



# DRY TIMES

NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM NEWSLETTER

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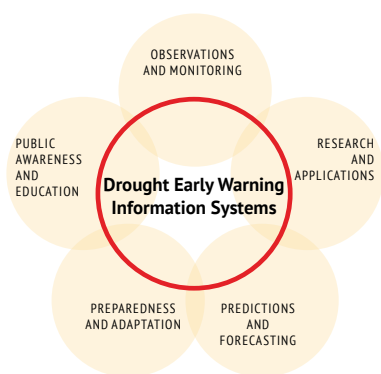


Receding water levels in August crowded houseboats at New Melones Lake, east of Stockton, California. As of Sept. 10, 2014, water storage at the lake was at 39% of the historical average. Find current water levels at major California reservoirs at <http://cdec.water.ca.gov/cdecapp/resapp/getResGraphsMain.action> . ANDREW WILLIAMS PHOTO



**National Integrated Drought Information System**  
325 Broadway, Boulder CO 80305

Roger Pulwarty, Director  
(Roger.Pulwarty@noaa.gov)  
Veva Deheza, Deputy Director  
(Veva.Deheza@noaa.gov)  
Chad McNutt (Chad.McNutt@noaa.gov)  
Claudia Nierenberg  
(Claudia.Nierenberg@noaa.gov)  
Kathleen Bogan (Kathleen.Bogan@noaa.gov)  
Michael Brewer (Michael.J.Brewer@noaa.gov)

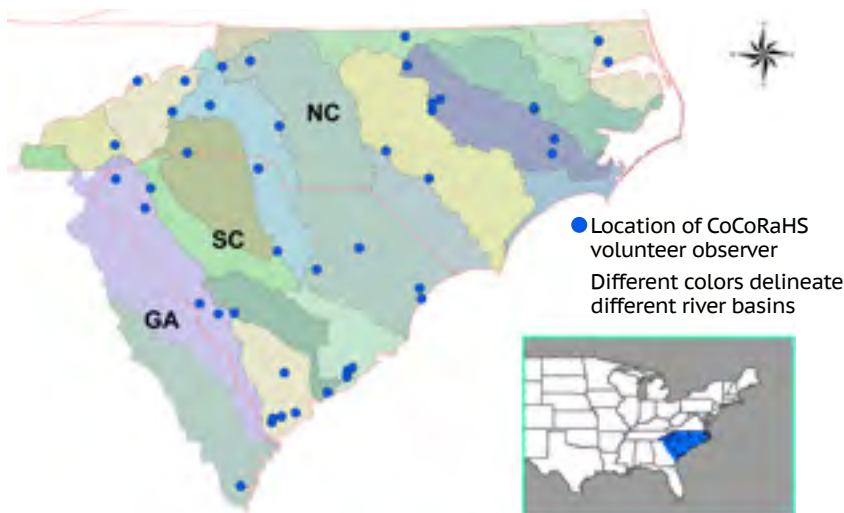


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## RESEARCH

On-the-ground observations from community members in the Carolinas paint a picture of drought -- or its absence



# Tapping grassroots for impacts data

**BY AMANDA BRENNAN**  
Carolinas Integrated Sciences & Assessments

Since September 2013, researchers with the Carolinas Integrated Sciences & Assessments (CISA) have been recruiting citizen scientists throughout the Carolinas to participate in a project aimed at providing on-the-ground information about how precipitation, or a lack thereof, affects communities and ecosystems in the Carolinas. Using tools developed by the Community Collaborative Rain, Hail, and Snow (CoCoRaHS) network, volunteers submit daily precipitation measurements and weekly status reports about local conditions and any changes that week. Volunteers have submitted over 550 reports to date describing a variety of aspects of their local environments such as soil moisture conditions, water levels in local rivers, lakes, and streams, and impacts to flower and vegetable gardens this summer.

As part of the NIDIS Carolinas Drought Early Warning System (DEWS) pilot, one objective of this project is to assess ways in which citizen science can contribute to drought impacts monitoring. CISA team members are analyzing the reports by coding them according to the National Drought Impact Reporter categories (e.g., agriculture, water supply and quality,

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#### ABOUT CISA

Based at the University of South Carolina, the Carolinas Integrated Sciences & Assessments (CISA) is one of eleven NOAA-funded Regional Integrated Sciences & Assessments. CISA's work includes activities to advance scientific understanding of climate and hydrological processes in the Carolinas, improve the assessment of climate-related vulnerabilities and impacts, and provide timely and relevant information for decision makers.



Calendar marks 2015 with a salute to citizen science

# Show us your gauges



Reges delivers for analysis the U.S. record hailstone that fell in Vivian, South Dakota, in July of 2010 to the National Center for Atmospheric Research in Boulder, Colorado.

**BY KATHLEEN BOGAN**  
NIDIS Communications Specialist

Henry Reges is “an artistic kind of guy,” he says. He’s also the CoCoRaHS National Coordinator. And what does an artistic kind of guy do to promote his organization? He finds a way for 20,000 volunteers to “show off their gauges.”

Those gauges are rain gauges, the stars of the 2015 CoCoRaHS Rain Gauge Calendar, which showcases twelve months’ worth of portraits depicting the clear plastic tubes. CoCoRaHS volunteers use the tubes to measure precipitation. They send data they collect to the CoCoRaHS website, where CoCoRaHS turns it into numbers and maps that aim to “provide the highest quality data for natural resource, education and research applications.” Texas boasts the most volunteer observers, with Colorado second. There’s even a volunteer whose gauge is on a 70-story apartment building in downtown Chicago.

Reges came up with his brainchild calendar in 2010, and solicited photographs from the CoCoRaHS network of volunteers. CoCoRaHS headquarters narrowed that first year’s crop of submissions down to those with the most personality and best photographic quality, cropped and laid them out, and sent them off to BrownTrout Publishing ([browntrout.com](http://browntrout.com)). The



CoCoRaHS rain gauge calendar was born.

The calendar’s quality can hold its own with any of the slick fine-art ones displayed at your local bookstore that show 12 months of tulips or Our National Parks or Amish quilts or any other image collection.

For the 2015 calendar, about 900 picture entries came in, from about 800 contributors. Four images around a theme for each month were selected. January gauges are hairy with hoarfrost; March features critters. April gauges are by bodies of water. June is the desert. And so forth.

Every contributor whose image made the cut got a calendar. Compensation beyond that is a credit line.

The calendars are one of CoCoRaHS’s fundraising efforts to keep the network going. The calendars retail for \$14.99, or you can purchase one for \$13.50 plus shipping at <http://www.weatheryourway.com/cocorahs/cal2015coco.htm>.

If you have a rain gauge you’d like to make famous for 2016, take a shot of its best side and send it to [hreges@atmos.colostate.edu](mailto:hreges@atmos.colostate.edu).

## More information

Learn more about CoCoRaHS at (the Community Collaborative Rain, Hail & Snow Network) at <http://www.cocorahs.org/>.

Donors of \$50 or more to CoCoRaHS get a calendar free! Donate here: <http://www.cocorahs.org/Content.aspx?page=2014yearend>

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business and industry, tourism and recreation, etc.). They are also coding reports according to spatial scale (i.e. are observers reporting about their backyard, neighborhood, community, or a broader region) and status of on-the-ground conditions (e.g. are conditions normal, drying, getting wetter, getting worse or improving).

Earlier this summer, US Drought Monitor (USDM) authors were looking closely at the possibility of emerging drought in the Southeast. Information about the project and condition monitoring reports submitted in the weeks leading up to the dry period were shared with USDM authors to consider in their analysis. Since that time, central and eastern regions of the Carolinas have moved in and out of D0 (abnormally dry) status on the Drought Monitor while condition monitoring observers

continue to share information about changing conditions on the ground.

CISA team members are maintaining regular communications and supporting continued learning opportunities for volunteers so that they have a better understanding of the type of information useful to include in their reports. Communication efforts include a monthly newsletter, project web page, and the ‘Cuckoo for CoCoRaHS in the Carolinas’ blog. Each Monday a ‘Condition Monitoring Star of the Week’ is selected from submitted reports. The report is highlighted in the blog along with notes about what makes it a good report from the project’s perspective. You can find more information about the project, including a link to the most recent newsletter and the blog on the project web page, <http://www.cisa.sc.edu/CoCoRaHS.html>.

Bills passed by the California legislature incorporate research team's discussion of sustainable yield and recommendations on groundwater withdrawal

# Reducing groundwater overdrafts, developing a buffer

Principal Investigator:

**RUTH LANGRIDGE**  
University of California,  
Santa Cruz  
rlangrid@ucsc.edu

Co-Principal Investigator:

**NIGEL QUINN**  
University of California,  
Merced and Lawrence  
Berkeley National  
Laboratory  
nwquinn@lbl.gov

Co-Principal Investigator:

**BEN CROW**  
University of California,  
Santa Cruz  
bencrow@ucsc.edu

Our project is evaluating a key adaptation strategy to reduce the risk of water shortages associated with climate-related extreme drought events: the establishment of local groundwater drought reserves. Our project is based in California where the severe drought has exposed the need to more sustainably manage this critical resource. Although many of the state's groundwater basins are already in overdraft, pumping has increased significantly to compensate for reduced surface supplies. This has amplified overdraft impacts including land subsidence in parts of the Central Valley and seawater intrusion along the coast.

To lay the groundwork to manage the more extreme droughts predicted under climate change, and sustain the resource over the long term, our research is centered on the processes and relations involved in reducing overdraft and developing a groundwater reserve to buffer future droughts.

This past year we focused on:

- Identifying factors that motivate agencies and community members, in areas with long-term groundwater overdraft and significant conflicts over water, to reduce drought vulnerability through

improved groundwater management and the development of a drought reserve;

- Analyzing the impacts of establishing and sustaining a local drought reserve versus a no-reserve option, and outlining an integrated modeling approach to calculate financial costs and benefits;

- Developing an approach to determine sustainable groundwater thresholds.

Our study site is the Pajaro Valley Watershed, an area of coastal California where groundwater is the sole source of supply and where a potential reserve could be both located and used during a drought. Challenges in the region include long-term groundwater overdraft in the valley that continues today, and conflicts over water management.

## Part I: Investigating stakeholder concerns

For Part I, our team conducted more than 25 semi-structured interviews with a range of stakeholders in the valley, and met several times with Pajaro Valley Groundwater Management Agency scientists. Our objective is to assess how stakeholders perceive their resource, and the people and processes that influence groundwater management. We identified stakeholders, developed interview questions and analyzed data using the qualitative research analysis software NVivo 10. Our aim is to consider not just agency issues but also a wider range of stakeholder concerns in our analysis of factors that motivate communities to both improve groundwater management and increase drought resilience through the establishment of drought reserves.

Our initial studies are: 1) illuminating the multiple constellations of community that arise within the shared watershed and how these influence different management approaches, and 2) identifying who is included and excluded in decision-making processes around groundwater management.

## Part II: Developing a framework for evaluating water restrictions

For Part II, we examined an extensive body of literature on impact and cost/benefit analysis; investigated several different potential models including agency models; developed an economic

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### Seawater (SW) Intrusion within the Pajaro Valley

90% of water in Pajaro basin is pumped groundwater

Extent of SW as of 1951

Extent of SW as of 1966

Extent of SW as of 1998

Extent of SW as of 2011

Chloride contours are set to concentrations of 100mg/L



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profile of the Pajaro Valley and an impact analysis of reduced groundwater supplies for the region. We considered land use, including land use type, total agricultural acreage, urban acreage and native vegetation; water usage, including crop patterns and the proportion of costs spent on water, per crop, in the coastal zone; and municipal changes, including population and employment. Our aim is to assess the long-term economic benefits of sustaining the resource and developing future drought reserves.

We put together an initial framework to first consider the economic implication of a given percentage of water restrictions on all water users utilizing a water balance analysis with climate simulations to indicate how likely those scenarios will be.

### Part III: Assessing approaches to influence groundwater levels

For Part III, we examined how agencies across California, as well as in other states and countries, are currently approaching the establishment of a sustainable yield metric, and whether and how climate change and drought considerations are included. Our goal is to assess how different approaches to incorporate drought protection in determining water budgets, and particularly groundwater withdrawals, could influence long-term groundwater levels.

We are pleased that in the past year California legislators and agencies, and the Governor's Office of Research and Planning, expressed interest in our research. Along with other groundwater scientist and practitioner contributions, our discussion of sustainable yield along with a recommendation to develop state-local cooperative structures to establish enforceable standards for groundwater withdrawals, are now included in bills just passed by the California legislature.

## Kids try a hands-on game of water management



Four- to eight-year-olds at a day camp program ponder which sectors should get the water, represented by glass slugs, in this water management and drought awareness game.

## Making the idea of drought click

If you're the boss, how much water would you give to the farms that grow your food? To the lakes and streams where the fish and animals live? To the power plants that make the electricity that runs your television?

And what happens if the next year, you only have half as much water to hand out?

Some Boulder, Colorado, kids answered these questions through a water budgeting game meteorologist Lisa Darby developed in collaboration with the National Drought Mitigation Center (NDMC) in Lincoln, Nebraska. The kids were part of an August day camp program at a local non-profit, the Safehouse Progressive Alliance for Nonviolence.

The game covered where our water comes from, how it's used, and what might happen if a drought occurs. (Guess what uses the second biggest proportion of household water in Denver? Toilets!)

Darby introduced the concept of budgeting by showing what \$7 would buy at Burger King: a burger + fries + chicken nuggets + a drink, OR a BBQ

Bacon Whopper + fries. With that idea in mind – that a budget means you have to make choices, and when you run out, you run out – the kids then assigned water “droplets” (glass tokens) to a game board, choosing which sectors got more and which less.

Then, game change: Darby took half their tokens. With half as much water, the kids had to rethink where it all went. To the fish? The farmers raising their food? The power that keeps the TV on? There were no right or wrong answers; it was all about awareness.

Darby customized the game for four- to eight-year-olds, and eight- to twelve-year-olds, using Colorado-specific scenarios. Together with colleagues at NOAA and the NDMC she hopes to develop the exercise for school groups visiting NOAA.

For more information contact Lisa Darby ([lisa.darby@noaa.gov](mailto:lisa.darby@noaa.gov)) or Nicole Wall ([nwall2@unLedu](mailto:nwall2@unLedu)).



Rapid decreases in evapotranspiration measurements warn of increased risk for drought development within two to eight weeks

# New metric measures rate of change in moisture stress

**BY JASON OTKIN**

University of Wisconsin-Madison

**MARTHA ANDERSON**

United States Department of Agriculture

**CHRISTOPHER HAIN**

University of Maryland-College Park

**MARK SVOBODA**

University of Nebraska-Lincoln

Prior research has shown that a reliable signal of incipient drought stress can be obtained using land surface temperature observations via satellite thermal infrared (TIR) imagery. The reason for this is that as the root zone soil moisture decreases, canopy temperatures rise in comparison with unstressed vegetation because less energy is used to evaporate water in a process known as evapotranspiration (ET). Instead more energy is available to heat the vegetation.

The Atmosphere-Land Exchange Inverse (ALEXI) surface energy balance model uses measurements of morning surface temperature rise to estimate ET with high spatial resolution across large geographic areas. Drought severity can then be inferred through reductions in the ratio of the actual to potential ET, as expressed by the Evaporative Stress Index (ESI), which is computed using multi-week ET composites.

The ESI is uniquely sensitive to rapid changes in soil moisture because an energy-balance approach can account not only for the impact of rainfall deficits on vegetation health, but also for

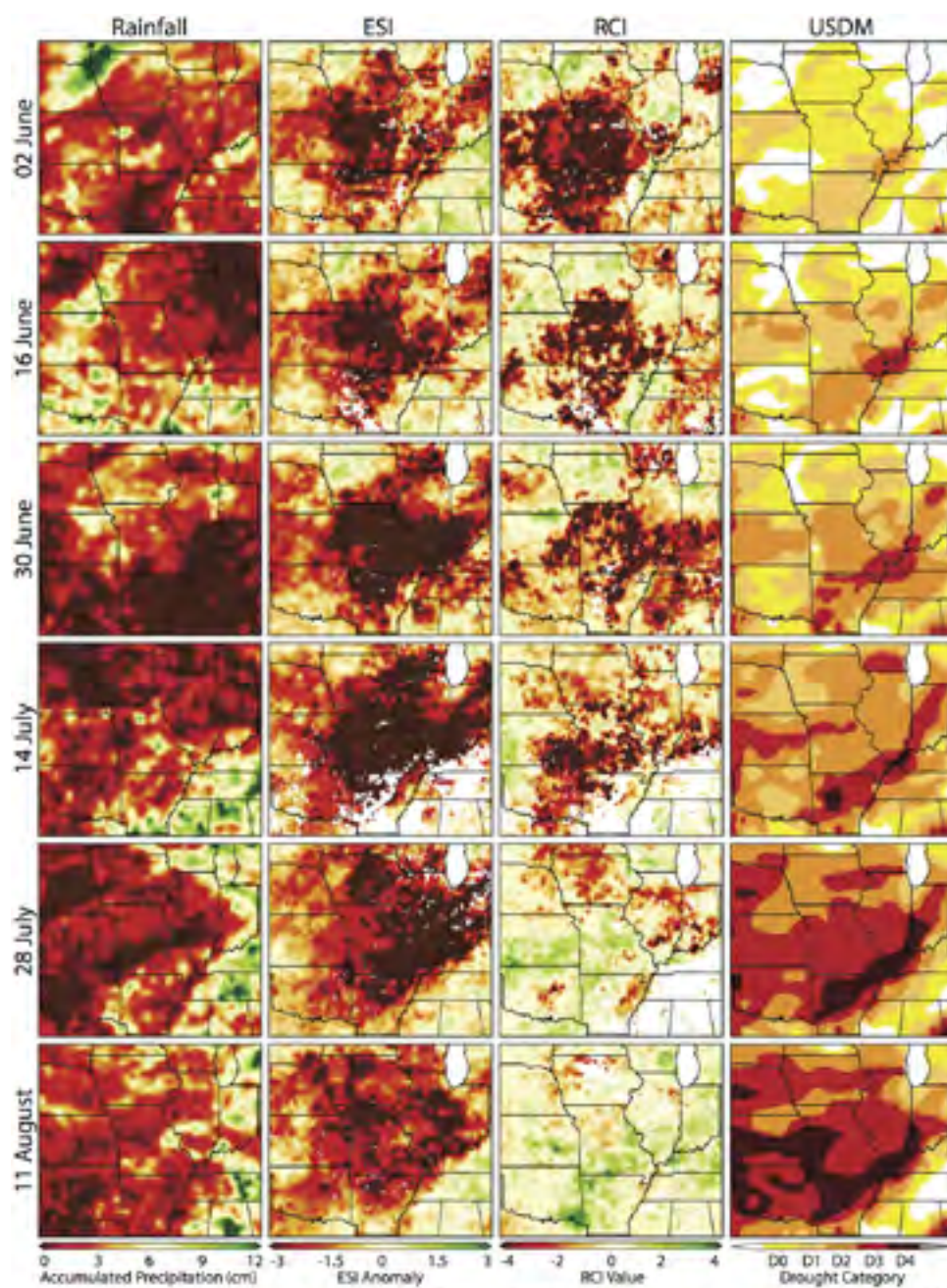


Fig. 2. Evolution of 2-week rainfall, ESI, RCI, and USDM from 02 June until 11 August 2012.

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the impact of hot temperatures, strong winds, and sunny skies that also contribute to rapid drought development. Daily updates to the ESI for the continental U.S. are disseminated during the growing season (March–October) via the web at <http://hrl.arsusda.gov/drought/>, and through the NIDIS drought portal (<http://drought.gov/drought/content/products-current-drought-and-monitoring-remote-sensing/evaporative-stress-index>).

### A new metric: the Rapid Change Index

Recent results have shown that unusually rapid decreases in the ESI can provide substantial early warning of an increased risk for drought development occurring over sub-seasonal time scales (two to eight weeks). Because anomalous weather patterns conducive to drought development can persist for several weeks, large weekly decreases in the ESI can also occur for an extended period of time.

To account for this behavior, we developed a new drought metric known as the Rapid Change Index (RCI) that depicts the total rate of moisture-stress change occurring over longer time periods and is designed to identify areas undergoing rapid increases in moisture stress.

During the 2012 flash drought across the central U.S. (see image on page 8), the impressive scale of the rapid decreases in the ESI is clearly depicted by the large area of negative RCI values at the beginning of June, which spread to surrounding areas in later

weeks. In many locations, the initial appearance of negative RCI values preceded by more than a month the introduction of extreme (D3) drought conditions depicted in the U.S. Drought Monitor. Improved use of this drought early warning information may promote drought mitigation activities.

### Research directions

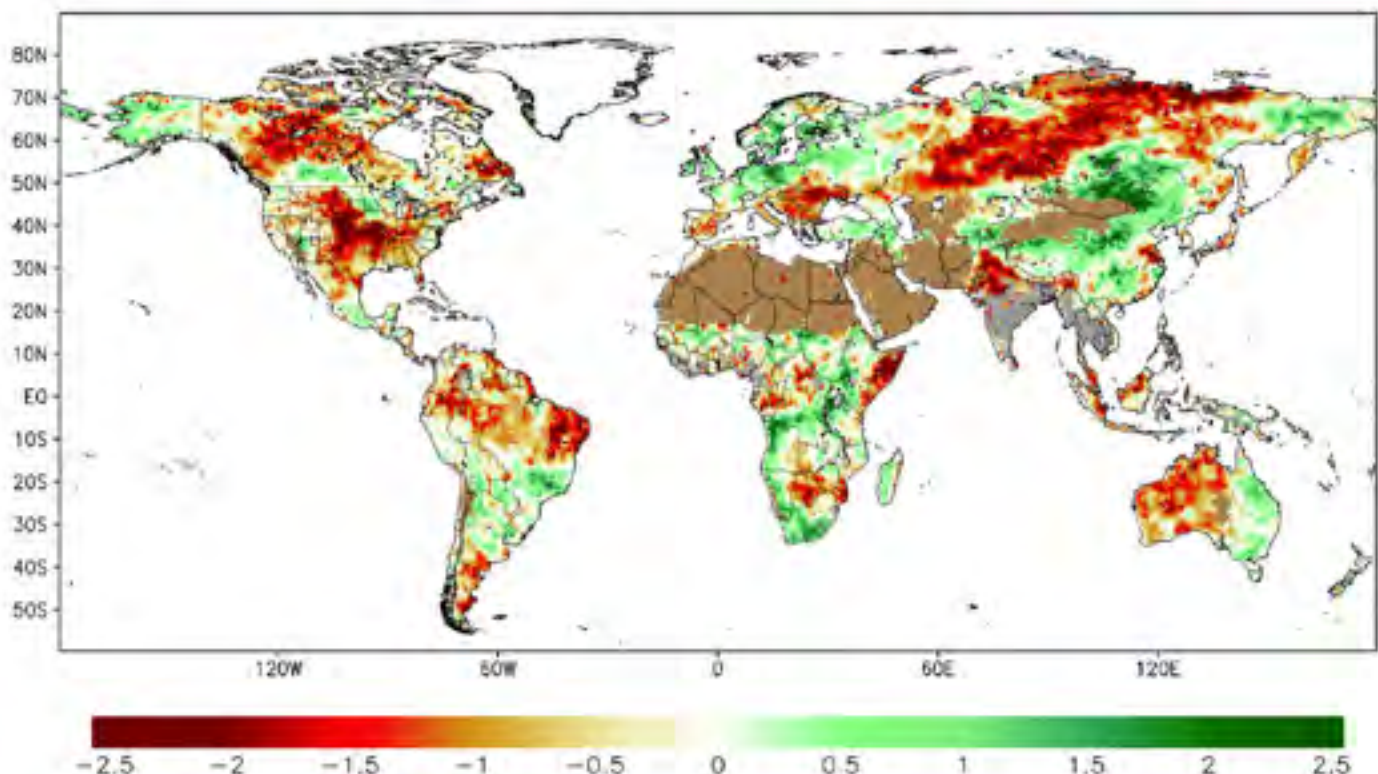
To further enhance the utility of the ESI and RCI as drought early warning tools, we are currently developing methods to generate drought intensification probabilistic forecasts using the RCI.

We held focus group meetings with stakeholders in the agricultural sector this summer to better understand how they could use the drought early warning information provided by these products to reduce their exposure to drought. These discussions have provided valuable guidance concerning the dissemination and visualization of this information.

In addition, routine production of the ESI over North America is being transitioned to operations as part of the GOES Evapotranspiration and Drought Product System (GET-D) at NOAA's Office of Satellite and Product Operations. ESI products will be available operationally by mid-2015 covering most of North America.

Additional research includes development and evaluation of global-scale ESI products using a newly developed methodology incorporating day-night LST differences to estimate mid-morning LST rise needed by ALEXI (see figure below).

The Evaporative Stress Index (ESI) shows higher and lower than normal evapotranspiration rates from the land surface, corresponding to areas of higher and lower water use. <http://hrl.arsusda.gov/drought/>





Surveys of 864 agricultural advisers show their attitudes toward climate change appeared unchanged by 2012 drought -- but perception of risk increased

# Does an extreme event shift attitudes toward climate risk?

**BY MELISSA WIDHALM**

RESEARCH TEAM:

**LINDA S. PROKOPY, MICHAEL DUNN, MELISSA WIDHALM**

Purdue University

**AMBER S. MASE**

University of Wisconsin

**NICK BABIN**

Taylor University

**STUART CARLTON**

Texas A&M University

**LOIS W. MORTON, JEAN MCGUIRE, CHAD HART**

Iowa State University

**CODY KNUTSON, TONYA HAIGH**

National Drought Mitigation Center, University of Nebraska-Lincoln

**MARIA C. LEMOS**

University of Michigan

Understanding the impact of extreme events on peoples' climate risk perceptions has important implications for developing effective communication strategies, motivating people to take action, and improving disaster readiness. However, the relationship between extreme events and changing beliefs and attitudes is inherently difficult to study in part due to the unpredictable nature of weather disasters.

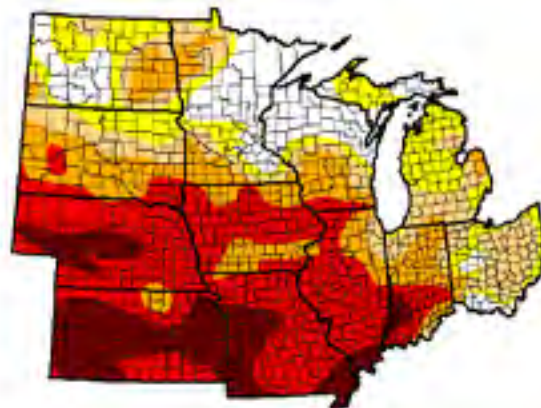
With support from the NOAA Sectoral Applications Research Program (SARP) our team is leveraging survey research conducted by the USDA-funded Useful to Usable (U2U) project with additional social science research to gain a unique perspective of how the 2012 drought influenced the farming sector. In this ongoing, two-year effort we specifically focus on agricultural advisers in the U.S. Corn Belt because they are highly influential members of the agricultural community, and farmers rely heavily on their expertise to support on-farm management decisions.

Our research seeks answers to the following questions:

- Did the 2012 drought change advisors' perceptions of risk associated with climate change?
- Did the 2012 drought change advisors' beliefs about the existence and/or causes of climate change?
- Did the 2012 drought change advisors' willingness to respond to climate change?
- Are agricultural advisers ready to use climate information in their decision making?

## More concern with flooding, runoff

We used results from two surveys<sup>1</sup> conducted before and after the record-setting 2012 Midwestern



The U.S. Drought Monitor for August 21, 2012, showed the North Central states undergoing drought conditions, with 14 percent of the region experiencing exceptional drought (D4).

drought to determine if or how the drought affected agricultural advisers' risk perceptions, climate change beliefs, and/or adaptation attitudes. This opportunistic natural experiment included responses from 864 advisers in Indiana, Iowa, Michigan, and Nebraska, who participated in both surveys and experienced varying levels of drought severity in their region.

Our preliminary analysis revealed that advisers' climate change beliefs *did not* significantly change after the 2012 drought. Additionally, attitudes towards climate change adaptation and advisers' willingness to use climate information *did not* significantly change after the 2012 drought. However, we found that risk perceptions *did* change. Specifically agricultural advisers reported increased concern with drought, heat, weeds, insects, and disease. They reported decreased concern related to flooding, ponding, and nutrient runoff.

From these early findings we conclude that for sectors regularly affected by weather variability, such as agriculture, a single event like the 2012 drought may not be enough to cause a shift in climate change beliefs and, subsequently, adaptive

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## More information

To see a webinar recording of findings from this research, go to <https://www.youtube.com/watch?v=p9radX-mQQ>

To see slides from the webinar, go to [http://www.jscarlton.net/files/talks/carlton\\_NIDIS\\_Webinar.pdf](http://www.jscarlton.net/files/talks/carlton_NIDIS_Webinar.pdf)

1 The Climate Needs Assessment Survey was conducted by the Useful to Usable (U2U) project in February and March 2012 (pre-drought) and repeated in February and March 2013 (post-drought). Additional information about U2U is available at [AgClimate4U.org](http://AgClimate4U.org).



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behaviors. However, heightened risk perceptions after an extreme event may present an opportunity to build readiness toward specific climate impacts.

### In-depth interviews explore climate beliefs

Agricultural systems are complex, and weather and climate are among many factors that influence risk perceptions, planning decisions, and farming success. To capture these intricacies and provide context to our survey research we conducted 57 in-depth interviews with agricultural advisors between December 2013 and April 2014. Participants included Certified Crop Advisors (CCAs), staff at conservation agencies, agricultural bankers, and university Extension personnel located in Indiana, Iowa, and Nebraska.

These interviews used a series of open-ended questions to broach a diversity of interrelated yet distinct topics, including climate beliefs, financial considerations, Farm Bill impacts, and more. Analysis is ongoing and results will be used to improve our understanding about how attitudes and perceptions are formed in an individual and to gauge advisors' readiness to use climate information.

### Looking Ahead

With future climate projections pointing to likely increases in the frequency of extreme events there is interest in learning how we can rally support for mitigation and adaptation efforts, and whether such events result in specific challenges or opportunities for influencing behavior. Early analysis shows a complex connection between extreme events and climate risk perceptions. Our project team is continuing to explore the many facets of this issue with final results expected in 2015 at the conclusion of our project.

## Increasing drought resilience in the Missouri River Basin



Participants pose for a group photo during the workshop. BETHANY PERRY PHOTO

## Gathering engages Tribes, scientists, local and national organizations

**BY BETHANY PERRY**

NOAA Central Region Collaboration Team

Tribal representatives, scientists, academicians and members of both state and federal governments gathered in September in Rapid City, S.D., to discuss drought and climate change, impacts, early warning systems, and planning for extreme events.

The meeting, sponsored by NIDIS, focused on engagement with the tribes in the Missouri River Basin. Sixteen of twenty-eight tribes from the Basin attended, as well as two tribes from Oklahoma with Missouri Basin roots.

A goal of the workshop to share information about the history and culture of the tribes residing in the Missouri River drainage, specifically about impacts from local weather and climate. The workshop built on NIDIS' previous and current work in the Basin, to strengthen lasting relationships with the tribes. The goal of the ongoing activities is to increase drought planning and resilience.

At the workshop tribal representatives shared the conditions, needs and efforts in

their lands to prepare for climate extremes and drought. Key drought partners from various sectors delivered information on resources and opportunities to work together on resilience and planning.

NIDIS, NDMC, NOAA Regional Collaboration, tribal individuals, the American Association of State Climatologists and the HPRCC organized and presented the meeting.

Next steps:

- Exploring opportunities to expand and strengthen monitoring capabilities throughout tribal lands

- Investigating partnerships with tribal colleges to build capacity for climate and drought planning efforts with their specific tribe

- Continuing outreach to the tribes in the basin through several mechanisms, including direct outreach to tribal councils.

- Expanding funding potential via other federal agencies and programs.

A more detailed report specifying outcomes and next steps will be forthcoming.

Next steps in study include quantifying impact of pumping for irrigation, developing procedure for forecasting groundwater levels, examining management policies

# Groundwater measurement as drought indicator in Southeast

**BY PUNEET SRIVASTAVA**

Auburn University  
with

**SUBHASIS MITRA**

Auburn University

**SARMISTHA SINGH**

Auburn University

**LYNN TORAK**

U.S. Geological Survey

**MARK**

**MASTERS**

Georgia Water  
Planning and Policy  
Center

**DAVID YATES**

National Center for  
Atmospheric Research

**KATHLEEN MILLER**

National Center for  
Atmospheric Research

In the Southeast, large seasonal to inter-annual climate variability that causes frequent droughts is considered to be greatly influenced by El Niño Southern Oscillation (ENSO). El Niño years tend to be cool and wet, while La Niña years tend to be warm and dry between October and April there.

Dry winter conditions caused by La Niña have an enormous impact on the southeastern states (especially Alabama and Georgia) because those states depend on water recharge during the cool season. Recurring droughts, caused by La Niña, led NIDIS to select the Apalachicola-Chattahoochee-Flint (ACF) River Basin as a pilot for developing a Drought Early Warning System (DEWS) for the Southeast. NIDIS efforts in the basin have resulted in the development and use of a number of drought indicators derived from measurements of precipitation, stream flows, and lake levels.

Since the ACF River Basin (and much of the Southeastern Coastal Plain) exhibits a highly interacting surface-groundwater system, this NIDIS-funded project is investigating groundwater levels as

an indicator of drought.

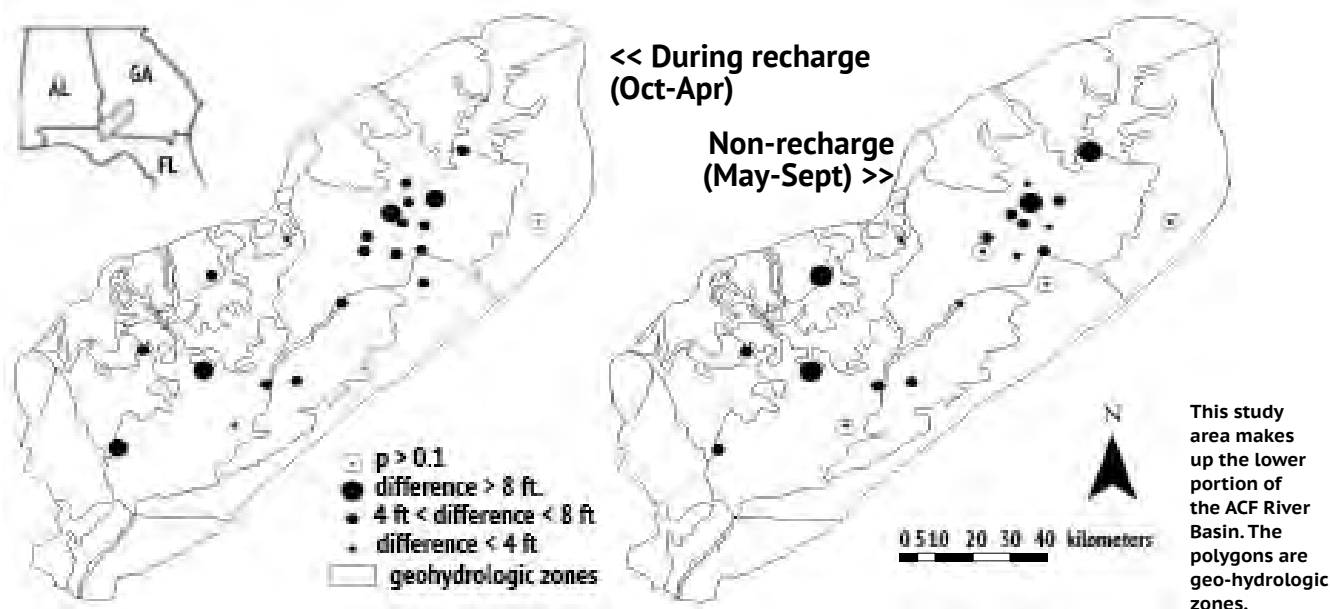
Compared to other indicators, groundwater levels respond to droughts at a different time scale and integrate the effect of drought over larger area. Therefore, together with other indicators, they can provide a more complete picture of the severity, spatial extent, and recovery from drought, and can be used to develop more effective drought triggers and response policies.

## Groundwater levels lower during La Niña

Our team used 21 groundwater observation wells with 30 years of monthly groundwater level data to study the relationship between ENSO and groundwater levels. Wavelet analysis techniques were used to study the teleconnection, while the Mann-Whitney tests were conducted to quantify the impact. The effect of prolonged La Niña on groundwater levels and their corresponding recovery periods were also studied. Results of the wavelet analysis indicated that wells representing shallow and moderately deep

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## Differences in groundwater level anomalies produced by El Niño and La Niña phases





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overburden conditions respond to ENSO in the periodicity of 3–7 years. Mann-Whitney tests found significant differences in groundwater level anomalies between El Niño and La Niña for all wells, except for one in deep overburden condition. Groundwater levels were higher than long-term average during El Niño phases, while lower than average during La Niña phases.

Comparison of La Niña phases representing severe (2000–01) and average condition (1988–89) indicated that groundwater levels dropped approximately twice as much during the severe La Niña as compared to the average La Niña event. Recovery times for the severe La Niña during 2000–01 were significantly longer (22 months vs. two months) than those during the short La Niña of 1988–89.

This study illustrated that La Niña severely impacts groundwater levels in the study area, especially during severe events. The prolonged recovery periods during severe droughts validate the point that groundwater levels fluctuate at a different time scale as compared to soil moisture and stream flows. The study suggests that groundwater levels should also be used (in combination with precipitation deficit, soil moisture, stream flows and others) as an indicator of drought in this area.

### Other factors: Irrigation, geohydrology

We found, however, that the role of irrigation cannot be ignored for such large recovery periods because groundwater level depletions during droughts are caused not only by the lack of precipitation, but also because of increased irrigation pumpage.

Further, groundwater levels are affected by local geohydrologic characteristics. Therefore, in order to use groundwater levels as an indicator of drought in this region, a number of wells in different geologic formations and overburden conditions should be used. The results obtained can also be used to develop procedures for forecasting groundwater levels, which can then be used to better manage groundwater resources of this region.

The project team is now

- quantifying how pumping for irrigation exacerbates the effect of drought on groundwater levels and streamflows

- developing a procedure for forecasting groundwater levels, and

- analyzing pros and cons of existing drought management policies in an attempt to propose a set of policy alternatives that can be used to effectively manage drought in the basin.

The project has two specific outcomes. First, the project will develop a spatially-explicit groundwater-level forecasting protocol that is tailored to the needs of stakeholders of the ACF River Basin, and that can be integrated as a drought indicator into NIDIS DEWS for the Southeast. Second, the project will develop new policy alternatives that can potentially be used by state officials in Georgia for managing future droughts without adversely impacting the state's agricultural economy and water resources.

## WEBINARS: Keep up with current conditions in your area

Several of NIDIS' partner organizations offer regular live reports on drought conditions in their regions, through webinars. Upcoming and past webinar listings are at <http://www.drought.gov/drought/content/regional-programs/regional-drought-webinars>. How to sign up for future events, or view past sessions:

### Managing Drought in the Southern Plains

The Southern Climate Impacts Planning Program (SCIPP) holds bi-weekly discussions of drought and its impacts on the second and fourth Thursdays of each month at 11:00 a.m. Central Time. States covered include Oklahoma, Texas, and New Mexico. To join in, please register at <http://www.southernclimate.org/>. You can view past webinars on YouTube at <https://www.youtube.com/user/SCIPP01>.

### Upper Colorado River Basin Webinar

The Colorado Climate Center conducts Climate, Water and Drought Assessment briefings detailing events in the basin states of Colorado, Utah and Wyoming. To register, please visit: [http://ccc.atmos.colostate.edu/drought\\_webinar\\_registration.php](http://ccc.atmos.colostate.edu/drought_webinar_registration.php)

### Apalachicola-Chattahoochee-Flint (ACF) River Basin Drought Assessment Webinar

The Southeast Climate Consortium (SECC) organizes a drought assessment webinar that includes current conditions and outlooks for the ACF basin.

Currently the webinars occur monthly, and will increase in frequency if drought conditions warrant. Webinar partners include the U.S. Army Corps of Engineers, National Weather Service and USGS. To receive webinar announcements, send a request to [reuteem@auburn.edu](mailto:reuteem@auburn.edu) to get on the email list. To view previous webinar summaries, visit <http://www.drought.gov/drought/regional-programs/acfrb/acfrb-home> and choose from the list on the right side of the page.

### Midwest and Great Plains Drought Update

The National Oceanic and Atmospheric Administration (NOAA), the American Association for State Climatologists (AASC) and the High Plains Regional Climate Center (HPRCC) have responded to drought across the Midwest and Great Plains by organizing, creating and presenting webinars since July 2012. These presentations are held monthly but can be more frequent when conditions warrant.

The webinars consist of a regional climate summary, impacts due to drought and climate outlooks.

The webinars are held on the third Thursday of every month at 1 pm Central Time. A link to the webinar registration page, along with recordings and powerpoints from previous webinars, can be found here: <http://drought.gov/drought/content/regional-programs/regional-drought-webinars>.

## PHOTOS BY ANDREW WILLIAMS



**Far right: Kayaks piled in the same location in August this year.**





# gasping



Marooned on mud, rafts that once floated in the Don Pedro Reservoir lie at an angle near the boat launch in the background.

Andrew Williams graduated from Parsons The New School for Design with a B.F.A. in photography, as well as the 2012-2013 Vera List New School Writing Award. His work is an interpretation of how American culture interacts with the natural environment. He strives to transform the ways in which we view our relationship to nature, while reminding us of the dangers if we continue to pollute the planet.

Website: [www.awilliamsmedia.com](http://www.awilliamsmedia.com)  
Email: [andrew@awilliamsmedia.com](mailto:andrew@awilliamsmedia.com)

Tribal perspective on the California drought taps traditional ecological knowledge, experience of past droughts to adapt to current conditions

# No 'one-size-fits-all' solution

## PRESENTERS AT THE FORUM

### **CHRISTI HANSARD**

Environmental Specialist, Buena Vista Rancheria of Me-Wuk Indians

### **KAROLA KENNEDY**

Environmental Director, Elem Indian Colony of Pomo Indians

### **EMILY LUSCOMBE**

Environmental Specialist II, Coyote Valley Band of Pomo Indians

### **SARAH RYAN**

Environmental Director, Big Valley Band of Pomo Indians

### **JAVIER SILVA**

Environmental Director, Sherwood Valley Rancheria

A “first look at our values about water” was the theme of the tribal panel at the NIDIS-sponsored California Drought Forum in Sacramento in May. The perspective offered by this group of environmental specialists revolved around transparency about how human water use impacts the environment as a whole.

## Climate change brings loss of traditional foods, medicines, and waters

Christi Hansard gave this overview of the effects of drought on all tribes of California:

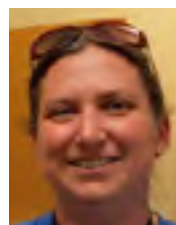
“The people, lands, and resources of tribal communities face the same array of climate change impacts as every other stakeholder represented here today, and more. Tribal governments work collaboratively with federal, state, and local agencies to address specific environmental concerns.

“The consequences of climate change have and will continue to damage Tribal ways of life that have persisted for thousands of years. Native cultures are tied to geographical locations. Language, cultural practices, ceremonies, and food sources all evolved over time with the inhabitants of specific homelands.

“Every California tribe has a unique set of issues related to climate change. Loss of traditional foods, medicines, and waters are often compounded by social and economic issues. Where tribes are concerned, there is no “one-size-fits-all” solution.

“Tribal governments have been working proactively to assess their natural resources and to prepare for the expected impacts of climate change. Tribes use traditional ecological knowledge, gleaned from elders, from stories, and from family histories, combined with Western science, to make balanced decisions. Tribes support the scientific community and its ongoing work to provide accurate data.

“The risks to people, property, infrastructure, and the environment from climate change cannot be underestimated. Tribes are an important part of California and we will contribute to solving problems associated with climate change.”



Luscombe

## ‘Water is sacred because it is life’

Emily Luscombe focused on natural environments:

“When discussing the drought, water is often referred to as a commodity and a price given for its purchase.

“Water is far more than a commodity. It is sacred and native people believe it has a living spirit as do all basic elements. Some people might tune out when they hear ‘spirit’ and ‘sacred,’ but think about why water is sacred, why it has spirit. Water is sacred because it is life. No one can dispute the portion of our bodies which is water, or the necessity of water to living things.

“Think of spirit and you think of energy. Water clearly has and transmits energy. No one can deny there is conductivity in water or that it transfers large amounts of energy. It is undeniably a great force.

“Water has memory like a living being. Water picks up minerals, nutrients, sediments and pollutants everywhere it flows and carries this memory along with it. How can such an important life force be a commodity with a price to buy and sell?

“As water levels drop with the drought, pollutants become more concentrated. This impacts Tribes significantly because you cannot drink polluted water or perform ceremonies or make acorn mush with it. Fish which are essential for subsistence in some areas cannot survive with low water levels and pollution.

“Water needs to be left in the streams to protect these important uses. Once water levels drop and riparian plants die and fish become extinct, it is permanent. They cannot be brought back.

“Some people are saying to drill more wells. This too causes permanent damage. There is not adequate water to replenish the draw from wells in a drought. And California is already suffering subsidence issues, another permanent problem.

“Instead we need to work together to conserve water in all areas. Ten percent voluntary reductions are not enough. We live in a state which is dry more than it is wet and it is important to live within our means. A lifestyle change is needed for California. There is a lot more that we can do to conserve and we can look to traditional ecological knowledge to help inform us about appropriate activities for an area. We can make reductions not just for this year, but for every year, so that drought is not an emergency and we can mitigate some of the impacts of climate change.”

## Historically, tribal people adapted to the land, not the land to the people

Javier Silva said:

“Our reservoir is almost dry, but we’re used to

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These hitch were among those trapped in Adobe Creek on in March, 2014, when water levels fell rapidly.

At that time numbers of adult fish were still in the creek. As of early summer, the creek was dry in a number of places, with some disconnected pools and no flow. The conditions made it impossible for any surviving fry (juveniles) to return to the lake.

Some tribes got together to rescue more hitch in May. About 500 fry were stuck in a shrinking pool of water in Adobe Creek. Some of the rescued fish were Sacramento suckers.

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Silva

‘dealing with what you have.’ We’re practicing adaptation all the time. We don’t force on nature what we ‘need’ or ‘want.’ We adapt to what nature provides.

“The Sherwood Valley Band of Pomo Indians is made up of 400-plus members and occupies approximately 700 acres of its aboriginal territory within what is now Mendocino County. The band gets drinking water from three public water systems. One is operated by the city of Willits and two operated by the band. The band also oversees several scattered water systems which provide water to individual homes. The primary sources of water for the tribally operated systems are springs and groundwater. The city-operated system provides surface water from a reservoir.

“On January 1, 2014, the band had to shut off one of its systems because there was no water coming from the spring and the groundwater well was not pumping enough to sustain an amount to hold in the storage tank. This was due to the lack of sufficient rains during the winter months. Later in the month, the band found out that the city of Willits and Mendocino County had declared water emergencies. The band then decided to also declare a water emergency and did so in February by resolution.

“The band currently has no water rates or usage data. We do have approximations but nothing

concrete. The band has relied on agencies such as the Indian Health Service, Rural Community Assistance Corporation and Bureau of Indian Affairs to address the needs of the drinking water systems. Unfortunately, through that process the band has had to compete with other tribes for priority.

“What has helped the band has been its history of water shortages, which typically occur in the late fall. The band has taken conservation measures to help alleviate the current problem. The band has purchased water in the past and may have to do that again, a little earlier than expected. The band has asked tribal members to voluntarily restrict their usage. There are agricultural activities on and off tribal lands which will have severe impacts to the band. The band is looking into outreach and education to help keep these issues from becoming bigger than they are.

“The band is going to adapt to the lack of water.

We ask that everyone do the same.”



Ryan

### Consideration for native species

Sarah Ryan observed that “local agricultural well permits doubled in 2014 compared to 2013; yet no consideration was given to potential impacts on the Pomo native species – oak and tule (a kind of bulrush), as well as hitch (a species of fish) — which rely on groundwater. Fish kills have been happening since then.” No groundwater monitoring



Tabletop exercise in planning helps Oklahoma representatives of different sectors practice collaboration, invent solutions and balance a Monopoly money budget

# Dress rehearsal for drought

**BY  
KATHLEEN  
BOGAN  
NIDIS**

Somewhere in Oklahoma the Clear Branch and the Salty Branch merge south of Salt Lick (pop. 1200) and Wheatville (pop. 15,000).

The Salty feeds Small Reservoir, which supplies water to Salt Lick. The Clear flows through Big Reservoir, just northeast of Wheatville, south of Happy Cow Ranch and west of Green Valley Farms. Logear Bass thrive in Big Reservoir, attracting fishing folk and boaters alike.

Or at least they did for eight hours in September, when Oklahoma water managers, wildlife biologists, farmers and others gathered at the National Weather Center in Norman to take the Challenge: the Oklahoma Water Supply Reliability and Management Challenge.

The Oklahoma Water Resources Board (OWRB) and the Bureau of Reclamation sponsored this exercise, designed to enhance the state's approach to drought mitigation, preparedness and response. The Colorado office of AMEC Environment and Infrastructure, an engineering, project management and consultancy company, facilitated the activity.

OWRB invited participants from many sectors: agriculture, recreation, conservation, energy and more. They formed the invitees into five teams of five or six members, each representing a different

sector. The teams' tasks were to develop drought plans for the fictitious Old Faithful River Basin, home of the Clear Branch and the Salty Branch. The characteristics of the basin mirrored Oklahoma's terrain, hydrology, climate, economy, history and water use.

The facilitators set up the game with slides, maps and descriptions. Scenario One: an extreme drought and a menu of coping mechanisms. As they got to know each other, teams identified the drought's impacts and formulated responses. Options included voluntary/mandatory water restrictions, rate changes, leasing in-basin supplies, use of auxiliary equipment to access alternate supplies and so forth. They had a Monopoly money budget. Each option had a cost/benefit ascribed to it. Teams scored points based on how well they balanced costs and benefits while meeting as ably as possible the sectoral needs.

Scoring also took into consideration a third factor: opinions of the referees.

The referees answered questions while assessing the quality of the interchange at each table. Referees included drought and water experts from the National Drought Mitigation Center in Lincoln, Nebraska, and Oklahoma agencies. They watched for

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**Above: Referees, facilitators and organizers confer among the team tables at the Water Supply Reliability and Management Challenge, staged at the National Weather Center in Norman, Oklahoma in September. Refs stand out in their black and white striped jerseys.**

PHOTO BY  
KATHLEEN BOGAN





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cooperation, practicality, innovative solutions and other factors which, from the referee's expertise, would contribute to the success of the team's plan.

After Scenario One's hour-long drought emergency, teams had an interlude of "wet years" during which they could plan future strategies with a replenished budget. Again, teams had to balance pay with payoff, and short-term with long-term solutions and investments. They weighed the cost and benefits of reusing marginal quality water; installing meters; xeriscaping; educational programs; expanding the reservoirs; habitat restoration, and so forth. They had the option of inventing solutions that weren't on the list of possibilities as well.

After lunch, Scenario Two: Drought struck again, and the teams put their wet-year plans to the test. Some federal Monopoly money rolled in to assist with the crisis, but there were strings attached: It could only be used for emergency response.

In every case, a team's response to the second drought exercise came in with a much lower price tag than it had in the first scenario before long-term planning.

In the end, Team "Up the Creek" took the prize. But in a sense everyone won, by developing a better understanding of how the same challenges affected each sector differently, practicing ways to prioritize actions to mitigate impact, and coming up with inventive solutions.

## Western Governors dedicate 2014 to drought



### More information

Find meeting summaries, presentations, case studies, video and media coverage at <http://westgov.org/drought-forum>

The Western Governors' Association, in partnership with NIDIS, is sponsoring an ongoing forum designed to foster a regional dialogue in which states and industry can share case studies and best practices on drought policy, preparedness and management.

Drought Forum meetings gather experts from government, industry and other areas to discuss drought impacts in various sectors. In addition, the forum is creating an online library that features a growing collection of drought-related resources. The collection includes examples of best practices (<http://westgov.org/drought-forum/best-practices>) and case studies for energy, agriculture, water supply, recreation, manufacturing, mining and state policies (<http://westgov.org/drought-forum/case-studies>).

Recent and upcoming meetings include:

■ Managing Drought in the Energy Sector: Sept. 18-19, National Weather Center, Norman, Okla.

■ Drought Impacts and Solutions in the Manufacturing, Mining and Industrial Sectors: Oct. 7-8, Salt River Project Pera Club, Tempe, Ariz.

■ Drought Impacts and Solutions in the Agricultural Sector: Nov. 13-14, Sacramento, Calif.

■ Drought Impacts and Solutions for Water Supply: Dec. 8-9, Las Vegas, Nev.

Since 1999, eleven authors around the country have tapped the expertise of 350 contributors every week to build the U.S. Drought Monitor map

# USDM 'not as straightforward as it might seem': a Q&A

**AN INTERVIEW WITH RICH TINKER, AS TOLD TO KELLY SMITH**  
National Drought Mitigation Center

Editor's note: The U.S. Drought Monitor (USDM), established in 1999, is a weekly map and set of data about drought conditions, produced jointly by the National Oceanic and Atmospheric Administration, the U.S. Department of Agriculture, and the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln. NDMC hosts and maintains the USDM website (<http://droughtmonitor.unl.edu/Home.aspx>).

USDM map comes out every Thursday morning. It is based on measurements of climatic, hydrologic and soil conditions as well as reported impacts and observations from more than 350 contributors around the country. Eleven climatologists from the partner organizations take turns serving as lead author each week. The authors examine all the data and use their best judgment to reconcile any differences in what sources are saying.

Kelly Smith interviewed USDM author Rich Tinker of the National Climatic Data Center in August.

**Q: How long have you been a U.S. Drought Monitor author?**

**A:** Since around the time of its inception, which was in the late 1990s.

**How did you get into it?**

Someone in our office decided we needed something a little more official in describing drought across the country than the array of varied indicators we'd had until then. I looked at the map, and at the time, right after one of the strongest El Niño episodes on record, only about two percent of the country was significantly dry. I thought to myself, "This might look good on a resume. I'll volunteer to work on it."

Since then, a quarter to half or more of the country has been in drought, and I've been working on it ever since.

**How does someone get to be a Drought Monitor author? What are the qualifications?**

There are actually several paths they could take: any sort of meteorological or agricultural background, and usually some expertise about how precipitation works in some part of the country, either through experience or through education. Either of those avenues would certainly qualify you.

But nothing will work as well as experience.

**What have you learned as a USDM author?**

It's not as straightforward as it might seem.

There was a gathering back when we were first getting the Drought Monitor together, probably 100 people, to discuss drought. We were trying define drought, and we couldn't come up with a definition that everybody agreed with. It's essentially some degree of dryness on some time scale that's affecting something, and that's about as strict a description as you can get without causing an argument.

You have to look at a lot of different things and you have to understand how precipitation works in different parts of the country. Here in the East you pretty much get precipitation throughout the year, maybe a little more in the summer. In California it's almost completely dry during the summer but very wet during the winter. You have to understand how those things play into different aspects of drought.

**The USDM seems ambitious, condensing a vast amount of data into five stages of dryness and**

*continued on next page*

## THE USDM AUTHORS

**Anthony Artusa**  
National Oceanic and Atmospheric Administration

**Michael Brewer**  
National Climatic Data Center

**Brian Fuchs**  
National Drought Mitigation Center

**Richard Heim**  
National Climatic Data Center

**Eric Luebehusen**  
U.S. Department of Agriculture

**David Miskus**  
National Oceanic and Atmospheric Administration

**Brad Rippey**  
U.S. Department of Agriculture

**Matthew Rosencrans**  
Climate Prediction Center

**David Simaral**  
Western Regional Climate Center

**Mark Svoboda**  
National Drought Mitigation Center

**Richard Tinker**  
Climate Prediction Center

## What does "D0" mean?

- D0: Abnormally dry
- D1: Moderate drought
- D2: Severe drought
- D3: Extreme drought
- D4: Exceptional drought

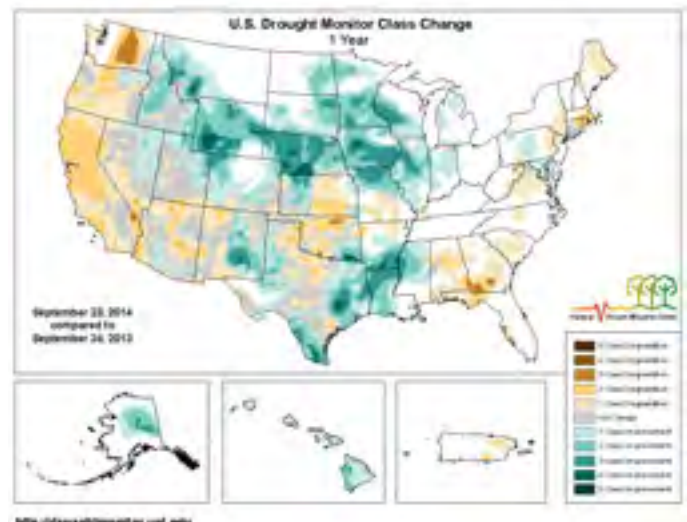
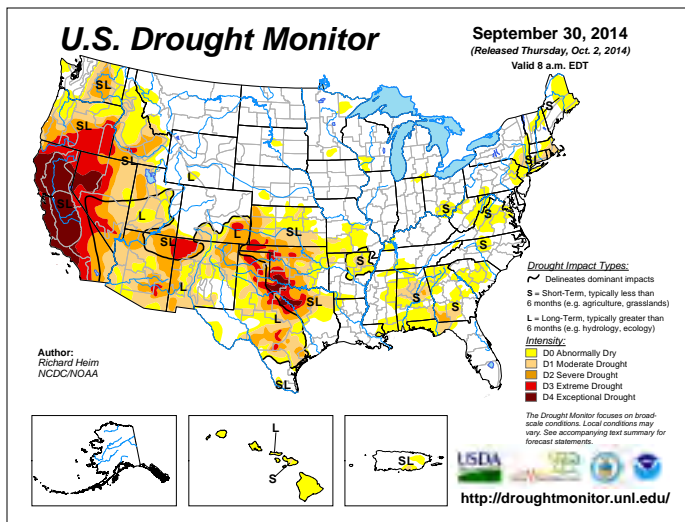
D0 (D-zero) is not considered drought. D0 is best used to describe conditions prior to drought developing, or conditions emerging from drought where there are lingering concerns.

In D0, the majority of the indicators (both short and long-term) fall in the driest/lowest 21st-30th percentiles.

You do not necessarily have to have dryness-caused impacts to be abnormally dry (D0). However, if the dryness is indicated by the data and impacts are occurring, the area may be better suited for D1 (or worse) drought level, where the majority of the indicators fall in the driest/lowest 11-20th percentile.

*-- Brian Fuchs, NDMC*





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**drought on a two-dimensional map each week. What can you tell us about the need to balance simplicity and complexity?**

Our intent is to come up with an assessment that combines indicators and impacts on all time scales, leaning on those indicators and impacts that seem to be affecting a given region the most.

In California, a lot of our emphasis is on the condition of water supply, because that's what's important there. In the Midwest, what's more important is how much rain can feed agriculture, corn and soybeans and such, during the summer, and that can react on a very short timescale. A decent rain can make the crops grow even if they've been dry for a while. Timescales depend on where you are in the country, and have very different impacts.

**What makes the process rewarding?**

First of all you make contacts with people, and we learn from each other. We have local and regional experts, a few hundred, who have the opportunity to comment on the Drought Monitor as we're assembling it each week, and talk about their local or regional area.

It's also rewarding because you know that a lot rides on it. It's become fairly common for people to quote the Drought Monitor as the standard describing how severe a drought is, rather than going through a whole series of different parameters and saying, "Well, the drought is some average of all this."

Quite a bit of agricultural aid is based at least in part on the Drought Monitor.

**What is most challenging about it?**

Sometimes you get different people in the same part of the country recommending different things, usually according to what their expertise is. Somebody who works mostly with water supply is going to have a different perspective and make

different recommendations from someone who is worried mainly about agriculture and topsoil moisture. Part of the challenge is how to weigh different impacts at different timescales and come up with one assessment.

**Have any natural or man-made disasters ever made it hard to get the USDM out on schedule [every Thursday]?**

We have had a few times, especially during snowfall here in the East, where they would close the federal government, and the Drought Monitor might need to be done remotely, if you have that sort of connection, or somehow get into the office.

Also, the government shutdown did affect us, especially at the Department of Agriculture. The authors who work there didn't have remote access and couldn't get in to the office when it was closed, as opposed to the people at the Climate Prediction Center. "Climate operations" are considered an essential function of the Department of Commerce, and we remained open under those circumstances.

Still, a lot of the information we use and some offices that give us feedback weren't available. We've had to shift authorships a couple of times as somebody was slated to be primary author when something natural or political has caused them physically not to be able to put together the Monitor. We've had to shift responsibilities on short notice.

**Are there any misconceptions about drought or the Drought Monitor that you'd like to clear up?**

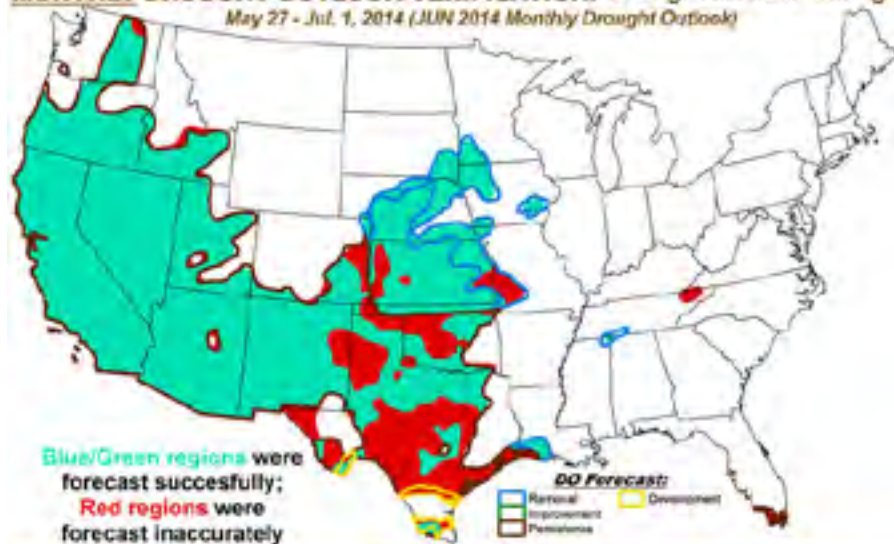
A lot of people think that rain on the short-term can be more beneficial than it actually is. Especially some of the places out west now, when you've had multiple years of drought you can get even a decent period of heavy rain and everything looks nice and green, and people wonder why you're still calling the drought a drought, when in fact you're looking at longer-term indicators and things that respond to those, like water supply and groundwater availability.

The U.S. Drought Monitor produces a weekly map (above, left) but there is more: Change maps (above right) showing how drought levels have intensified or eased from week to week, month to month, year to year; statistics tables showing percentage of land affected by drought for each state, region or the entire country; population affected by drought, and more.

Refined process, new color scheme enhances accessibility of map that helps show short term information pointing to flash drought

# Scoring the monthly outlook

**MONTHLY DROUGHT OUTLOOK VERIFICATION: Drought Monitor Change**  
May 27 - Jul. 1, 2014 (JUN 2014 Monthly Drought Outlook)



FORECAST	HIT	MISS
Improvement/Removal	26,194	3,007
Persistence	128,041	24,501
Development	579	5,491
<b>TOTAL</b>	<b>154,814</b>	<b>32,999</b>
<b>SCORE</b>	<b>82.4</b>	
PERSISTENCE FORECAST BASELINE	132,529	55,229
<b>PERSISTENCE FORECAST SCORE</b>	<b>70.6</b>	
<b>"SKILL" (forecast score) minus (persistence score)</b>		<b>+11.8</b>

Verification scorecard shows hit-or-miss tracking for each monthly outlook. Green areas indicate success; red areas show inaccurate forecasts. On this map, the most discrepancies between the forecast and actual events occurred in the Southern Plains states of Texas, New Mexico and Oklahoma, as well as Kansas and Colorado. See more scores at [http://www.cpc.ncep.noaa.gov/products/expert\\_assessment/mdo\\_archive/](http://www.cpc.ncep.noaa.gov/products/expert_assessment/mdo_archive/)

**BY MATTHEW ROSENCRANS, DAVID MISKUS and RICH TINKER**  
NOAA/CPC

In the summer of 2013, NOAA's Climate Prediction Center (CPC) began issuing the Monthly Drought Outlook (MDO) as a complement to the Seasonal Drought Outlook, a product issued by CPC for many years. The monthly outlook is designed to reflect changes in drought conditions that evolve more rapidly than seasonal timescales, such as the 2012 Midwest flash drought. This shorter-term information can more fully inform communities, in particular agricultural interests during the growing season, allowing them to become more resilient and prepared for short-term changes in drought.

Since the launch, forecasters at CPC have revised the process by which the MDO is created. Initially, the CPC monthly outlooks served as the primary input for the product, so as the forecast tools for the monthly outlook have evolved, so have the tools for the MDO. Now forecasters are making use of outputs from the National Multi-Model Ensemble (NMME), Climate Forecast System, in-house statistical tools, and outputs from various other numerical weather prediction systems such as GFS and the model from the European Center for Medium Range Weather Forecasting (ECMWF).

## Creating the outlook means collaboration

Developing the MDO involves assessing the factors that are likely to impact the drought situation across the U.S. The process requires significant analysis and collaboration each month. Forecasters do a pure numerical analysis and spend time interpreting data to create the beginning of an outlook.

They also hold a conference call

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with internal and external partners to pore over data, discuss the trends in precipitation and temperature, and consult with in-house experts on modes of climate variability such as El Niño-Southern Oscillation (ENSO) and Tropical Intraseasonal Oscillations (TIO). The conference call typically includes representatives from each National Weather Service region, many of the CPC seasonal and monthly forecasters, the current forecaster responsible for the 6-10 day and 8-14 day outlooks, and others. Additional inputs come from researchers and others involved with NIDIS projects as well as NOAA's regional Climate Service Program Managers and Regional Climate Leads, who are able to relay more specific impacts of drought being reported across the country.

This collaborative process contributes to a better, more accurate and more useful MDO.

### How accurate is it?

MDO skill scores during the past year have shown that about 75% of each forecast is accurate.

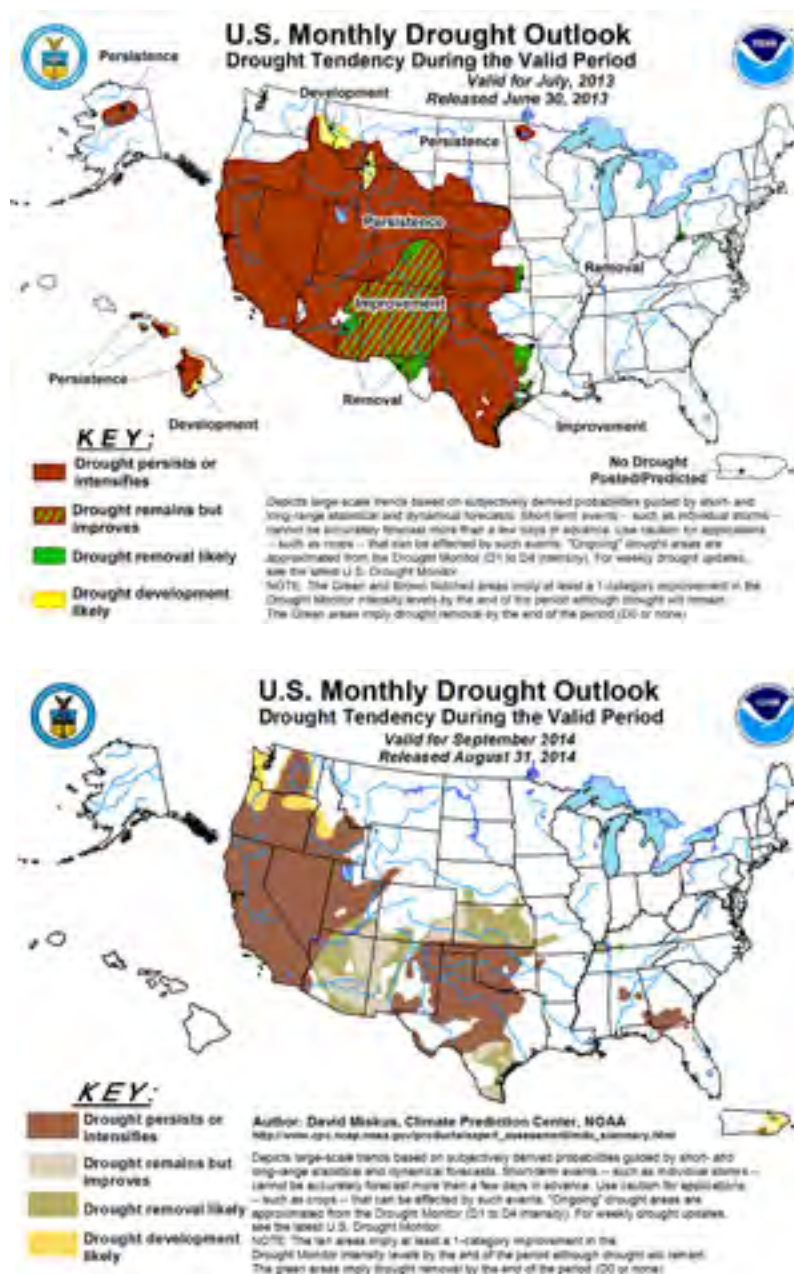
The MDO forecasts are more accurate concerning areas where drought is expected to persist or worsen. We do not yet have enough data to assess how accurate monthly forecasts are for areas where drought is expected to develop, but in the seasonal (three-month) outlooks, areas where drought develops (or is expected to develop) are not forecast as successfully.

You can track verification scores (accuracy of the forecast) each month at [http://www.cpc.ncep.noaa.gov/products/expert\\_assessment/mdo\\_archive/](http://www.cpc.ncep.noaa.gov/products/expert_assessment/mdo_archive/)

### Revisions improve accessibility

Earlier this year, the MDO product was revised to be more accessible to the widest range of audiences. The original graphic featured patterns and colors not conducive to proper interpretation by all and not supported by all display technologies. Collaboration with NOAA's Climate Program Office resulted in two changes to the color scheme, with the final color scheme released in January 2014. The newer color scheme complies with the amended Rehabilitation Act of 1973, Section 508 (29 U.S.C. 794 d) and allows the product to be displayed in more mapping software packages.

CPC is always looking for way to refine and improve the product. One major focus would be the improvement of precipitation forecasts in dynamical models. Using lessons learned from the first year and technological improvements, we hope to deliver accurate Monthly Drought Outlooks for many years, helping to make the country a Weather-Ready Nation.



A comparison of the initial design of the Monthly Drought Outlook (upper map) from midyear 2013, and changes to the color scheme shown in the lower map, released in January, 2014. NOAA updates the Monthly Drought Outlook on the last day of each month at

[http://www.cpc.ncep.noaa.gov/products/expert\\_assessment/mdo\\_summary.html](http://www.cpc.ncep.noaa.gov/products/expert_assessment/mdo_summary.html)

‘This country is rapidly reverting to an actual desert.’

# Dust Bowl diary documents life and loss in the Thirties

**BY KELLY  
HELM SMITH**  
National Drought  
Mitigation Center

Three quarters of a century ago, Don Hartwell and his wife, Verna, were enduring the Dust Bowl in the town of Inavale on the Nebraska-Kansas border.

Hartwell, who had an eighth-grade education, was a life-long diarist. Hartwell's one surviving diary, with daily entries from 1936 through 1940, doesn't tell a happy story: They lost the farm and everything but each other. But it does provide a clear description of life in that time and place, and how long-term drought erased the hard-won holdings and hopes of a family and a community.

Hartwell's years of daily observations are now accessible, thanks to the efforts of Marsha Davis, a retired French teacher from Greeley, Colorado, with a passion for history. She has just published *One Man's Voice*, available at The Tattered Cover bookstore in Denver and at the Willa Cather Foundation in Red Cloud, Nebraska. Davis first heard of Hartwell's diary when her book group read *The Worst Hard Time*, by Timothy Egan, an account of Dust Bowl survivors' experiences written in 2006.

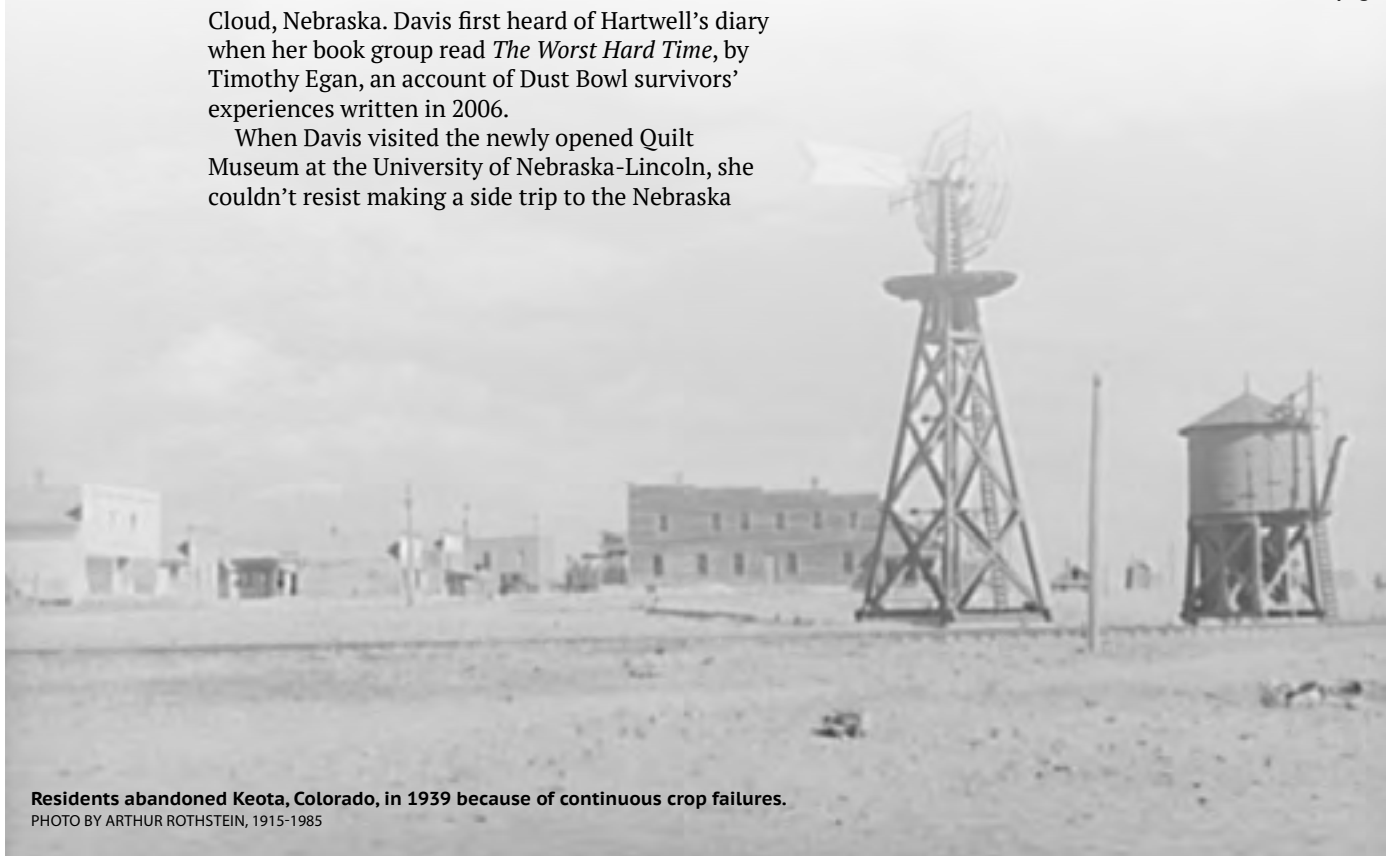
When Davis visited the newly opened Quilt Museum at the University of Nebraska-Lincoln, she couldn't resist making a side trip to the Nebraska

State Historical Society, where Hartwell's diary is on microfilm. What she thought would be a 30-minute glimpse into the past turned into four hours, and then into five years of transcription, research and editing.

"The way he writes, I found to be fascinating, and there are cultural references to events from the '30s' and '40s; the national events that were happening, and the international events," Davis said. "This was a person who had an eighth-grade education. These were just regular people. They didn't save the farm. They were pretty much bankrupt. They just kept going. It really touched me. Here were two people who kept trying, and everything went wrong. I just wanted their story out there in a readable form."

Hartwell reminisces wistfully about the fertile

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Residents abandoned Keota, Colorado, in 1939 because of continuous crop failures.

PHOTO BY ARTHUR ROTHSTEIN, 1915-1985



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summers of his younger years, but viewed his current circumstances much less optimistically. He comments a few times on brides and how they tend to disappear after the wedding, perhaps seeing a reflection of his own diminishing prospects.

Along with the loss of crops, livestock and land, he chronicles the loss of friends and social ties.

Davis says she omitted some of the repetitive weather and crop observations and retained passages that kept the story moving. Contemporary readers may appreciate Hartwell's brevity.

"It reads very quickly," Davis said. "He didn't have a lot of physical space to write. He wrote five or six lines every day, if that."

The unrelenting drought years were a constant stress for the Hartwells.

"He mentions the dust," Davis said. "He has six or seven crop failures in a row. Verna moved to Denver in 1938 to get a job because there was no money. He talks about people having to leave Inavale. He keeps talking about his love of the land, his love of livestock. He talks about the weather, and government programs that were there to help. He talks about the loss of crops, the lack of rain, and stock prices. By 1940 they had lost the farm.

"It is a sad tale," she said. "It didn't turn out the way they had hoped. It turned out the way it turned out, like most of our lives."

The Hartwells lived their final years in Denver. "He was a yard man; she was a maid. They worked for a very wealthy woman. From what I can gather, she was a lovely person," Davis said.

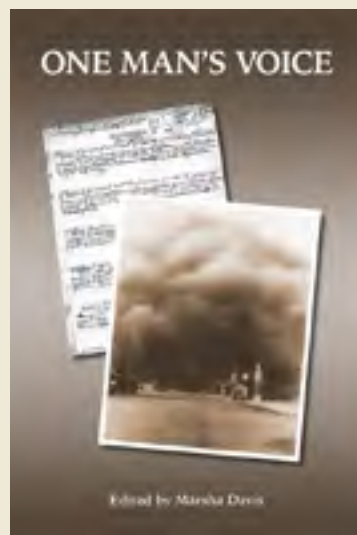
"I'm hoping they had time to take walks and go to the mountains, which they loved. And they were together, they weren't separated anymore, which was good."

The diary would be excellent supplemental material for anyone studying the Dust Bowl or Plains history, including secondary school students. The daily observations convey a sense of how people earned a living, what they did for fun (or wished they could do for fun), and how they viewed national and international events in the years leading up to and at the beginning of World War II.

#### FOR MORE INFORMATION

Davis worked with The Tattered Cover Press in Denver to create a printed book. She is also looking into e-book options. Visit The Tattered Cover Press, <http://www.tatteredcover.com/tcpress/one-mans-voice> or contact Davis, [mardavis@comcast.net](mailto:mardavis@comcast.net).

#### EXCERPTS FROM THE BOOK



Editor's note: Hartwell, like others of his time, consistently spelled drought as "drouth."

#### Sunday, July 26, 1936

This country is rapidly reverting to an actual desert.

#### Friday, May 14, 1937

Well, Ralph Stickneys (& Roberta) left today for California. By judicious management they should do well.

#### Friday, August 20, 1937

Verna is busy at the M.E. church today at a W.C.T.U. convention. Although I don't see how they apply to Inavale. Inavale has no liquor store & not even beer is sold here. In fact, Inavale has degenerated into a strictly "moral" condition.

#### Thursday, August 26, 1937

The drouth, heat etc. still drag on. Although drouth can do very little damage anymore, as nearly everything is destroyed. The Bladen Fair is on but I haven't heard of anyone going. People just don't seem to patronize those things anymore. Verna & I walked up to the hotel & got an ice cream cone in the evening.

#### Sunday, November 14, 1937

We swept & dusted in the forenoon – Verna is very much discouraged over the way things have gone & as to what lies before us. – I don't blame her. Failure is not attractive, either collectively or individually. – Mildred Bennett is in

Lincoln now. Dorothy A. "isn't going out much" now – with us, anyway.

#### Friday, September 30, 1938

Fair, pleasant, warm, little wind. I stayed in Denver last night. Verna & I went up to Boulder, we got our dinner at the "Colorado" & drove up to Boulder Falls as we used to so many times in past years, & I took one picture. I couldn't help feeling a little sad ... then – we went back to Denver, we went out to Humbolt St. and I left Verna there and Dust Bowl accessible started for Inavale. (I can hardly call it home anymore) alone. I can't write how I really felt about that, never could.

#### Saturday, November 5, 1938

I found a bearing in the left front wheel of the car about gone, I wonder what next? ... I went over to Tophams & got a load of wood in the afternoon. I wrote to Verna & mailed it on the train. Nebr. won this first football game from Kans. Their first win this fall.

#### Friday, May 10, 1940

I started planting corn in the field N. of the feed yard. Germany went into Holland & Belgium. The war in Europe goes on. Germany (Hitler) takes (& does) what he pleases & the rest "retreat to better positions" – but maybe they think War is better than a never-ending Depression, such as is fostered in this country.

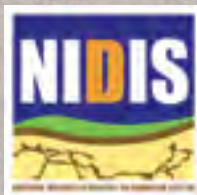
#### Sunday, December 29, 1940

Well, Verna packed her things, did some cooking & we started for home (Inavale) at 3 p.m. It was just dark as we left Brush, we got our supper in Wray & then came on. It was a nice evening to ride – hardly freezing, no wind. So we rode through the night, with the stars for company & the mysterious lights in the distant houses.

#### Tuesday, December 31, 1940

A heavy fog all day. Almost rain. Not cold. Verna & I were over to W. Tophams place for dinner. We didn't go anywhere to celebrate New Year's Eve & so ends 1940.

I haven't the least idea what we will do next year. Our place, which I have worked since 1909, is gone. Verna is here, but will have to go back to Denver & I will be alone, facing the New Year, & what? 1/8 in. rain.



The National Integrated Drought Information System (NIDIS) is a nexus of drought information, policy and research. We promote collaboration among government agencies, communities and individuals at all levels to share information about drought, and provide resources for planning, forecasting, management and recovery. Together with our federal, state and local partners we pursue these goals:

- Leadership and networking among all sectors to plan for and cope with the impacts of drought
- Supporting research on the science of drought, including indicators, risk assessment and resilience
- Creating regional early warning systems for drought management
- Developing resources, systems and tools to promote drought awareness and response