



The Nuts and Bolts of Drought

Luigi Romolo PhD

Minnesota State Climatologist

Presentation Overview

- Understanding Disaster Science: Disaster vs Hazard
- What Is drought and why is it so difficult to define?
- Drought and its unique characteristics
- Quantifying Drought
- Drought Indicators
- Drought classification/severity
- United States Drought Monitor Map

Disaster vs Hazard



Disaster Science

- No two hazards are the same:
 - Geography
 - Seasonality
 - Impact Sectors
 - Impact footprint
 - Warning time
 - Hazard exposure time
 - Total cost

Disaster Science

- No two “like” hazards are the same:
 - Intensity
 - Duration
 - Timing

- This is especially true for the hazard of Drought.

Where does Drought Fall on the Disaster List?

- Tropical Storms: \$22.3 billion per event
- **Drought: \$9.6 billion per event**
- Wildfires: \$5.0 billion per event
- Flooding: \$4.4 billion per event
- Freezes: \$3.4 billion per event
- Winter Storms: \$2.9 billion per event
- Severe Storms: \$2.2 billion per event

Why is Drought so Costly

- It's not like other hazards.
- No defined season.
- It has an insidious nature.
- It can occur in all 50 states...it can span dozens at a time.
- Once a drought starts, there really is no guarantee as to when it might end.
- The threat of drought never really goes away.
- There are secondary impacts.
- Impact Sectors

Why is Drought so costly?

- To answer this further, we need to define drought.
- Drought is extremely difficult to define.
- Conditions that constitute drought in one location may not constitute drought elsewhere.
- There are over 150 different definitions of drought.
- These definitions can be integrated into 5 principal categories.

Drought Types

- **Meteorological Drought:**
 - Shortage of precipitation relative to normal conditions over an unspecified period of time. In the mid-west almost all droughts fall into this category or they start off that way.
- **Hydrological Drought:**
 - Deficiencies in precipitation result in reduced streamflows, lake and reservoir levels and groundwater supplies.
- **Agricultural Drought:**
 - Deficiencies in precipitation create situations where moisture demands for crop and plant life are not met.
- **Ecological Drought:**
 - Most nascent drought type in the literature. IT occurs when the collective effects of met/hydro drought begin to impact the delicate balance of a given ecosystem.
- **Socio-Economic Drought:**
 - Occurs when the collective impacts of the preceding four drought types begin to affect the economy of a given region.

Quantifying Drought

- Drought scientists quantify drought using what we call drought indicators or drought indices....of which there are many.
- No one indicators tells the whole story.
- A suite of indicators is often needed.
- Looking at Impact Reports.
- No substitute for ground truthing.

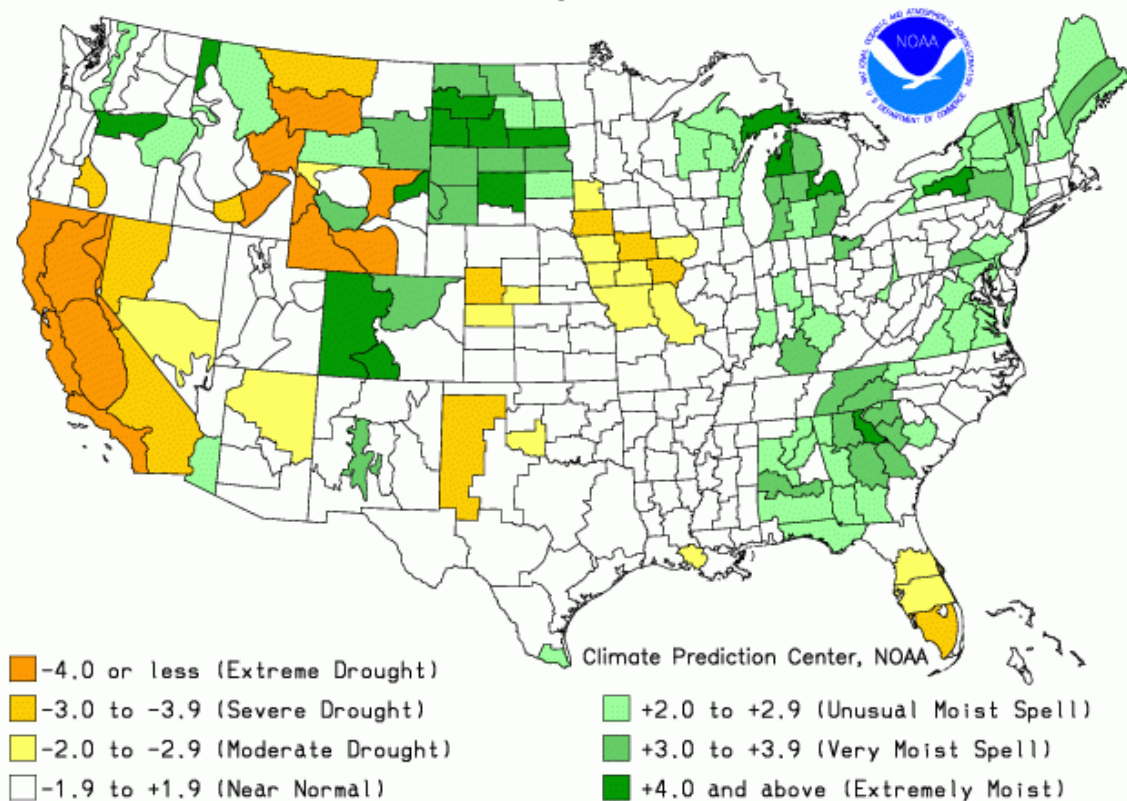
Palmer Drought Severity Index

- Uses temperature and precipitation data to estimate relative dryness.
- Index is standardized and spans from -10 to +10 but operationally the index spans from -4 to 4.

There are variants: Palmer Hydrological Drought Index, Palmer Modified Drought Index, and Palmer Z-Index but they all typically tell the same story, some at longer time scales, others at longer time scales

Palmer Drought Severity Index

Drought Severity Index by Division
Weekly Value for Period Ending JAN 25, 2014
Long Term Palmer

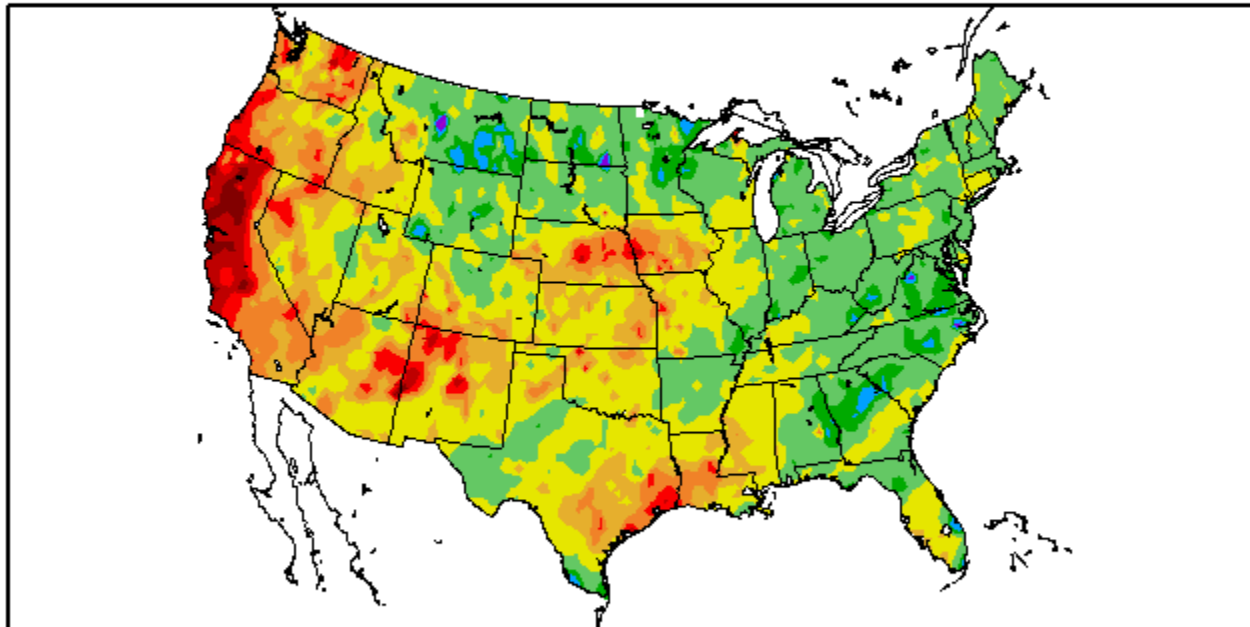


Standardized Precipitation Index

- Like a “z-score” for Precipitation
- Can be compared apples to apples
- Can be calculated over many time scales for indexing short-term or long-term drought

Standardized Precipitation Index

60 Day SPI
12/2/2013 - 1/30/2014



Generated 1/31/2014 at HPRCC using provisional data.

Regional Climate Centers

Drought Classification

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: <ul style="list-style-type: none">• short-term dryness slowing planting, growth of crops or pastures Coming out of drought: <ul style="list-style-type: none">• some lingering water deficits• pastures or crops not fully recovered
D1	Moderate Drought	<ul style="list-style-type: none">• Some damage to crops, pastures• Streams, reservoirs, or wells low, some water shortages developing or imminent• Voluntary water-use restrictions requested
D2	Severe Drought	<ul style="list-style-type: none">• Crop or pasture losses likely• Water shortages common• Water restrictions imposed
D3	Extreme Drought	<ul style="list-style-type: none">• Major crop/pasture losses• Widespread water shortages or restrictions
D4	Exceptional Drought	<ul style="list-style-type: none">• Exceptional and widespread crop/pasture losses• Shortages of water in reservoirs, streams, and wells creating water emergencies

Image Source: National Drought Mitigation Center

Drought Severity Classification

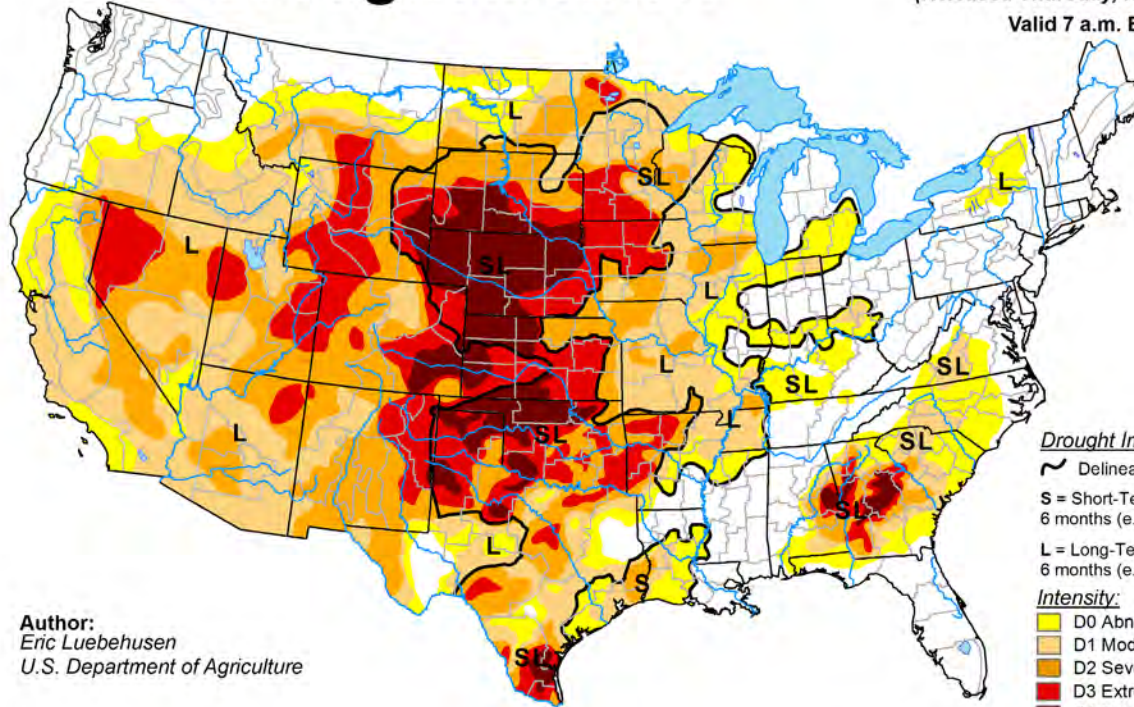
Category	Description	Possible Impacts	Ranges				Objective Drought Indicator Blends (Percentiles)
			Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	
D0	Abnormally Dry	<p>Going into drought:</p> <ul style="list-style-type: none"> short-term dryness slowing planting, growth of crops or pastures <p>Coming out of drought:</p> <ul style="list-style-type: none"> some lingering water deficits pastures or crops not fully recovered 	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	<ul style="list-style-type: none"> Some damage to crops, pastures Streams, reservoirs, or wells low, some water shortages developing or imminent Voluntary water-use restrictions requested 	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	<ul style="list-style-type: none"> Crop or pasture losses likely Water shortages common Water restrictions imposed 	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	<ul style="list-style-type: none"> Major crop/pasture losses Widespread water shortages or restrictions 	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	<ul style="list-style-type: none"> Exceptional and widespread crop/pasture losses Shortages of water in reservoirs, streams, and wells creating water emergencies 	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

Image Source: National Drought Mitigation Center

US Drought Monitor Map

U.S. Drought Monitor

November 20, 2012
(Released Thursday, Nov. 22, 2012)
Valid 7 a.m. EST



Author:
Eric Luebehusen
U.S. Department of Agriculture

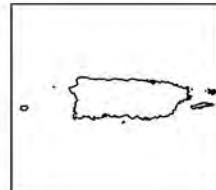
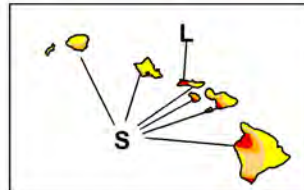
Drought Impact Types:

- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- Yellow: D0 Abnormally Dry
- Light Orange: D1 Moderate Drought
- Orange: D2 Severe Drought
- Red: D3 Extreme Drought
- Dark Red: D4 Exceptional Drought

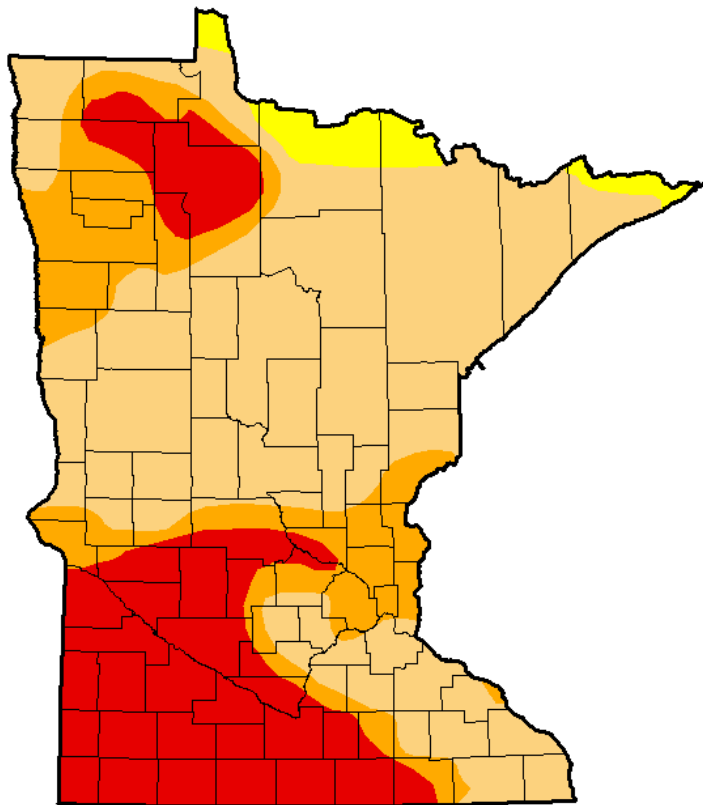
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



<http://droughtmonitor.unl.edu/>

US Drought Monitor Map

U.S. Drought Monitor Minnesota



November 20, 2012

(Released Thursday, Nov. 22, 2012)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	96.38	43.17	25.25	0.00
Last Week <i>11/13/2012</i>	0.00	100.00	96.38	43.17	25.25	0.00
3 Months Ago <i>8/21/2012</i>	47.67	52.33	36.31	17.98	0.24	0.00
Start of Calendar Year <i>1/3/2012</i>	0.79	99.21	57.45	24.08	0.00	0.00
Start of Water Year <i>9/25/2012</i>	1.92	98.08	77.45	35.36	18.51	0.00
One Year Ago <i>11/22/2011</i>	0.48	99.52	40.58	20.75	0.00	0.00

Intensity:



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

Author:

Eric Luebehusen

U.S. Department of Agriculture



<http://droughtmonitor.unl.edu/>

Summary

- Drought is a very unique hazard.
- Everyone is vulnerable to drought.
- The threat of drought never really goes away.
- Understanding drought means understanding how it impacts you.

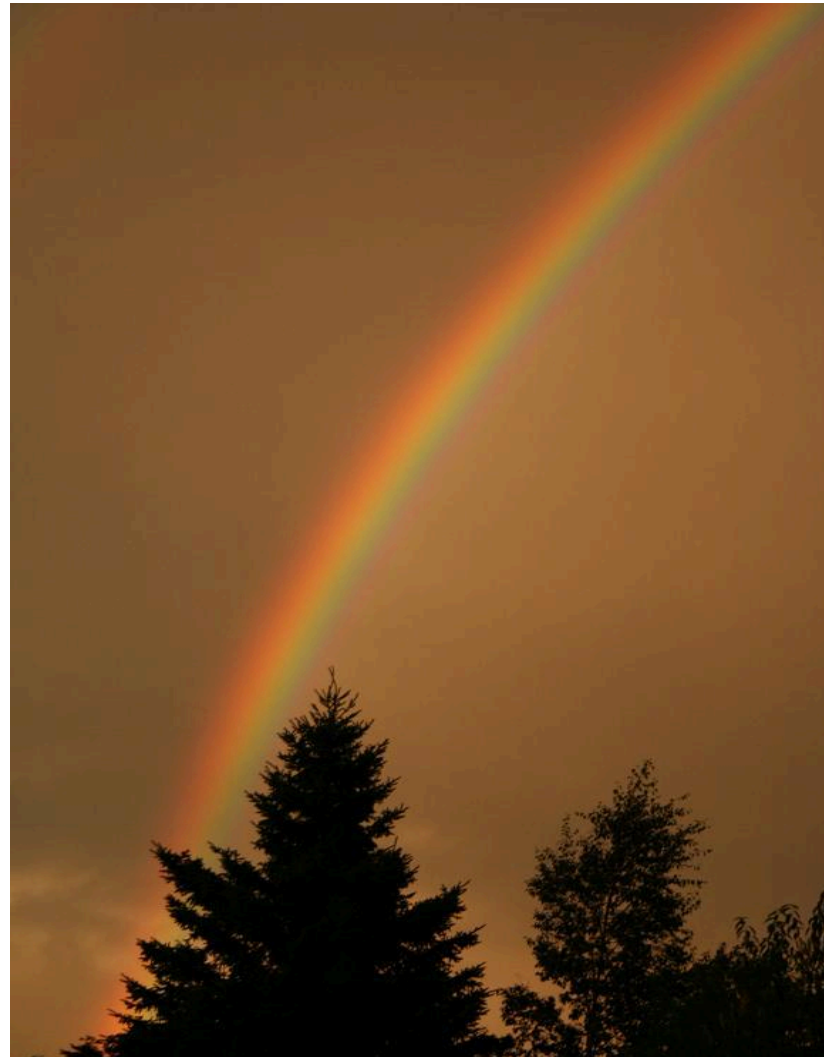


Photo Credit: Pete Boulay

Thank You!