CLIMAS Update

News from the Climate Assessment for the Southwest Project

Integrating science, policy, and community

THE UNIVERSITY OF ARIZONA.

Volume 4,
Number 1,
April 2001

Predicting Valley Fever Incidence

CLIMAS researchers Korine Kolivras and Andrew Comrie, along with investigators at the University of Arizona's Valley Fever Center for Excellence and other investigators at the University of Arizona Department of Geography and Regional Development, have been investigating the connection between climate variability and the incidence of valley fever. The following research update summarizes key aspects of their work to develop a model for the prediction of valley fever incidence.

Background Valley fever is a disease endemic to the southwestern United States (Figure 1), as well as parts of Central and South America. It is caused by a soil-dwelling fungus, *Coccidioides immitis (C. immitis)*, that responds to changes in climate conditions.

When soil conditions are dry, a disturbance may cause fungal spores to become airborne, and infections may occur when the spores are inhaled. The majority of those infected do not exhibit symptoms, or experience cold-like conditions. However, a small number experience severe, potentially fatal conditions such as meningitis and organ damage.

Previous studies, mainly conducted in the 1950s and 1960s, established anecdotal relationships between climate conditions and outbreaks of valley fever, but very few quantitative studies were conducted that compared the two. According to past research, the fungus is found in the soil most often following a rainy period. A dry spell, however, is required for the fungus to become airborne.

A relationship also exists between *C. immitis* and temperature. It is thought that very high temperatures, coupled with dry soil conditions, partially sterilize the surface soil and remove competing microorganisms. When optimal surface soil conditions return, *C. immitis* returns to the surface and grows relatively free of competition.

Given this context, Kolivras and Comrie conducted research aimed to further explore and define the relationship between climate conditions and valley fever. They used monthly temperature and precipita-

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For more information about Kolivras and Comrie's investigations, see the March 2001 issue of *Aerobiologia*, or the following web sites:

http://www.casa.arizona.edu/~peter/valleyfever/web/index.html

http://www.u.arizona.edu/~korine/

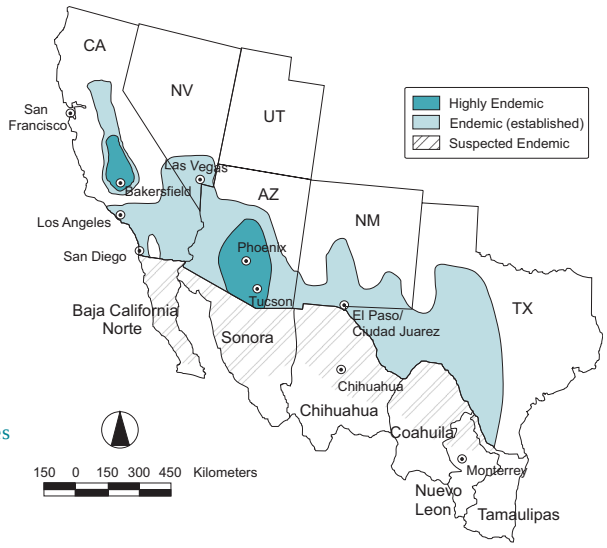

Figure 1. The areas of the United States to which valley fever is endemic.

Announcements

- 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 U.S. Geological Survey office on the UA campus in Tucson, AZ. For information, contact Robert Webb at 520-670-6671 ext. 238.
- 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 U.S.-Mexico border issues, including water and climate. For information, see http://www.encuentrofronterizo.org or email Evelyn Alvarez at bordenv@u.arizona.edu.
- The following paper is now available: B.J. Morehouse, R.H. Carter, and T.W. Sprouse, 2000. The Implications of Sustained Drought for Transboundary Water Management in Nogales, Arizona, and Nogales, Sonora. *Natural Resources Journal* 40:783-817.

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...

CLIMAS Outreach CLIMAS researchers, Diane Austin, Gregg Garfin, and Holly Hartmann presented talks on fire and climate, a CLIMAS overview, and climate forecasting, respectively, at the Bureau of Indian Affairs Western Region Forestry and Natural Resources Meeting in Camp Verde, AZ.

Climate & Health CLIMAS researchers, Korine Kolivras and Andrew Comrie, presented the following papers on their valley fever research (see page 1): "*Coccidioides immitis* as a Southern Arizona Environmental Biohazard," at the UA Department of Plant Pathology, (along with co-researchers J. Galgiani, and M. Orbach); "Climate and health: predicting valley fever incidence from climate variability," at the 97th Annual Meeting of the Association of American Geographers (AAG), New York, NY; and "Development of a climate-*coccidioidomycosis* predictive model," presented at the 45th *Coccidioidomycosis* Study Group Conference, Tucson, AZ.

Climate Prediction & Variation At the 18th Annual Pacific Climate (PACLIM) Workshop, in Pacific Grove, CA, Andrew Comrie spoke about the experimental seasonal forecast of monsoon precipitation in Arizona that he and CLIMAS postdoctoral researcher Tereza Cavazos have developed (see CLIMAS Update v.3 no. 3-4). At the same workshop, Malcolm Hughes, who organized a session on decadal-to-centennial climate variation in the western United States, presented results of his research on millennial tree-ring records of climate. At the same meeting, postdoctoral researchers Fenbiao Ni and Tereza Cavazos presented a poster on the reconstruction of atmospheric circulation indices and Southwest cool-season precipitation from millennial networks of tree-ring records.

David Brown presented the results of his research on modeling and analyzing winter climate variability in the Southwest at the 97th Annual Meeting of the AAG. At that meeting, he was awarded 2nd place in the Climate Specialty Group Student Paper Competition. Holly Hartmann and Tom Pagano presented a paper on the CLIMAS experience with stakeholders at the first annual meeting of the NSF Science and Technology Center for Sustainability of Semi-arid Hydrology and Riparian Areas (SAHRA), Tucson, AZ.

Climate & Society Barbara Morehouse presented a paper on the Nogales Arizona climate sensitivity analysis to members of the Border XXI Water Working Subgroup. Morehouse also presented a paper entitled "Socializing Place-Based Science: A Pragmatic View," at the 97th Annual Meeting of the AAG in New York, NY. She was one of the co-organizers of the *Assert-ing Geography in the 'New' Place-Based Science* session at the AAG meeting.

Morehouse and CLIMAS researchers Rebecca Carter and Petra Tschakert have recently published papers, one on transboundary water management in Nogales, Arizona and Nogales, Sonora (see page 1), and one accepted for publication, on the sensitivity of Arizona urban water resources to severe drought. CLIMAS researchers, Marcela Vásquez-León, Colin West, and Timothy J. Finan, presented a paper entitled, "Assessing climate vulnerabilities in the postglobal age: agriculture and ranching on both sides of the U.S.-Mexico border," based partly on CLIMAS research, at the Society for Applied Anthropology meetings held in Merida, Yucatan, Mexico.

At the winter meeting of the American Meteorological Society, in Albuquerque, NM, Morehouse and Roger Bales presented papers (on behalf of several CLIMAS researchers) in a special session, organized by Roger Pulwarty of NOAA Office of Global Programs (OGP), entitled *Regional Integrated Assessment*. This session showcased the projects, including CLIMAS, that are currently being funded by NOAA-OGP under its Regional Integrated Sciences and Assessment Program.

Fire & Climate CLIMAS researchers, Andrew Comrie, Holly Hartmann, Barbara Morehouse, and Tom Pagano presented papers on a variety of climate-related topics at CLIMAS co-sponsored national and regional meetings on the topic of climate and fire (see page 3).

Finally...the new CLIMAS Fire & Climate in the Southwest web pages are up (http://www.ispe.arizona.edu/climas/fire/)! Expect substantial changes in the CLIMAS web pages during the next several months, as we add detailed content and graphics related to the research reports about which you have been reading in *CLIMAS Update*.

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 Summer issue: June 22, 2001
Send to: Gregg Garfin at GMGarfin@email.arizona.edu
Newsletters are archived at: http://www.ispe.arizona.edu/climas/archive.html

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Spring 2001 Climate Outlook

NOAA's Climate Prediction Center (CPC) seasonal climate outlook for April-June suggests a slightly increased probability of higher than average temperatures (based on the 1961-1990 mean) for much of Arizona and New Mexico. The highest confidence in above-average temperatures is centered on the Arizona-California border. By comparison, the International Research Institute for Climate Prediction (IRI) experimental forecast indicates enhanced probabilities of above-normal temperatures over the southern 2/3 of the U.S. and northern Mexico, and greatly enhanced probabilities of above-normal temperatures over central and northern New Mexico.

The CPC has reserved judgment about precipitation in the April-June forecast, and the IRI has forecasted slightly enhanced probabilities of below-normal precipitation over the central and southwestern U.S., Baja California, and northwestern Mexico.

These forecasts reflect, in part, the climate anomalies expected during a weakening of La Niña conditions. The pattern of climate anomalies associated with weakening La Niña conditions has been of keen interest to climate forecasters, who have reported unprecedented successes in forecasting during these transition conditions.

Longer-term CPC precipitation forecasts for the Southwest (June-September) indicate a slightly higher chance of above-average precipitation, with highest confidence centered on southern and central New Mexico. CPC June-September temperature forecasts show greater probabilities of above-average temperatures, with high confidence centered on western Arizona.

CLIMAS research on evaluation of the CPC forecasts indicates that there is great uncertainty in forecasting spring and summer precipitation; however, CPC temperature forecasts issued during winter months for spring and summer temperature have been fairly successful. Year-to-year variability in temperature in the Southwest is small in relation to decade-long trends toward increasing temperatures; thus, predictions for above-average summer temperatures are a pretty good bet.

Southwest Assessment Update

The Southwest assessment report, "Preparing for a Changing Climate," is now available at the ISPE office and web site. The report brings together research on the climate of the Southwest, how it might change in the future, and the potential consequences for the region's economy, environment, and quality of life.

As part of a national assessment by the U.S. Global Change Research Program, the study considers climate projections that depict a warmer and wetter future for the Southwest. The potential implications of these changes is assessed for several sectors, including water, ranching, ecosystems, mining, human health, urban areas, and energy.

The report draws a great deal on the work of CLIMAS researchers and was supported by the U.S. Geological Survey and the National Oceanic Atmospheric Administration. People from private industry, local and national agencies, and universities with a stake in the region also participated in the assessment.

Copies of the report and supporting documentation can be found at the website: http://www.ispe.arizona.edu/research/swassess/. For more information contact William A. Sprigg, (520) 622-9014, wsprigg@u.arizona.edu.

2001 Fire and Climate Workshops

In February and March, CLIMAS, along with the Institute for the Study of Planet Earth, the UA Laboratory of Tree-Ring Research, and the Desert Research Institute's Program for Climate, Ecosystem and Fire Applications, hosted two workshops to discuss the links between climate variability and wildfire.

Fire and Climate 2001 focused on climate and wildfire occurrence throughout the U.S. The meeting attracted regional-level fire and land-use managers, fire scientists and climatologists from the western and southeastern U.S., and Alaska, representing a variety of federal land management agencies. For two-and-a-half days, participants evaluated the devastating 2000 fire season and discussed the forecast for the upcoming 2001 fire season. Of particular concern were potential fire hazards in the northwestern U.S.

The meeting ended with recommendations for improvements in climate forecast and assessment products, fire and climate data collection, and climatology training for fire managers.

Fire and Climate in the Southwest 2001 focused on climate and wildfire in Arizona and New Mexico. Key individuals representing agencies ranging from Arizona Emergency Management to the Bureau of Indian Affairs, National Park Service, U.S. Forest Service, and Arizona State Land Department, attended the meeting. Barbara Morehouse and UA researcher Steve Yool presented an overview of research to develop an innovative GIS model that fire managers will be able to use in strategic planning for long-term fire management. The model, of great interest to fire managers in southern Arizona's Chiricahua, Huachuca, and Santa Catalina Mountains and the Jemez Mountains in New Mexico, will integrate fire hazard data, climate factors, human factors, and policy considerations into a single system.

Participants identified a number of issues for follow-up, including the need for research to identify specific climatic conditions that enhance or decrease fire danger.

A combined proceedings from the two workshops will be available by summer 2001…stay tuned!

Predicting Valley Fever Incidence (continued)

tion data, as well as valley fever incidence data for Pima County, Arizona (acquired from the Arizona Department of Health Services). Climate variables and time periods important to the growth and dispersal of *C. immitis* were identified during the exploratory portion of the study. They then used these findings to develop monthly multivariate predictive models for use in tandem with climate forecasts. These predictive models are useful to health officials to prepare for future outbreaks.

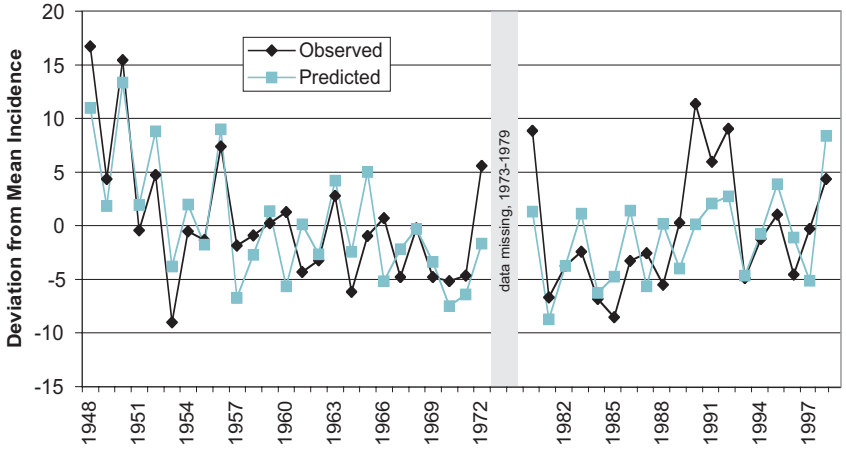

Figure 2. November deviation from mean valley fever incidence. November is a month during which valley fever incidence is high. Predicted incidence (teal points); observed incidence (black points). Data are unavailable, 1973-1979.

Model Development In the exploratory portion of the study, Kolivras and Comrie found that there is a complex seasonal relationship between temperature, precipitation, and valley fever incidence. Precipitation, for example, is an important variable both in the long-term (almost one year prior to a particular month of incidence), and in the short term. Precipitation a year or more prior to a certain month of incidence may affect the growth of the fungus in the soil. A lack of precipitation several months prior may allow fungal spores to become airborne, causing infections. Based on previous research and the results of the exploratory analysis, Kolivras and Comrie developed monthly models designed to predict monthly deviation from a month's percentage of the total annual incidence (Figure 2).

Preliminary Results Model calibration results suggested selection of temperature and precipitation variables for months one year or more prior to the month for which valley fever incidence was being predicted. This result demonstrated to Kolivras and Comrie that long-term climate conditions are important for predicting valley fever incidence.

Kolivras and Comrie found that 40% of the predictor variables are from the winter season. They speculate that climate conditions in winter may be more important than conditions in other seasons for the prediction of valley fever. During the model evaluation stage, they also found they were best able to predict valley fever incidence for those critical months with high valley fever incidence – a result most useful to public health officials.

Kolivras and Comrie are currently implementing a user-friendly version of their models in cooperation with the medical community involved in valley fever research in Tucson, Arizona. They will continue to evaluate these predictive models, and explore options for the improvement of predictive capabilities.

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