climatologists and hydrologists will be present to explain the science behind forecasts and to discuss with stakeholders how to best deliver the information they need.

This kind of field research and stakeholder interaction is aimed at improving understanding of the complex dynamics between climate, people, and agriculture in the Southwest.

Research Update: Predicting Monsoon Precipitation

CLIMAS researchers Tereza Cavazos and Andrew Comrie have been investigating the intraseasonal variability of North American monsoon precipitation, and have developed a new model for the prediction of summer (July-September) monsoon precipitation in Arizona. The following research update summarizes key aspects of their research.

Background Diagnostic studies have shown that the interannual variability of the Southwest summer monsoon is chiefly controlled by three factors: 1) cool-season conditions in the Pacific Ocean, 2) atmospheric connections between the tropical Pacific Ocean and the region of the North Pacific Ocean and western North America (called the Pacific-North America or PNA *teleconnection*), and 3) land-surface conditions, such as rainfall and snow cover. Cool-season sea surface temperature (SST) *anomalies* (unusual changes) in the north, central, and equatorial Pacific, in particular, are linked to summer precipitation, but less is known about the possible role of SST anomalies in the North Atlantic.

In theory, local and regional land-surface conditions modulate precipitation, but, from the predictive point of view, little is known. This is due to the lack of long-term soil moisture and snow cover data. Nevertheless, a few studies have shown that dry winter and spring conditions may precede a wet monsoon season. These conditions produce a strong temperature contrast between the ocean and the land surface, which can entrain moist air from the ocean onto the land surface.

During *extended dry periods* the land-surface may continue to heat and drought conditions may intensify. In addition, studies have shown that the onset of the summer monsoon is negatively correlated with the intensity of the monsoon; thus, an early onset is usually associated with a wet monsoon and vice versa. Although the complexity of the large-scale and local-scale climate forcing mechanisms makes it difficult to predict monsoon precipitation, Cavazos and Comrie set out to identify some variables with possible skill for predicting an index of all-Arizona summer monsoon precipitation (AZSMP).

Experimental Model Cavazos and Comrie created two empirical models to forecast AZSMP. Their nonlinear model was slightly more skillful than their linear model. The best predictor variables were total precipitation for the months December-February (DJF), the Pacific Decadal Oscillation (PDO) index for DJF (see http://www.ispe.arizona.edu/climas/forecasts/pdo/index.html for background on the PDO), and SST indices from the North Atlantic.

Results Cavazos and Comrie correlated SST anomalies and AZSMP for 1958-1990. For winter season data, they found significant correlations between AZSMP and SST anomalies in the Eastern Pacific and the North Atlantic basins (Figure 1). The *meridional* (north-south) gradient in the Pacific Ocean, shown in Figure 1, has been previously linked to decadal SST variations (PDO) and atmospheric teleconnections (PNA). Cavazos and Comrie also found regions of significant correlation between AZSMP and SST anomalies in the north and

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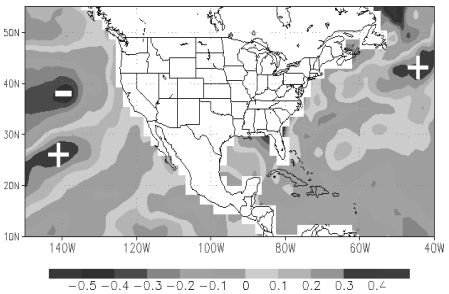

Figure 1. Correlations between all-Arizona summer monsoon precipitation and January-March gridded SST (1958-1990).

CLIMAS Publications

The following CLIMAS Reports are now available on our web site: http://www.ispe.arizona.edu/climas/reportseries/index.html

Austin, D., Gerlak, S., Smith, C., 2000: Building Partnerships with Native Americans in Climate-Related Research and Outreach. CLIMAS Report Series CL2-00.

Finan, T.J., West, C., (eds.), Austin, D., Barabe, P., Benequista, N., Fish, A. Gardner, A., Hansen, E., McGuire, T., Stewart, S., Tschakert, P., 2000: An Assessment of Climate Vulnerability in the Middle San Pedro River. CLIMAS Report Series CL3-00.

Carter, R.H., 2000: The Potential Responsiveness of Arizona Water Policies to Increased Climatic Variability. CLIMAS Report Series CL4-00 (part 1), DRAFT.

Submissions and Publication Information

CLIMAS Update is published quarterly and welcomes the submission of items of interest. The editorial staff reserves the right to select and edit copy submitted for publication. All material in the newsletter may be reproduced, provided CLIMAS is acknowledged as the source. The newsletter is provided through the support of the National Oceanic and Atmospheric Administration (NOAA).

Deadline for Spring issue: March 23, 2001
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western Atlantic basins (Figure 2). They believe that these anomalies (especially in spring and early summer) may play an important role in modulating the intensity and location of the Bermuda high and the North Atlantic jet stream.

Cavazos and Comrie also investigated interdecadal variations (5-year moving averages) of AZSMP and an index of the North Pacific Ocean during January-March. Figure 3 shows the strong

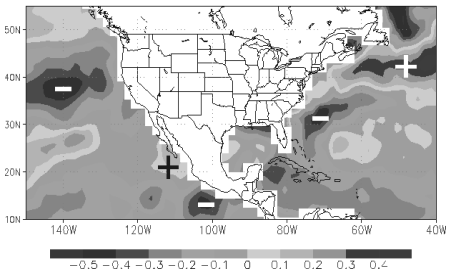

Figure 2. Correlations between all-Arizona summer monsoon precipitation and March-April gridded SST (1958-1990).

negative relationship between the two during the period 1960-1990. They believe that the lack of a strong relationship during the 1990s shows the complexity of the interdecadal variations and, possibly, a shift in climate variability. According to University of New Mexico researcher, David Gutzler, a similar change has been observed in the covariability of spring snow cover and monsoon precipitation in New Mexico. The SST index shown in Figure 3 is significantly negatively correlated with the PDO, a result consistent with Cavazos and Comrie's empirical model.

Based on their model results and the evolution of the SST anomalies during the winter and spring of 2000, Cavazos and Comrie forecasted close to average SMP for Arizona. In particular, Cavazos and Comrie found conflict between the expected effect of many of the mechanisms that control AZSMP. For example, during the 1999-2000 cool-season the SST anomalies in the subtropical and North Pacific basins showed only weak meridional gradients, which suggested the possibility of a *dry* monsoon season.

On the other hand, the combined effects of *La Niña* and weak meridional SST gradients suggested a very dry winter in the Southwest, which would lead to an early and wet monsoon (see http://www.ispe.arizona.edu/climas/forecasts/lanina/index.html for background on La Niña). They also found that the North Atlantic SST anomalies were conducive to a *wet* monsoon. By spring, weak negative SST anomalies along the east coast of Florida and negative anomalies along the Baja California Peninsula, also suggested a *dry* monsoon.

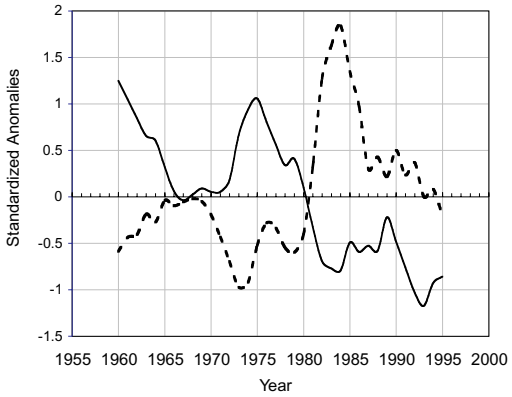

Figure 3. Five-year moving average of standardized anomalies of all-Arizona summer monsoon precipitation (dashed) and an index of North Pacific SST anomalies (solid).

These counteracting mechanisms led Cavazos and Comrie to conclude that SMP would be close to normal. Although SMP in Arizona was below-normal to normal, their forecast was more accurate than the above-normal precipitation forecast issued by the Climate Prediction Center (CPC). Based on the results of their preliminary research, Cavazos and Comrie believe that the CPC forecast for the Southwest might rely too much on El Niño/Southern Oscillation conditions.

Cavazos and Comrie plan to continue work that still needs to be done to refine their experimental model and to make progress on future forecasts.

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