Climate Science and Arizona Cooperative Extension

Mike Crimmins
Climate Science Extension Specialist
Dept. of Soil, Water, & Environmental Science
The University of Arizona
Presentation Overview

• About my new position
• About Extension
• Educational/Outreach Programs
• Research and Development
  – Climate Science and Resource Management
  – Citizen Science
What is a Climate Science Extension Specialist?

• Develop extension programs that address climate related issues of importance to Arizona and the desert Southwest
• Work with stakeholders and natural and social scientists on program development
• Facilitate partnerships between Arizona Cooperative Extension and the Institute for the Study of Planet Earth
• Expected areas of programmatic focus include the impact of climate variability/change on regional water supplies, range management, and forest ecology and management.
• 70% Extension/30% Research
Climate Science Extension

• NOAA recognized success of NASA model
  – Built on existing, proven model in Geospatial Extension position
  – Capitalized on existing infrastructure and social networks provided by Arizona Cooperative Extension

• Climate Science Extension recognizes needs and opportunities beyond traditional state climatologist role

• Arizona has first NOAA-sponsored Climate Science Extension program in country

• Climate extension concept is growing with support of top-level NOAA administrators and program managers
Why a ‘Climate Science’ Extension Specialist?

• Climate has traditionally been addressed within Extension by crop meteorologists, agronomists, and soil science specialists

• Arizona has unique climate-related extension needs beyond traditional agriculture
  – water resource management
  – land management
Program Objectives

- Improve climate literacy across Arizona and the greater southwest U.S.
- Increase the utilization of existing climate products and develop new tools
- Assist in the development of climate monitoring networks
- Encourage and facilitate public participation in climate science
- Ultimately develop an extension program that highlights the importance of climate science in resource management and contributes to sound policy development and decision-making
Why Extension?

Cooperative Extension is a non-formal educational network bringing research-based information into communities to help people improve their lives.

National Drought Committee members, 1936 (Library of Congress)
Infrastructure and People

- 68 FACULTY off-campus
- 43 FACULTY on campus
- 150 STAFF supporting programs
- 14,000 VOLUNTEERS
- 100,000 YOUTH enrolled in 4-H Youth Development programs
- 250,000 PARTICIPANTS in 2004

(from D. Young, 2005)
Flow of Climate Science and Services

Climate Science End Users
- **Federal & State Agencies**: U.S. Forest Service, Natural Resources Conservation Service, Bureau of Land Management, National Park Service, Bureau of Indian Affairs, Arizona Department of Water Resources
- **Professional Societies**: Arizona Society for Range Management, Southwest Vegetation Management Association, Arizona Hydrological Society

Climate Assessment for the Southwest
- NOAA RISA/Univ of Arizona

University of Arizona Climate Science Extension

National Oceanic & Atmospheric Administration

University of Arizona Research Community
Partnerships within Extension

- Working with Extension Specialists in other disciplines (e.g. range, watershed management, ag. economics)
- Regular meetings and working groups
- Programming climate science in existing programs
- Established relationships with communities around the state
Partnerships Outside of Extension

• Ongoing coordination and cooperation with CLIMAS
• Working with federal, state, and local land management agencies
• Bringing extension resources to state-level committees
• Collaborating with other on-campus research groups (e.g. SAHRA, ISPE, Arizona Remote Sensing Center)
Vertical Integration

- Workshop on climate change and range management organized in conjunction with Arizona Society for Range Management, CLIMAS & Cooperative Extension
- Presentations and panel discussions with both university and agency scientists were followed by a hands-on climate-range management exercise
- Pre & Post-workshop surveys conducted
Communications: Monthly to Seasonal Climate Bulletins

Southwest Climate Outlook

April 16, 2006 - Winter was exceptionally dry and warm for southwest Arizona with record. The winter period of January through March 2006 was the 9th driest (average Jan-Mar) and 10th warmest average Jan-Mar temperature, 51.4°F for climate division 7 (southwest Arizona) the 1930-2006 period of record. January and February were exceptionally dry across the entire state. Southwest Arizona received 0.50 inches of precipitation in February, and only received a trace in March 2006. The winter period was very dry for most locations across southwest Arizona due to the lack of crest snowpack. Arizona snowpack was 20% of average precipitation fell below 30 inches of snow during the winter period, with portions of Cochise County only receiving 7.0% of average winter precipitation. Snow conditions in Arizona March 2006 providing very limited snowpack relative to snowpack from previous years. Pima County received above average precipitation amounts, but most of Cochise County did not receive enough snow for seasonal snowpack.

Forecasts for the late spring-early summer season (May–June–July) from the Climate Prediction Center for the southwestern U.S. will see above-normal temperatures with a slightly increased chance of drought. A trend in above-normal temperatures is expected to continue leading to the above-average temperature forecast. The precipitation forecast is based on the continuation of weak La Niña conditions associated with Pacific Ocean. The spring is the summer monsoon season, which could lead to above-average precipitation based on current and forecasted circulation and sea-surface temperatures. (More information at http://cpc.ncep.noaa.gov/products/precip/stratus/straw_SINGLE.html.)

Monsoon

The seasonal outlook for southwest Arizona 2006 did show some development in the season’s early stages. However, the Southwest is also one of the most unstable regions in the United States. It is also possible for snowfall damage due to Arizona’s 18th percentile flood potential and has the potential for more intense storms.

Northwest Arizona Climate Summary

September 24, 2006 - Exceptionally dry conditions experienced across northwest Arizona during the winter of 2006-2007. This year’s winter conditions were below the long-term average of 0.34 inches. Precipitation amounts for July around the Kingman area measured by the Mohave County Flood Control weather station were near or below 0.15 inches per month, indicating very dry conditions. The Mohave County Flood Control weather station measured 0.10 inches of rainfall for July which is below the long-term average of 0.30 inches. Conditions have been dry across northwest Arizona for the past 3 months. Temperatures have been generally 2-4 degrees above average through the 2006 winter season. Forecast conditions for the upcoming fall season (October-November-December) from the Climate Prediction Center indicate that the southwest U.S. will see an increased chance of above-normal temperatures with equal chances of above-average precipitation amounts. A trend in above-normal temperatures is expected to continue leading to the above-normal temperature forecast. The “weak” La Niña precipitation forecast is an indication that there is no strong ENSO signal on which to base either an above or below-average precipitation forecast for this fall. This is due to the fact that fall weather patterns over the southwest are not strongly tied to circulation patterns and sea-surface temperatures over the Pacific Ocean. Weak El Niño conditions have developed and may continue into the winter season, leading to an increased chance of above-average temperature precipitation for Arizona. Winter temperature forecasts are strongly based on the Pacific Ocean sea-surface temperature patterns related to the ENSO Southern Oscillation (i.e. El Niño and La Niña events). (Note: to view the latest climate forecasts, visit www.cpc.ncep.noaa.gov.)
Communications: Extension Bulletins

• ‘Outreach’ publication
• Being developed with diverse partners (e.g. CLIMAS, NOAA-NWS, AzDWR)
• Peer-reviewed
• Wide distribution through extension county offices, programs, & websites
• Very few existing climate related publications

- Using Seasonal Climate Forecasts
- Monitoring Drought
- Finding and Utilizing Climate Products
- ENSO and Arizona
- Climate Change in Arizona
Extending Information on Climate Change

- Critical need for cutting edge climate change information
- Extension approach has included workshops, presentations to community groups, fact sheets, web-site development, and tools for teachers
- New approach under development: Team of social scientists and climatologists developing strategy to map out social networks of science/policy communications at county-level.

Hoerling & Eischeid 2007
Extension Example: Arizona Drought Preparedness Plan

- Coordinated effort led by ADWR to monitor drought, recommend actions to Governor and provide planning support to citizens of Arizona
- Plan works to empower local communities to develop drought plans and mitigation strategies
- Sustained focus on issue through wet and dry cycles
- Extension is taking a leadership role at county level
Organizational Structure

Governor’s Office & Cabinet

Arizona Department of Water Resources

Monitoring Committee

Interagency Coordinating Group

Local Area Impact Assessment Group(s)

Monitoring & Preparedness

Mitigation & Response

Assessment & Adaptation

From ADWR 2006
Local vs. National Drought Monitoring

**U.S. Drought Monitor**

**Arizona**

**October 10, 2006**

*Valid 8 a.m. EST*

<table>
<thead>
<tr>
<th>Drought Conditions (Percent Area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
</tr>
<tr>
<td>Current</td>
</tr>
<tr>
<td>Last Week: (10/3/2006 map)</td>
</tr>
<tr>
<td>3 Months Ago: (7/11/2006 map)</td>
</tr>
<tr>
<td>Start of Calendar Year: (1/1/2006)</td>
</tr>
<tr>
<td>Start of Water Year: (10/15/2006)</td>
</tr>
<tr>
<td>Cane Year Ago: (6/11/2006)</td>
</tr>
</tbody>
</table>

*Intensity:*
- **DO Abnormally Dry**
- **D0 Drought - Moderate**
- **D1 Drought - Extreme**
- **D2 Drought - Severe**
- **D3 Drought - Exceptional**

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Thursday, October 12, 2006

*Author: Rich Tinker, Climate Prediction Center, NOAA*
County Drought Impacts Reporting

- Critical link to corroborating observing network data
- Reporting worksheets developed with local guidance
- More timely response to the development of emergency or disaster level drought impacts
- A cooperative effort between UofA Coop Ext, CLIMAS, AZ Dept of Water Resources and the GDTF
Citizen Scientists and Climate Science

- Citizen science is the effort of volunteers (regardless of age, location, or experience) in gathering data about our environment. (http://www.citizenscience.ca).
- Arizona could be the *citizen science* state!
  - Unique and challenging environmental concerns (water resources, land management, wildfire…)
  - Quickly changing demographics (new citizens to the state, large population of skilled and interested retirees)
- Successful citizen science programs already exist within cooperative extension
  - Master Watershed Steward
  - Master Gardener
- Great opportunities for both citizens and researchers to partner around climate science
- Researchers fundamentally need public to be engaged in their research and can benefit from their informal datasets (e.g. backyard rainfall or observations of flora and fauna)
Master Watershed Steward Program

- Adult environmental education program = training citizen scientists
- Similar model to Master Gardener
- Climate is a core part of curriculum
- Service requirement
- Stewards = volunteer drought monitoring network (precipitation, drought impacts, phenology...)
**RainLog: Volunteer Precipitation Monitoring Network for Arizona**

- Network developed by SAHRA and Arizona Cooperative Extension in support of state drought monitoring needs
- Has over 400 volunteers and is continuing to grow
- More observations for characterization of drought
- Tool to manage personal data (*My Rainlog*)
- Opportunity to engage public on climate and drought concepts
Visualizing rainfall data

RainLog data can be shown:
- on maps for a user-defined time period
- as a time series plot
- in tables
My RainLog

- Encouraging volunteers to submit, store, and manage their own historical data
- Special functions and tools to create reports and graphics
- Historical data allows for calculations of ‘normals’ and percentiles useful in drought monitoring
- Further engages volunteers as Citizen Scientists

Check out http://www.rainlog.org for more information!
Current Rainlog Volunteer Map: 600 members
Partnering with Citizen Scientists

- Mr. Dave Bertleson, amateur botanist
- Hiked Finger Rock Trail 1,024 times between 1983-2004
- Collected phenological observations on over 400 species (total of over 110,000 records)
- Partnering on data analysis and connecting to National Phenology Network

Finger Rock Trail, Santa Catalina Mtns. (courtesy of W. van Leeuwen)
Finger Rock Trail Phenology

- Partnering on data analysis to support development of local phenology monitoring protocols and quantification of ecological change (w. T. Crimmins, W. van Leeuwen, M. Losleben, and J. Balmat)
- Community level pheno-climate analysis complete
- Additional work on interactions between trends in temperature and observed phenology changes
Increasing temps and phenology changes

- Late summer (JASO) perennial blooms in mile 5
- Summer (JAS) temperature
Thanks!

http://cals.arizona.edu/climate