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

- "To the Sea of Cortes, nature, water, culture, and livelihood in the Lower Colorado River Basin and Delta, a binational public symposium will be held September 29, 2000 in Riverside, CA. The symposium is being organized by the UA Udall Center for Studies in Public Policy and the University of California Institute for Mexico and the United States.
- A multidisciplinary gathering, entitled "Predicting hydrologic, geologic, and biologic responses to a drier and warmer climate in the desert Southwest" will be held January 31–February 2, 2001 at the United States Geological Survey office on the UA campus in Tucson, AZ.
- Newly available on our web site is a research report by CLIMAS team members at the UA Bureau for Applied Research in Anthropology, *An Assessment of Climate Vulnerability in the Middle San Pedro River Valley*. If you would like a paper copy, we will be happy to mail it to you.

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 & Society We have a team working in the Sulphur Springs Valley of southeastern Arizona assessing farmers' and ranchers' vulnerability to climate. We have completed a draft report, available later this fall, on the vulnerability to climate of urban water providers in selected Arizona cities, and have created a CD, for Arizona Native American tribes, that gives information linking climate and renewable energy resources. CLIMAS members investigating the links between climate and the occurrence of *valley fever* issued the first forecast of a possible increase in valley fever incidence in our area last winter.

Climate Prediction & Variation Team members are assessing some of the primary climate and hydrologic forecasts issued for this region (see p. 3–4). Other team members are downscaling climate information to the fine-scale resolution that our stakeholders have said they needed to make informed decisions. New tree-ring analyses show a 70–80 year pattern of recurrence in the Pacific Decadal Oscillation, a climate process that affects our region's precipitation over multiple decades. We have also made progress in understanding some of the processes behind summer monsoon variability.

Fire & Climate CLIMAS, in coordination with the UA Institute for the Study of Planet Earth (ISPE) and the UA Laboratory of Tree-Ring Research (LTRR), held a very successful fire-climate workshop in February, 2000 (see p. 2). We are planning a follow-up fire-climate meeting for early 2001.

And... Last but not least, Shoshana Mayden, our web designer, has given our web pages a new look. Check it out!

Fall 2000 Climate Outlook

NOAA's Climate Prediction Center (CPC) predicted a higher than usual chance of a hotter and wetter than average summer (based on the mean for 1961–1990) for much of the Southwest. Highest confidence in above-average precipitation was centered in the southeastern Arizona-New Mexico border, and indeed this area has seen notable monsoon rainfall.

High confidence was also expressed in a greater likelihood of above-average temperatures centered on the Arizona-California border. This area (especially northwestern Arizona) in fact had average daily temperatures far above the water-year mean (i.e., the period that runs from October 1, 1999 to September 30, 2000).

Temperature forecasts for the rest of 2000 from the CPC and the International Research Institute for Climate Prediction suggest a greater than average likelihood of above-average temperatures for the Southwest. Current predictions indicate an especially high likelihood of above-average temperatures for western Arizona-southeastern California during the October 2000–April 2001 time period.

Some situations are more difficult to forecast than others and the current situation (ENSO-neutral) is particularly difficult. Currently the CPC recognizes this and is reserving judgement about what may be likely to happen for this winter's precipitation in the Southwestern United States. 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). However, CPC confidently expects the decade long trend of warm conditions to continue for this winter.

Climate and Wildfire

CLIMAS, along with ISPE and LTRR, hosted a one-and-a-half day workshop in February, 2000 to discuss the links between climate variability and wildfire patterns. The workshop attracted fire managers, wildfire researchers, and climate specialists from the U.S. Southeast, Southwest, Pacific Northwest, California and Intermountain West for a first-ever dialogue between climatologists and fire specialists.

The sequence of a wet El Niño winter in 1997–98, a dry La Niña winter in 1998–99, wet summer in 1999, a very dry La Niña winter in 1999–2000, combined with predictions for continued dry conditions boded ill for the upcoming fire season. The high buildup of fine fuels (grasses, leaves, etc.) stimulated by this sequence, combined with a legacy of conditions resulting from a century of fire suppression and various land use changes, lay at the heart of the concern about the upcoming season.

The workshop was timed to give managers the information they needed to request extra emergency resources, and to consider how they might incorporate the existing climate information and forecasts into their operations.

The meeting ended with a set of action items, which included development of climate-fire web site that would provide forecasts and other information in forms useful to fire managers; continued research into the links between fire and climate, with the goal of improving predictive capabilities; and incorporation of climate information into long-range land management planning. A five-year plan was recommended that would establish an ongoing and dynamic assessment process, along with a permanent group to carry out the assessments and track both the success of the assessment process and the assessments themselves.

Participants also advocated initiation of climate training for fire managers, submitting research proposals that feature integrated teams of fire and climate specialists, forming an ongoing working group to move forward on integrated land management planning, and holding a follow-up workshop at the end of the 2000 fire season. CLIMAS, ISPE, and LTRR are already working on setting up the follow-up meeting, to be held early in 2001.

CLIMAS Post-docs

Tereza Cavazos (Ph.D. Pennsylvania State, 1998) joined the CLIMAS project as a research associate in August 1999. As part of the CLIMAS project, Dr. Cavazos is currently investigating the intraseasonal variability of North American monsoon precipitation, the causes and impacts of droughts in Northern Mexico in the last 50 years, and the reconstruction of winter precipitation in the Southwest during the last 1000 years.

Gregg Garfin (Ph.D. University of Arizona, 1998) joined the CLIMAS staff in August 2000. Dr. Garfin's expertise is in climatology. His research has focused primarily on paleoclimatology and synoptic climatology in the western United States and monsoon Asia. Dr. Garfin co-edits *CLIMAS Update* and provides our web site with the latest CLIMAS findings and related information.

Mary Glueck (Ph.D. University of Alaska, Fairbanks, 1999) joined the CLIMAS project in March 2000. Her specialty is regional climate variability. Her main contribution to the project this year will be a report summarizing the state of knowledge of hydrologic variability in the Southwest. Some of her research interests are regional climate and hydrologic variability, synoptic climatology, dendrochronology, air-sea-ice interaction, and remote sensing.

Fenbiao Ni (Ph.D. University of Arizona, 2000) from the Laboratory of Tree-Ring Research recently joined the project to study tree rings, climate and atmospheric circulation. He is interested in applying dendroclimatology and synoptic dendroclimatology to downscale climate information to fine spatial scales for the period prior to the instrumental record.

Marcela Vásquez-León (Ph.D. University of Arizona, 1995) joined the CLIMAS project in July 2000. Her expertise is in anthropology and agricultural economics. Dr. Vásquez-León's research has focused on the relationship between community decision making, folk and scientific knowledge, and environmental change. Her CLIMAS research currently involves an assessment of climate vulnerability and risk-buffering strategies in the Sulphur Springs Valley, an agricultural area in southeastern Arizona.

Research Update: Southwest Forecast Assessment

"Weather, Climate, and Hydrologic Forecasting for the Southwest U.S." (CLIMAS Report Series CL2-99), by Hartmann, Bales, and Sorooshian, provides a comprehensive review of the current state of weather, climate and hydrologic forecasting, with a focus on the situation facing the Southwest. The report provides a survey of forecast types, procedures, assumptions and performance, and includes guidelines for proper interpretation of some of the myriad forecasts issued by a variety of national and regional organizations.

The report also focuses on nonscientific features that inform usage of the various forecast products, such as jargon and acronyms; the missions, coordination, and modernization philosophies of various forecasting agencies; and the proliferation and reissue of forecasts.

Detailed recommendations focus on improving the modeling, evaluation and communication of forecasts. The report also includes a useful 14-page bibliography.

The report addresses three categories of forecasts: weather (time scales of minutes to several days), climate (composite conditions over one month and longer), and hydrology (water-related forecasts covering both weather and climate time-scales).

The authors focus on *operational forecasts* by governmental agencies, especially various branches of the National Weather Service (NWS). Operational forecasts are defined as "products that are routinely produced by an agency and generally created using established procedures or guidelines that have undergone extensive review." The other types of forecasts, the authors note, are often not identified by type, which can lead to some confusion.

Forecasts, Skill & Evaluation Generally, forecasts are created through subjective combination of a variety of data inputs, statistical analyses, numerical modeling results and forecaster expertise. Expert judgement is required because forecasters must weigh the strengths and weaknesses of an array of numerical and statistical model outputs, and they must assess short-term or localized conditions, which create complications that cannot be resolved by current modeling techniques (e.g., the summer monsoon season in the Southwest).

The authors noted that weather forecast skill is best over 0–36 hour time periods. By contrast, climate forecast skill varies by region, season, and dominant causes of climate variability. For the Southwest, climate conditions dominated by ocean conditions (e.g., winter precipitation) tend to be more reliably forecasted than climate conditions dominated by local-scale phenomena (e.g., summer monsoon precipitation).

Seasonal temperature changes are more consistent over large regions, which allows climate forecasts of temperature to be generally better than for precipitation. In contrast to weather forecasts, quality assessments of hydrologic forecast products are uncommon. CLIMAS team members, in coordination with other UA water resources researchers, have targeted this as an important research area.

Hydrologic versus Weather & Climate Forecasting An important insight provided by Hartmann et al. is that different NWS units responsible for different forecasts have markedly different institutional philosophies. One result is that, whereas weather and climate forecasting can be characterized by rapid incorporation of research findings and new forecast techniques, hydrologic forecasting is characterized by much slower evolution. Hydrologic forecasting is constrained by an

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Southwest Assessment Update

It is said that change presents opportunity. The study of implications of climate change to people of the Southwestern United States that ISPE has led for the past year is a resource for identifying opportunities and reducing risks under a changing environment.

The study report, "Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change for the Southwest," should be available in the ISPE office and on the ISPE web site by mid-October 2000.

The report adds background to today's headlines of forest fires, quality of urban living, infectious diseases, and the sustainability of fresh water resources. It is written for everyone with an interest in nature's influence on society and the environment. Sponsored by the USGS and NOAA, it is one of 16 studies that contribute to a nationwide assessment of the potential implications of climate change. The Southwest report draws a great deal upon the work of CLIMAS researchers and proves the wisdom of maintaining an underlying study to understand the integrated and shifting responses of nature and society to changes in climate.

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 Winter issue: December 4, 2000
Send to: Gregg Garfin at GMGarfin@U.Arizona.EDU
Newsletters are archived at: http://www.ispe.arizona.edu/climas/archive.html

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institutional preference for national uniformity in operations, long-standing standard operating procedures, and complex data management systems. However, modernization efforts within NWS hydrologic forecasting units, as well as coordination of provisional forecasts from a number of agencies (e.g., *water supply outlooks*), hold potential for incorporating new forecast methodologies more rapidly.

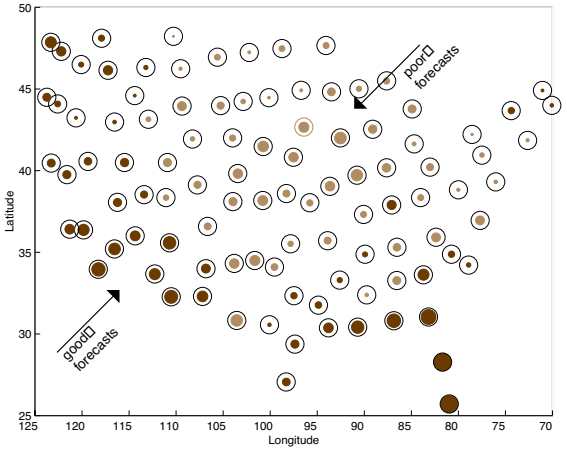
The Future of Forecasting Hartmann et al. observed that forecast products and methodologies are constantly evolving. Products are now delivered primarily via the Internet, although the Internet is not yet designated an official source of NWS forecasts. Rapid changes in forecast methodologies and upgrading of their status, from research to experimental to operational, frequently results in outdated documentation of forecast procedures. Rapid increases in computing power and the availability of remotely-sensed and other digitized data have fostered increasing model complexity, including higher spatial and temporal resolution, coupling of land-ocean-atmosphere processes, and the nesting of processes at multiple spatial and temporal scales. Further, forecasting will increasingly rely on a greater number of techniques.

The authors emphasize that finding the best means for documenting procedures, integrating results from many models, and clearly communicating information about forecast products will be important issues for both forecasters and forecast users.

Recommendations The report details a number of recommendations for improved forecasting, for the Southwest region in particular. The authors suggest that evaluation of forecasts, especially of climate and water supply outlooks for regions within the Southwest, should receive high priority, so that users will have a quantitative basis for judging forecast credibility. As shown in the figure, CLIMAS is making major progress toward these goals.

The report also suggests that incorporating climate outlooks into statistical water supply modeling techniques would produce the most rapid improvements in operational water supply forecasts; improving conceptual hydrologic models and evaluation of precipitation and snow estimates used as their inputs is important, but requires further research.

Finally, the report suggests (1) ongoing evaluation of the use of hydroclimatic forecast products during climate events (e.g., the recent La Niña episode), (2) development of site-specific climate outlook products, and (3) improved communication of hydrologic forecast products.



U.S. Map of Forecast Performance. Evaluation of NOAA Climate Prediction Center forecasts for seasonal total precipitation, as measured by the Ranked Probability Score. Forecasts considered include only those for which shifted probabilities were indicated, issued during August, September and October, 1995–1998 for the target periods December–February, January–March, February–April, March–May (48 possible individual forecast/observation pairs evaluated). The dots display the percent improvement over using only the 1961–1990 historic record as a predictor, i.e., equally likely to have conditions in the wettest, middle, and driest third of the 30-year baseline period. Brown circles indicate forecasts better (good forecasts); tan circles indicate forecasts worse (poor forecasts). Circle size indicates magnitude of the change; the black circle references a 50% change.

This CLIMAS research report, including full detail on the various types of hydroclimatic forecast products, models, and agencies, is available in hard copy from the CLIMAS Core Office. The full report and a nutshell summary are available online at http://www.ispe.arizona.edu/climas/archive.html.

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