Ten Years of the Drought Monitor: A Look Back and a Look Forward

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Drought Monitor Forum, Austin, TX October 7-8, 2009
1. Executive Summary

Recent Past and Present

- No serious widespread drought problems were noted anywhere in the region. In most places moisture excess is more likely to be a problem than moisture deficit. In the West, such situations seldom last for long.
- Developing drough was noted in September in eastern Montana and western North Dakota and in central Texas.
- Developing wet areas occurred in September in the western Pacific Northwest, and in the Southwest and much of the Lower Colorado Basin.
- Some areas in the northern Rockies continued to receive abundant precipitation through most of the summer, following a very wet winter. As a result, precipitation-based indices there are at high levels.
- The Missouri River has carried more water this year than any other year on record.
- The western fire season was much less active than in recent years, except in Alaska where large acreages burned.
- The Southwest monsoon began considerably later than usual, proceeded at an "average" rate thereafter, and continued through September.
- Five major hurricanes have occurred in the eastern Pacific, including the two most powerful ever recorded in that region. A sixth was in progress.
- Several tropical systems have affected the upper coasts of the eastern states, either directly or through extensive bands and surges.

Evolution

1998:
NDMC Drought Monitoring product

- Red: Recovering from state or federally "declared" drought but should be monitored closely for recurring conditions or lingering impacts
- Brown: Areas experiencing significant dryness
- Yellow: Areas experiencing dryness

National Drought Mitigation Center
1999: The U.S. Drought Monitor

Since 1999, NOAA (CPC and NCDC), USDA, and the NDMC have produced a weekly composite drought map -- the U.S. Drought Monitor -- with input from numerous federal and non-federal agencies.

August 3, 1999

Experimental U.S. Drought Monitor

U.S. Drought Monitor

“Drought” means moisture shortages leading to damaged crops or pastures, high wildfire risk, or water shortages. This map is based on information from many sources, including both satellite and surface data, and it focuses on widespread drought. Local conditions may vary.

Yellow (D1) = Drought Watch Area (abnormally dry but not full drought status)
Red (D1-D4) = Current drought ranging in severity from standard (D1) to severe (D2-D4) to extreme (D4)
Crosshatching (D4+1) = Overlapping drought type areas

Drought Type: Used when impacts differ
Ag = agricultural (crops, grasslands)
Fire = forestry (wildfire potential)
Hydro = hydrological (rivers, wells, reservoirs)

Plus (+) = Forecast to intensify
Minus (-) = Forecast to diminish

NDMCArtist: David Mullen, JAN/NOAA
NDMCProducer: US Drought Monitor
NDMCMaintainer: US Drought Monitor

Drought Impact Types:
A = Agriculture
W = Water (Hydrological)
F = Fire danger (Wildfire)
G = Geology
D = Dominant Impact
(E = Economic impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See a companion weather summary for forecasts at

http://drought.unl.edu/udm

Released Thursday, April 18, 2002

National Drought Mitigation Center
August 3, 1999
Experimental U.S. Drought Monitor

“Drought” means moisture shortages leading to damaged crops or pastures, high wildfire risk, or water shortages. The map is based on information from many sources, including both satellite and surface data, and it focuses on widespread drought. Local conditions may vary.

Yellow (D0) = Drought Watch Area (abnormally dry but not full drought status)

Red (D1–D4) = Current drought ranging in severity from standard (D1) to severe (D2–D3) to extreme (D4)

Crosshatching (●) = Overlapping drought type areas

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Hydro = hydrological (rivers, wells, reservoirs)

Plus (+) = Forecast to intensify
Minus (-) = Forecast to diminish
The DM is only a NDMC product.

FICTION!
The U.S. Drought Monitor

Since 1999, NOAA (CPC and NCDC), USDA, and the NDMC have produced a weekly composite drought map -- the U.S. Drought Monitor -- with input from numerous federal and non-federal agencies

• Western Region Climate Center on board 2008

• 10 authors in all

• Incorporate relevant information and products from all entities (and levels of government) dealing with drought (RCC’s, SC’s, federal/state agencies, etc.) (~270 experts)
The Drought Monitor is a forecast.

FICTION

The Drought Monitor is a declaration.

FICTION
Original Objectives

- “Fujita-like” scale
- NOT a forecast!
- NOT a drought declaration!
- Identify impacts (A, H)
- Assessment of current conditions
- Incorporate local expert input
- Be as objective as possible
The Drought Monitor is an index.
Approaches to Drought Assessment

- Single index or indicator (parameter)
- Multiple indices or indicators
- Composite Indicator
The drought monitor categories (D0-D4) have a quantitative basis.

FACT
U.S. Drought Monitor Map

Drought Intensity Categories

- **D0** Abnormally Dry (30\% tile)
- **D1** Drought – Moderate (20\% tile)
- **D2** Drought – Severe (10\% tile)
- **D3** Drought – Extreme (5\% tile)
- **D4** Drought – Exceptional (2\% tile)
Precipitation is the only indicator …

FICTION
Key Variables For Monitoring Drought

- climate data
- soil moisture
- stream flow
- ground water
- reservoir and lake levels
- snow pack
- short, medium, and long range forecasts
- vegetation health/stress and fire danger
- impacts
The DM authors have limited knowledge about the complex drought climatologies at the local scale

FACT and FICTION
The Importance of Local Expert Input

- The U.S. Drought Monitor Team Relies on Field Observation Feedback from the Local Experts for Impacts Information & “Ground Truth”
  - Listserver (270 Participants: 2/3 Federal, 1/3 State/Univ.)

Local NWS & USDA/NRCS Offices

State Climate Offices

State Drought Task Forces

Regional Climate Centers
USDM Listserve Subscribers
(as of June 22, 2009)

Total: 265 (does not include 1 participant from Canada)
USDM Listserve Subscribers
(as of June 22, 2009)

- EDU: 30% (79)
- NOAA: 52% (139)
- USDA: 6% (15)
- USGS: 2% (6)
- State govt.: 7% (19)
- Other: 3% (8)
U.S. Drought Monitor

Integrates Key Drought Indicators:

- Palmer Drought Index
- SPI
- KBDI
- Modeled Soil Moisture
- 7-Day Avg. Streamflow
- Precipitation Anomalies

Growing Season:

- Crop Moisture Index
- Sat. Veg. Health Index
- Soil Moisture
- Mesonet data

In The West:

- SWSI
- Reservoir levels
- Snowpack
- Streamflow

Created in ArcGIS
The Drought Monitor Concept

- A consolidation of indices and indicators into one comprehensive national drought map

- Trying to capture these characteristics:
  - the drought’s magnitude (duration + intensity)
  - spatial extent
  - probability of occurrence
  - Impacts

- Rates drought intensity by percentile ranks
Input to the DM is all climate division based.

FICTION
Applied Climate Information System (ACIS) is a key player.....
The Drought Monitor depicts both short- and long-term drought.

**FACT**

The Drought Monitor is purely subjective.

**FICTION**
Objective Blends

Short-Term Blend

- 35% Palmer Z Index
- 25% 3-Month Precip.
- 20% 1-Month Precip.
- 13% CPC Soil Model
- 7% Palmer Drought Index

Objective Short-Term Drought Indicator Blend Percentiles
October 3, 2009

Legend:

- 0 to 2 (D0)
- 2 to 5 (D3)
- 5 to 10 (D2)
- 10 to 20 (D1)
- 20 to 30 (D0)

Centiles (D0 to D4 equivalent):

- 70 to 80
- 80 to 90
- 90 to 95
- 95 to 99
- 99 to 100

Inputs (as percentages):

- 35% Palmer Z-Index
- 25% 3-Month Precipitation
- 20% 1-Month Precipitation
- 13% CPC Soil Moisture Model
- 7% Palmer Drought Index

This map approximates impacts that respond to precipitation over several days to a few months, such as agriculture, topsoil moisture, unregulated streamflows, and most aspects of wildfire danger. The relationship between indicators and impacts can vary significantly with location and season. Do not interpret this map too literally.

This map is based on preliminary climate division data. Local conditions and/or final data may differ. See the detailed product suite description for more details.
Objective Blends

Long-Term Blend

- 25% Palmer Hydrological Index
- 20% 24-Month Precip.
- 20% 12-Month Precip.
- 15% 6-Month Precip.
- 10% 60-Month Precip.
- 10% CPC Soil Model

Objective Long-Term Drought Indicator Blend Percentiles
October 3, 2009

This map approximates impacts responding to precipitation over the course of several months to a few years, such as reservoir content, groundwater, and lake levels. HOWEVER, THE RELATIONSHIP BETWEEN INDICATORS AND WATER SUPPLIES CAN VARY MARKEDLY WITH LOCATION, SEASON, SOURCE, AND MANAGEMENT PRACTICE. Do not interpret this map too literally.

This map is based on preliminary climate division data. Local conditions and final data may differ. See the detailed product suite description for more details.
The Drought Monitor is widely used.
The Drought Monitor is widely used:

- **Policy:** Farm Bill/IRS/USDA/NOAA DGT/State drought plan triggers
- ~3.5M+ page views and ~2M+ visitors/year
- **Media:** The Weather Channel/USA Today and all major newspapers/Internet Media/ Network News/ CNN/NPR/etc.
- Presidential/Congressional briefings
- NIDIS portal/portlet
- A model of interagency/level collaboration
Some Examples of Decision Making Using the DM

- USDA Dried Milk Program
- USDA CRP Release hot spot trigger
- Numerous states use as a drought trigger (Governor’s declarations)
- USDA Livestock Assistance
- IRS (tax deferral on livestock losses)
- 2008 Farm Bill (NOT the only trigger)
- NWS Drought Information Statements (DGTs)
The DM authors have engaged stakeholder communities

FACT
The NDMC (and DM authors) have engaged stakeholder communities:

- **USDM/NADM Forums and surveys**
- **USDM/NADM Listservers (participatory)**
- **USDA/RMA and other projects: workshops, listening session, focus groups w/ producers/etc. (60 since 2003)**
- **Meetings w/ Media (face-to-face, conferences)**
- **Meetings at annual conferences/trade shows/etc.**
- **Meetings/briefings/workshops with/for various federal/state/tribal officials**
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm
North American Drought Monitor
August 31, 2009
Released: Friday, September 18, 2009

Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- ~ Delineates dominant impacts
- A = Agriculture
- H = Hydrological (Water)

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

Regions in northern Canada may not be as accurate as other regions due to limited information.
The DM is so easy to make a Caveman can do it???

So easy a caveman can do it.

FICTION
Did you know???????
Visit the NDMC Photo Gallery to see photos of drought conditions in California, Georgia, South Carolina, and other states. If you have photos showing drought conditions, please consider submitting them to the Photo Gallery.

The data cutoff for Drought Monitor maps is Tuesday at 7 a.m. Eastern Standard Time. The maps, which are based on analysis of the data, are released each Thursday at 8:30 a.m. Eastern Time.

NOTE: To view regional drought conditions, click on map below. State maps can be accessed from regional maps.

U.S. Drought Monitor  September 29, 2009
Valid 8 a.m. EDT

To compare current drought conditions with last week’s map, click here.
To view tabular statistics of this week’s Drought Monitor, click here.
To view tabular statistics for the Drought Monitor archive, click here.
To view Drought Monitor Change Maps, click here.
U.S. Drought Monitor
South

September 29, 2009
Valid 7 a.m. EST

Drought Conditions (Percent Area)

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<th>D2-D4</th>
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Intensity:
- Yellow: D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- Red: D3 Drought - Extreme
- Brown: D4 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 1, 2009
Author: D. Miskus, JAWF/CPC/NOAA
# U.S. Drought Monitor
## Texas

### September 29, 2009
Valid 7 a.m. EST

#### Drought Conditions (Percent Area)

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#### Intensity:
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http://drought.unl.edu/dm

Released Thursday, October 1, 2009
Author: D. Miskus, JAWF/CPC/NOAA
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For more information regarding the Drought Monitor datasets, please contact Soren Scott at the NDMC via email at 402-472-5717. View the most current Drought Monitor in Google Earth: Current Drought Monitor View the most current Drought Monitor WMS service: Current Drought Monitor WMS For more information regarding the file formats, click on the appropriate format: Drought Monitor shapefiles, KML files, GML files, OGC WMS files, Excel files. For more information regarding the Drought Monitor color scheme, please visit DM Colors.

Please use the Drought Monitor by including the National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Association (NOAA).


http://drought.unl.edu/dm/dmshps_archive.htm
Coming Soon........
Drought Conditions: January 2007 - April 2008
Climate Links for Texas

Southern Regional Climate Center:
http://www.srcc.lsu.edu

Bureau of Reclamation Reservoir Levels:
http://www.usbr.gov/gp/water/rflow.cfm

USGS Real-Time Streamflow Data:
http://waterdata.usgs.gov/tx/nwis/rt
Local Weather Forecast Office:
http://www.srh.noaa.gov/sjt

State Climatologist:
http://www.met.tamu.edu/osc

State Drought Preparedness Response Plan:

Drought Impacts for San Angelo, TX

Fire Impact 1/3/2008
San Angelo, Texas—Tom Green county is one of 129 counties across Texas that have burn bans due to dry conditions as reported by the Texas Forest Service.
Looking Back.....has the Drought Monitor been all its “cracked” up to be?
CONUS DM Percent of Area Coverage
1999-2009

Drought Monitor (U.S.)
Percent Time of Greater Than 50 Percent Coverage of D2 or Worse
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<th>Area</th>
<th>D0-D4</th>
<th>D1-D4</th>
<th>D2-D4</th>
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<td>&gt;25%</td>
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<tr>
<td>&gt;90%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>&gt;95%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>&gt;99%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>100%</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
### Bastrop County, TX: DM % time by area

<table>
<thead>
<tr>
<th>Percent of the Time Period in Each Areal Coverage</th>
<th>D0-D4</th>
<th>D1-D4</th>
<th>D2-D4</th>
<th>D3-D4</th>
<th>D4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>49.21</td>
<td>59.13</td>
<td>70.44</td>
<td>81.35</td>
<td>91.87</td>
</tr>
<tr>
<td>&gt;1%</td>
<td>50.79</td>
<td>39.48</td>
<td>29.56</td>
<td>16.67</td>
<td>8.13</td>
</tr>
<tr>
<td>&gt;5%</td>
<td>50.60</td>
<td>39.48</td>
<td>28.97</td>
<td>16.67</td>
<td>7.54</td>
</tr>
<tr>
<td>&gt;10%</td>
<td>50.60</td>
<td>39.29</td>
<td>28.77</td>
<td>16.67</td>
<td>7.54</td>
</tr>
<tr>
<td>&gt;25%</td>
<td>49.80</td>
<td>37.70</td>
<td>26.98</td>
<td>16.67</td>
<td>7.54</td>
</tr>
<tr>
<td>&gt;50%</td>
<td>49.01</td>
<td>36.71</td>
<td>25.00</td>
<td>16.47</td>
<td>7.34</td>
</tr>
<tr>
<td>&gt;75%</td>
<td>48.21</td>
<td>34.92</td>
<td>23.61</td>
<td>16.07</td>
<td>7.14</td>
</tr>
<tr>
<td>&gt;90%</td>
<td>47.02</td>
<td>34.33</td>
<td>23.41</td>
<td>15.08</td>
<td>6.35</td>
</tr>
<tr>
<td>&gt;95%</td>
<td>46.03</td>
<td>34.13</td>
<td>23.21</td>
<td>14.88</td>
<td>6.35</td>
</tr>
<tr>
<td>&gt;99%</td>
<td>45.83</td>
<td>32.54</td>
<td>23.21</td>
<td>12.90</td>
<td>6.15</td>
</tr>
<tr>
<td>100%</td>
<td>44.25</td>
<td>32.14</td>
<td>23.21</td>
<td>12.50</td>
<td>3.57</td>
</tr>
</tbody>
</table>
Some closing thoughts:

- An explosion of good work and tools/models/products out there over the past 5 years
- Some nice state efforts out there….
- How can we better detect “flash drought”?
- Are blends really objective? They are both…indicators and weights were chosen
- The DM is both: Indicators and Impacts with unique local input
- What resolution are you comfortable with?
- Monitoring of impacts globally is virtually non-existent
- Progress yes; Perfect, no….we’ll keep trying
Next Steps

- NIDIS---meeting customer needs at the county level
  - “No county left behind”
- Robust IMS/GIS query/analysis (DM-DSS) (NIDIS Portal)
- Incorporate new/enhanced/innovative tools: ACIS gridded SPI/PDSI, remote sensing derived, NWS Precipitation Analysis, NLDAS, etc…
- Taking the blends from a climate division base to a station-based/gridded layer
Thank You

Any Questions?

Please contact me at:
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National Drought Mitigation Center
402-472-8238
msvoboda2@unl.edu