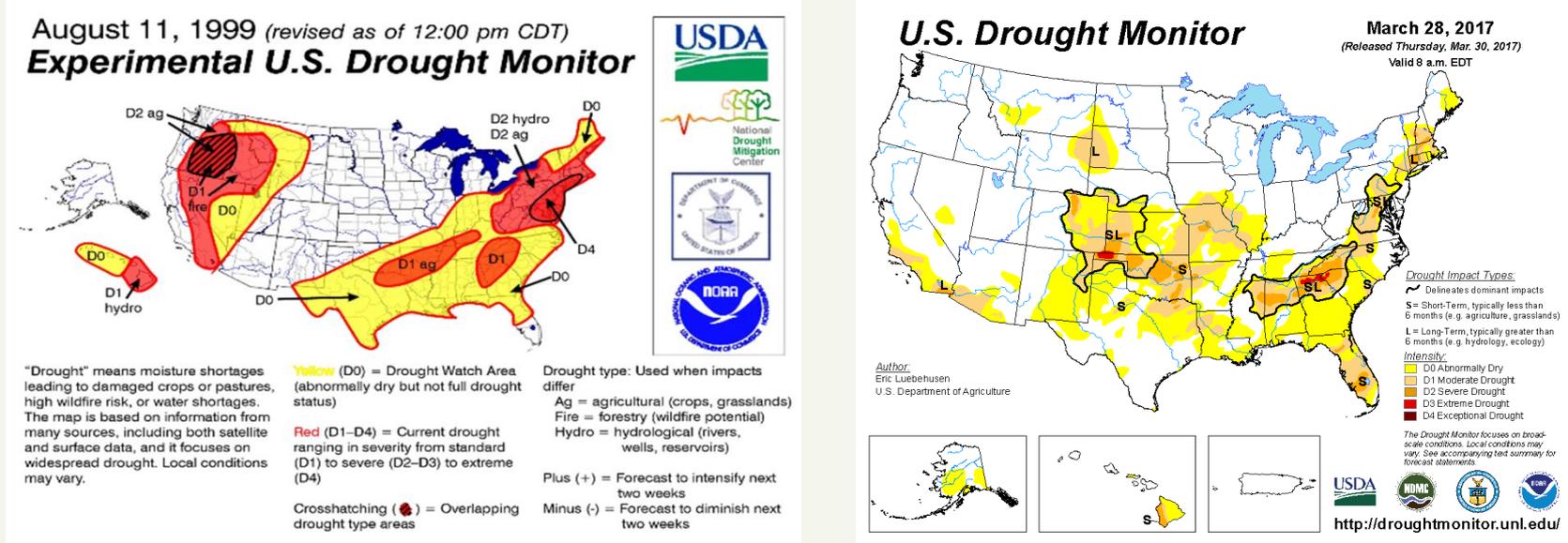
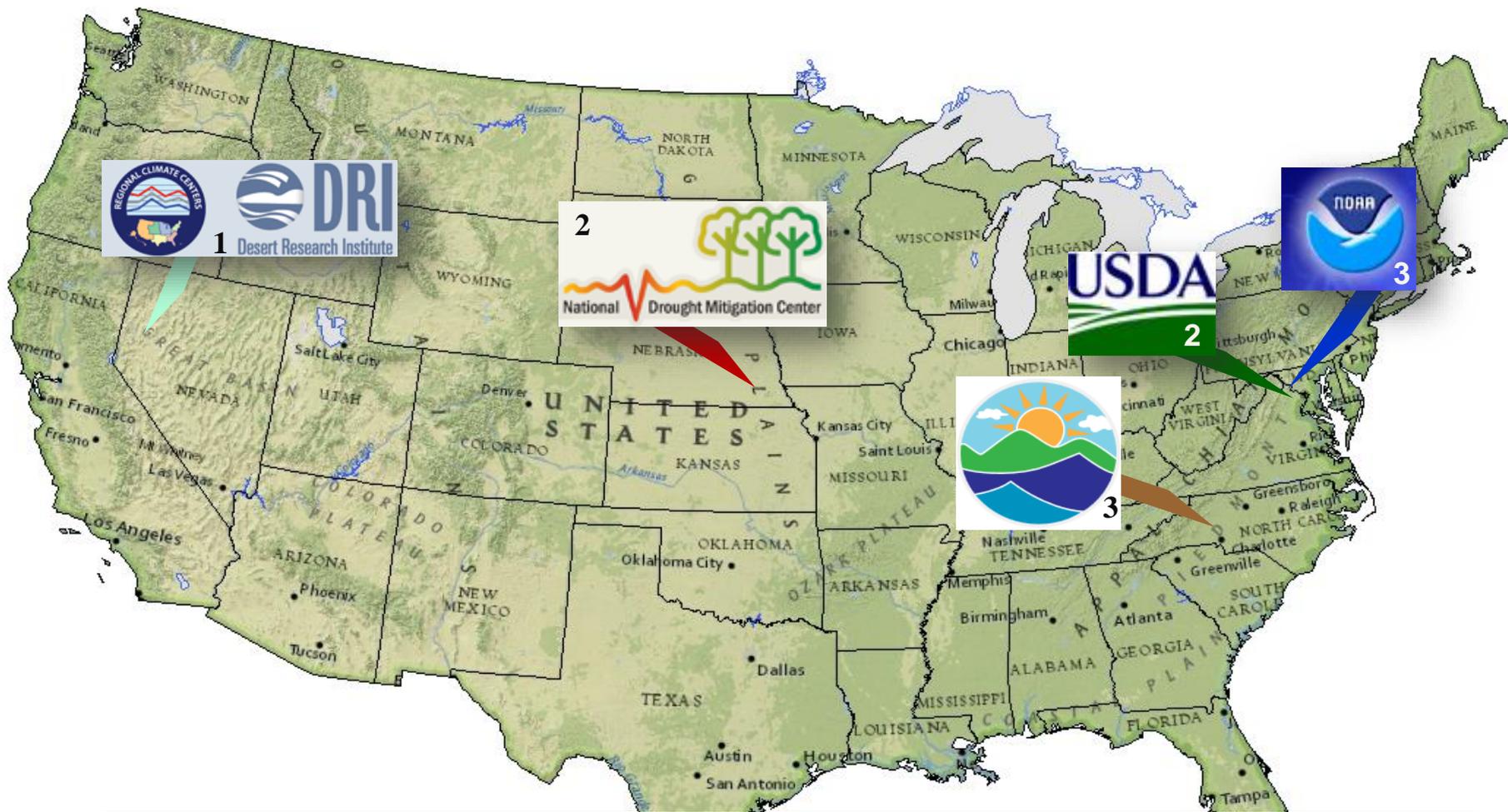


Dry Fusion: A Timeline of the U.S. Drought Monitor's Evolution



**Mark Svoboda, PhD, Director
National Drought Mitigation Center
University of Nebraska-Lincoln**
w/ all of my USDM Author colleagues

USDM Forum, Keystone, SD, April 3-5, 2017



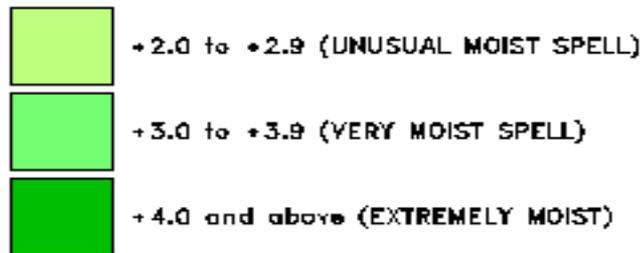
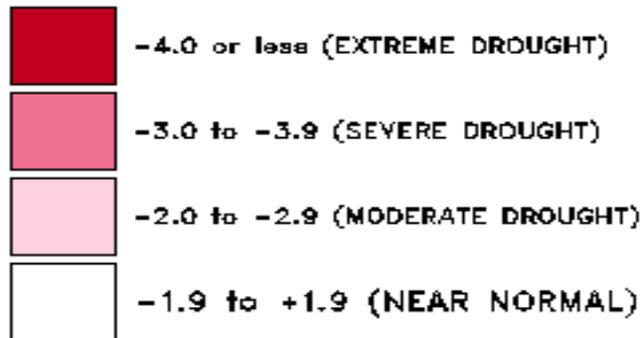
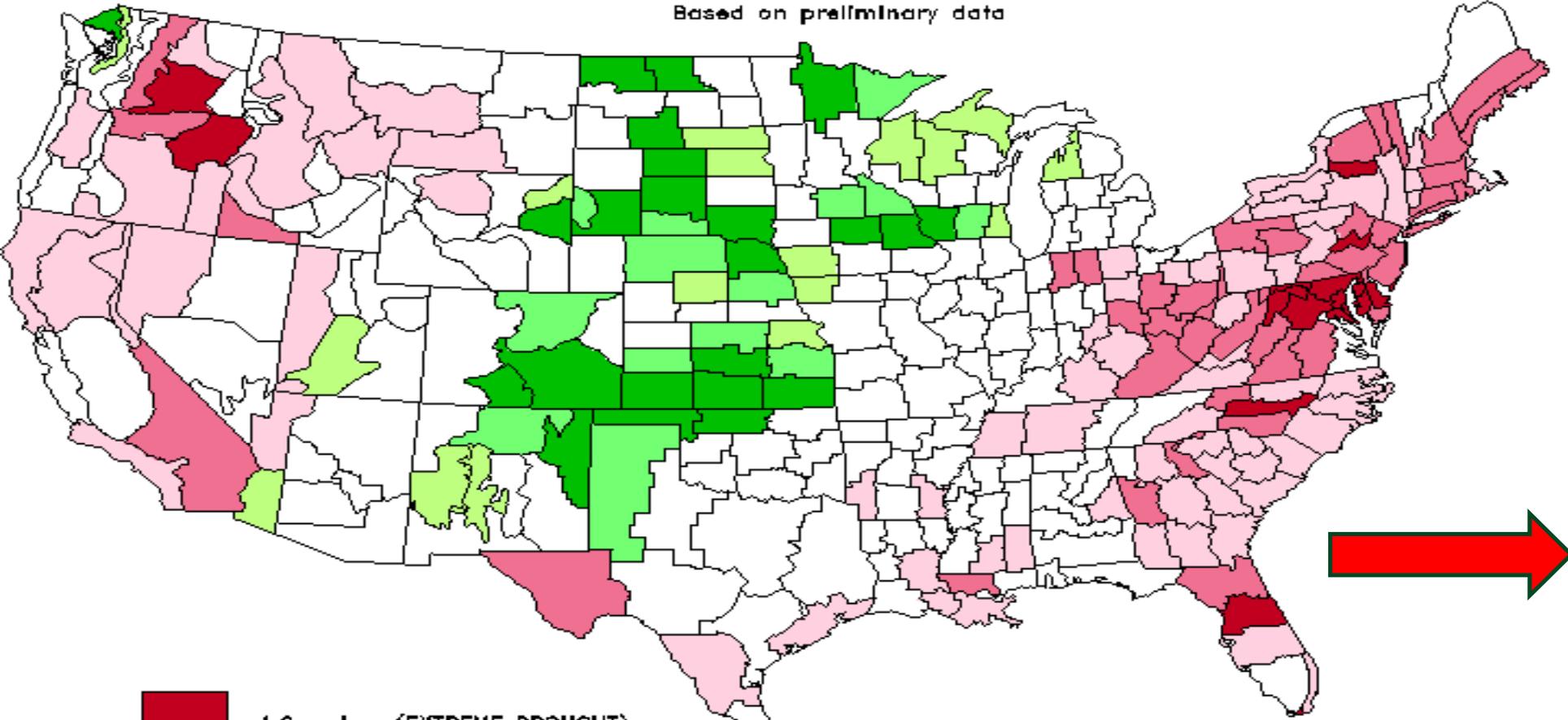
Partnership: Authors must work at a regional or national “center”, government or academia/research entity... There are currently 11 authors, and all are volunteers



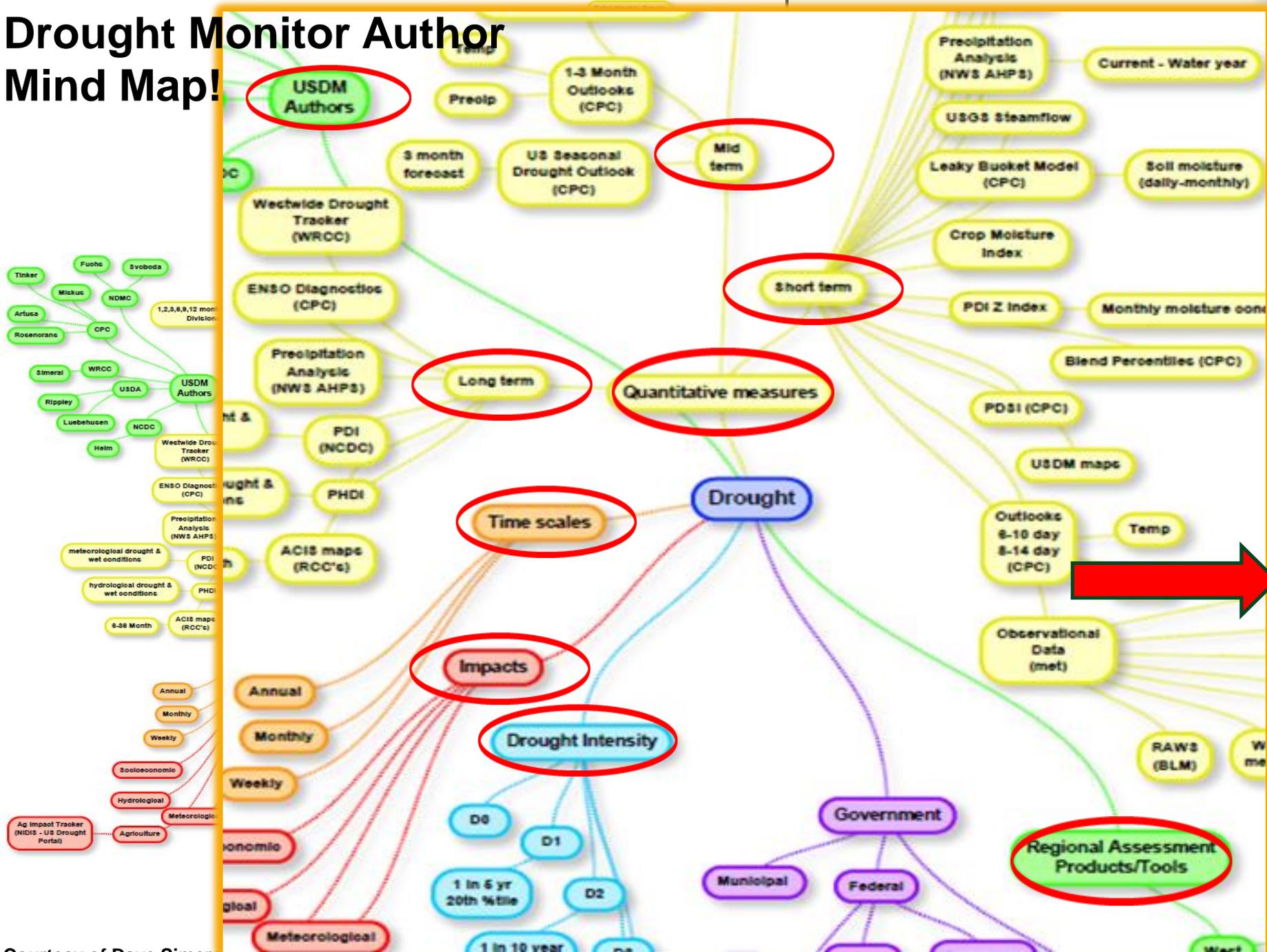
DROUGHT SEVERITY INDEX BY DIVISION (LONG TERM PALMER)

AUG 7, 1999

Based on preliminary data

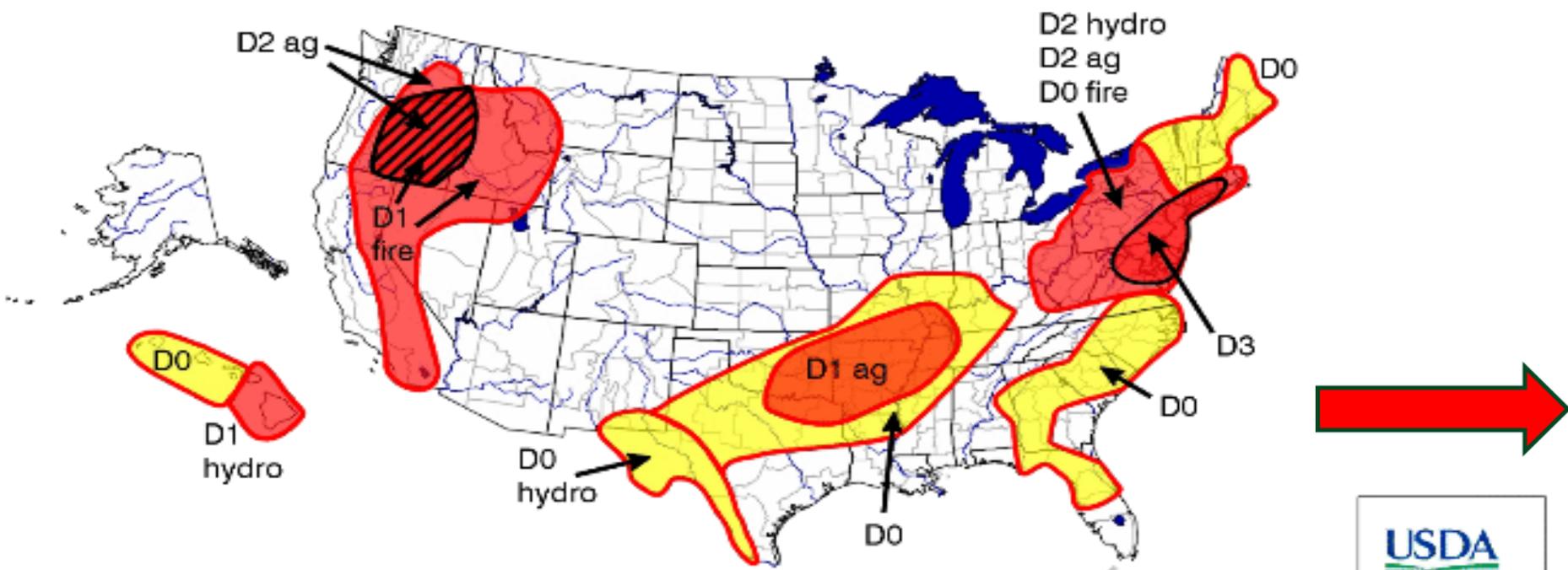


Drought Monitor Author Mind Map!



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

Drought type: Used when impacts differ

Ag = agricultural (crops, grasslands)

Fire = forestry (wildfire potential)

Hydro = hydrological (rivers, wells, reservoirs)

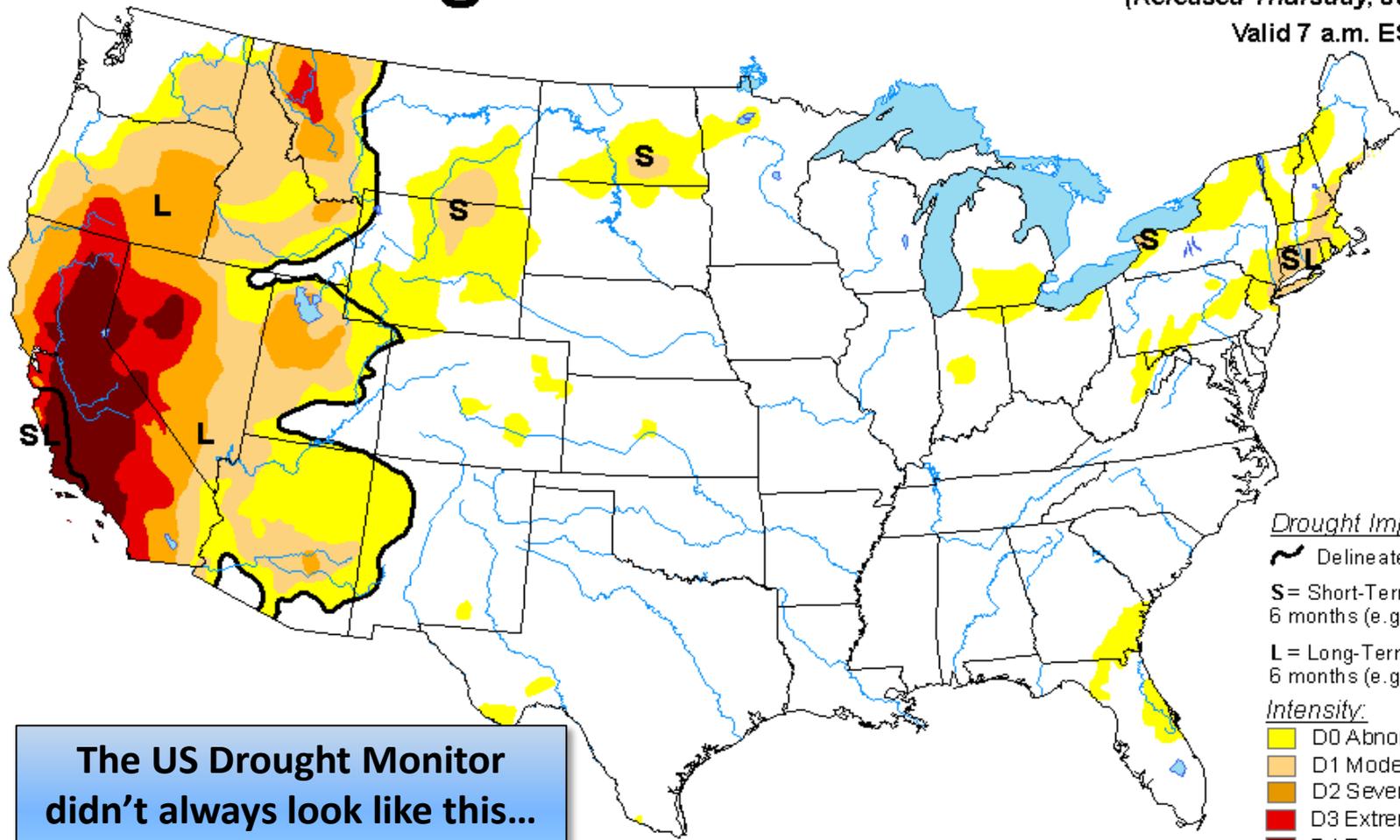
Plus (+) = Forecast to intensify

Minus (-) = Forecast to diminish



U.S. Drought Monitor

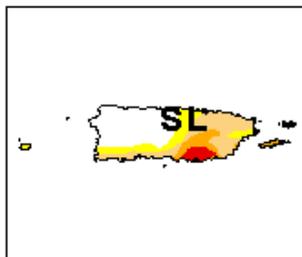
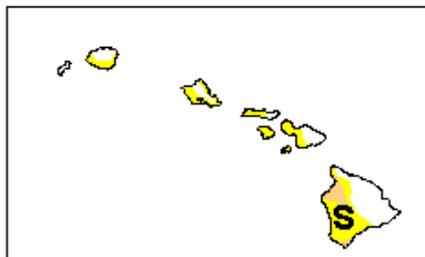
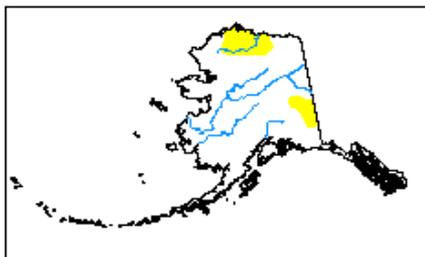
January 5, 2016
(Released Thursday, Jan. 7, 2016)
Valid 7 a.m. EST



The US Drought Monitor didn't always look like this...

- 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/>

EXPERIMENTAL DROUGHT MONITOR



May 20, 1999

D0a

D0a,h

D1a/D0h

D0a,h+

D1a,h

Areas depicted on chart are derived by consolidating information from a number of sources based on surface observation networks and satellite. "Drought" is used to mean abnormal moisture shortages

LEGEND:

D0 = Abnormal dryness but not currently classified as a drought.
D1 to D4 = Droughts ranging in severity from standard to exceptional.

a = impact on plant life (agric. or forests)

h = impact on water supplies (reservoirs, streams, wells)

+ or - refer to forecast 2-wk trend, where "+" means intensifying and "-" means weakening. No sign means no significant change.

1999 - The very first U.S. Drought Monitor!!

It was *experimental*, and became operational partially in response to intensifying dryness in the eastern U.S. and across portions of the West. The **map was created in CorelDRAW**.

1999

2001

2003

2005

2007

2009

2011

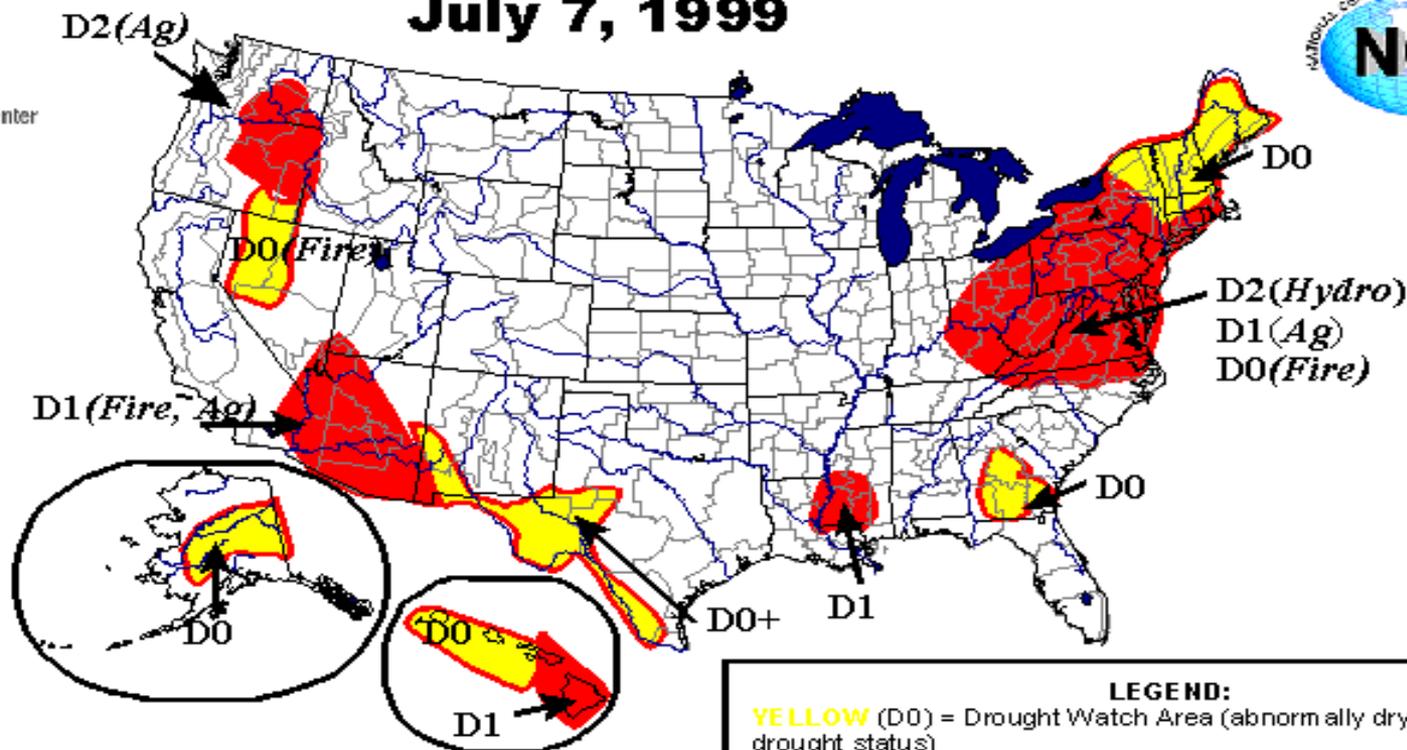
2013

2015



Experimental U.S. DROUGHT MONITOR

July 7, 1999



Areas depicted on map are derived

Summer, 1999 - Authors refined the map areas and tweaked the colors.

high wildfire risk; or water shortages. Only relatively large areas are shown; local conditions may differ markedly from those shown on the map.

LEGEND:

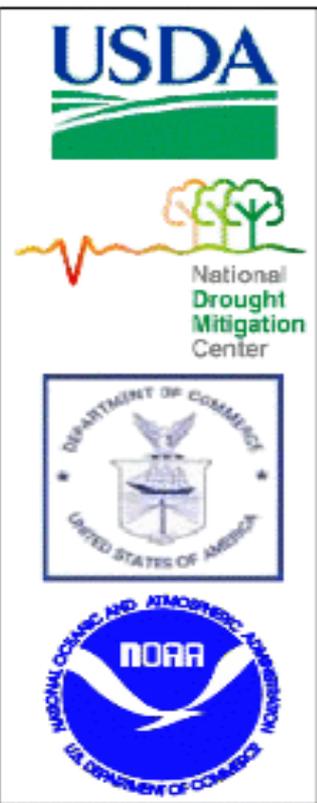
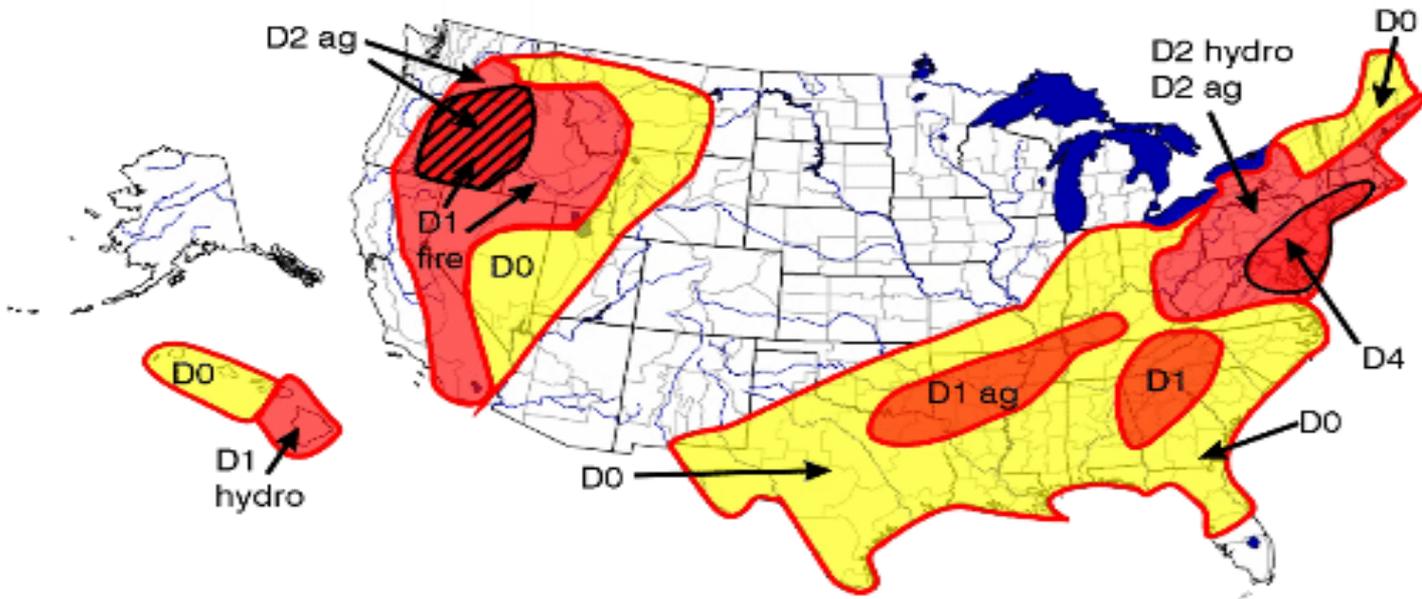
YELLOW (D0) = Drought Watch Area (abnormally dry but not full drought status)

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

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

August 11, 1999 (revised as of 12:00 pm CDT) 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

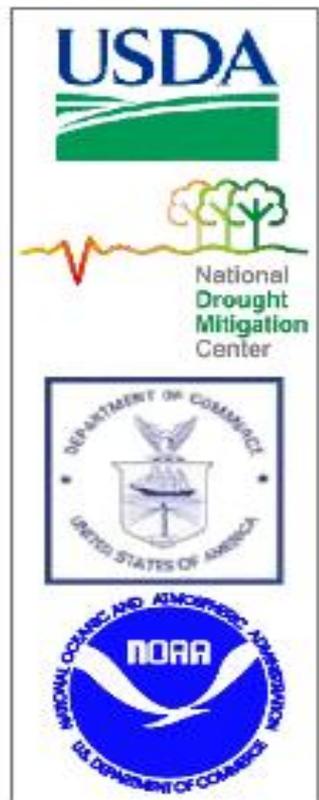
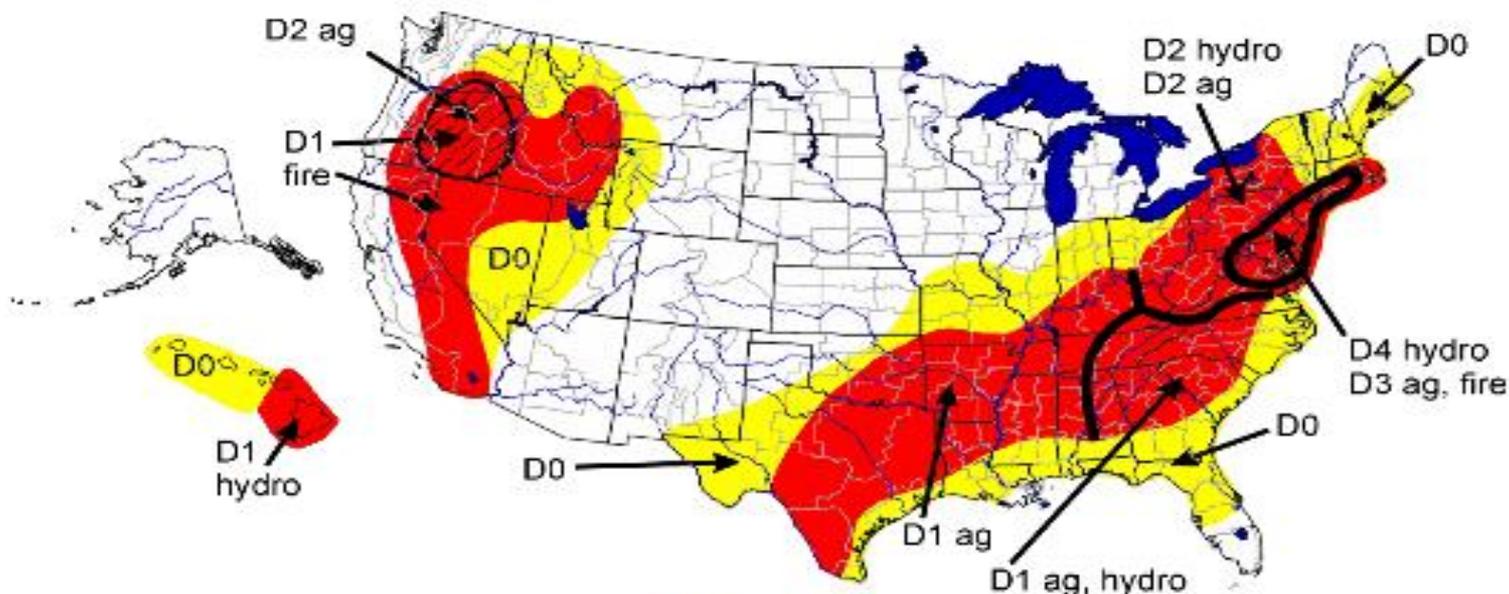
Drought type: Used when impacts differ
 Ag = agricultural (crops, grasslands)
 Fire = forestry (wildfire potential)
 Hydro = hydrological (rivers, wells, reservoirs)

Aug 11, 1999 - The revised map was presented to senior-level government officials at a **White House Briefing**. They liked it so much...

precipitation forecast to intensify next two weeks
 precipitation forecast to diminish next two weeks

August 18, 1999 (scheduled release time Thursday a.m.)

U.S. Drought Monitor



Drought means moisture shortages leading to damaged crops or pastures

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

Drought type: Used when impacts differ

- Ag = agricultural (crops, grasslands)
- Fire = forestry (wildfire potential)
- Hydro = hydrological (rivers, wells, reservoirs)

Plus (+) = Forecast to intensify next two weeks

Minus (-) = Forecast to diminish next two weeks

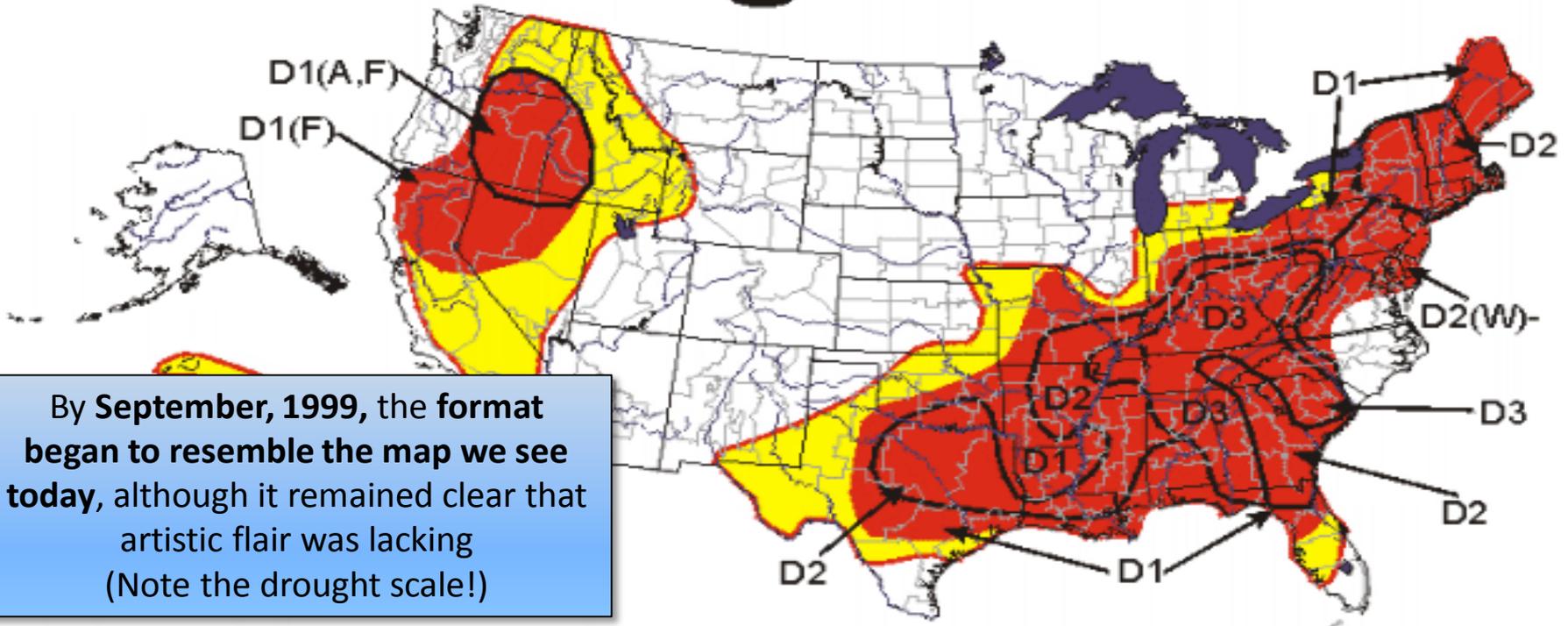
(4) = Current drought severity from standard here (D2–D3) to extreme

(red circle) = Overlapping areas

...the following week, it went operational, making this **the first "official" U.S. Drought Monitor!** This might have be the fastest ***Experimental to Operational*** product in government history!
24 experts comprise the DROUGHT listserver

September 7, 1999

U.S. Drought Monitor



- D0 Watch
 - D1 Drought
 - D2 Drought-Severe
 - D3 Drought-Extreme
 - D4 Drought-Exceptional
 - Delineates Overlapping Areas
- Drought type: used only when impacts differ
- A = Agriculture
W = Water
F = Forest fire danger



• Updated every Thursday morning •

Plus (+) = Forecast to intensify next two weeks
Minus (-) = Forecast to diminish next two weeks
No sign = No change in drought classification forecast

1999

2001

2003

2005

2007

2009

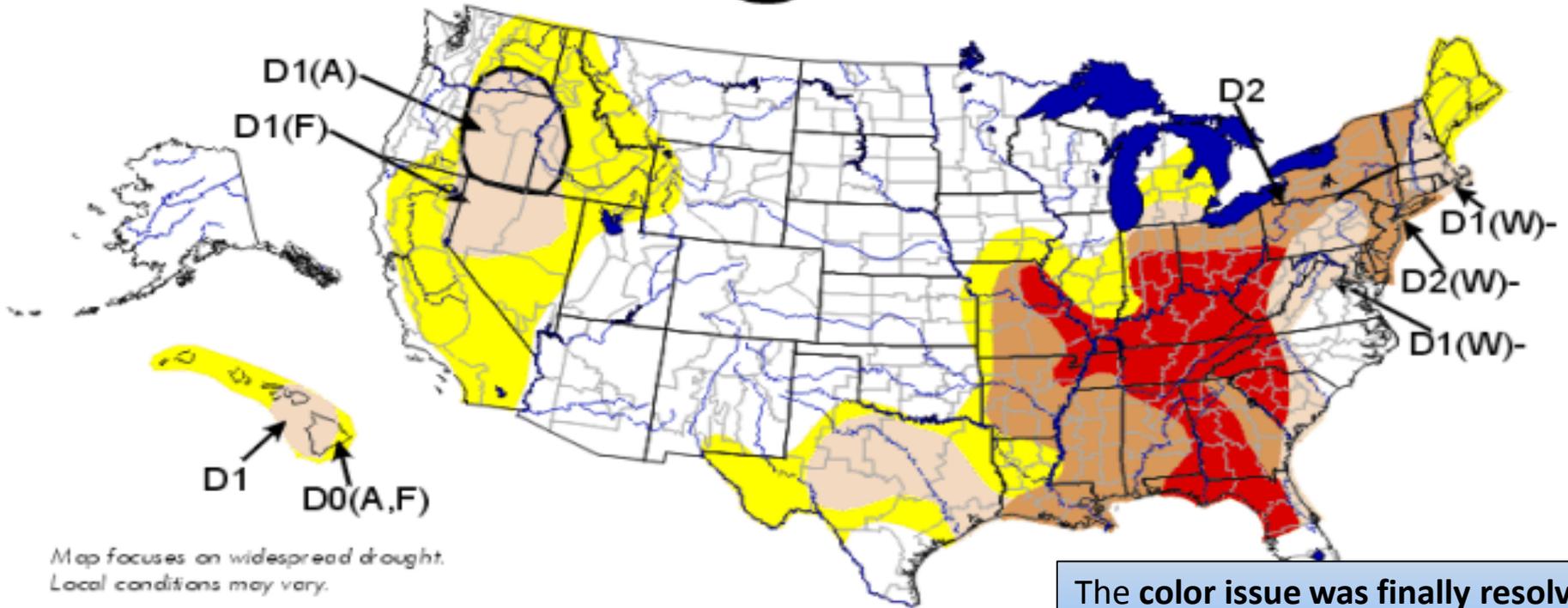
2011

2013

2015

September 15, 1999

U.S. Drought Monitor



- D0 Watch
 - D1 Drought
 - D2 Drought—Severe
 - D3 Drought—Extreme
 - D4 Drought—Exceptional
 - Delineates Overlapping Areas
- Drought type: used only when impacts differ
- A = Agriculture
 - W = Water
 - F = Forest fire danger



The color issue was finally resolved in mid-September, 1999; The USDM still had a "Watch" and Forecast component.

• Updated every Thursday morning •

Plus (+) = Forecast to intensify next two weeks
Minus (-) = Forecast to diminish next two weeks
No sign = No change in drought classification forecast

1999

2001

2003

2005

2007

2009

2011

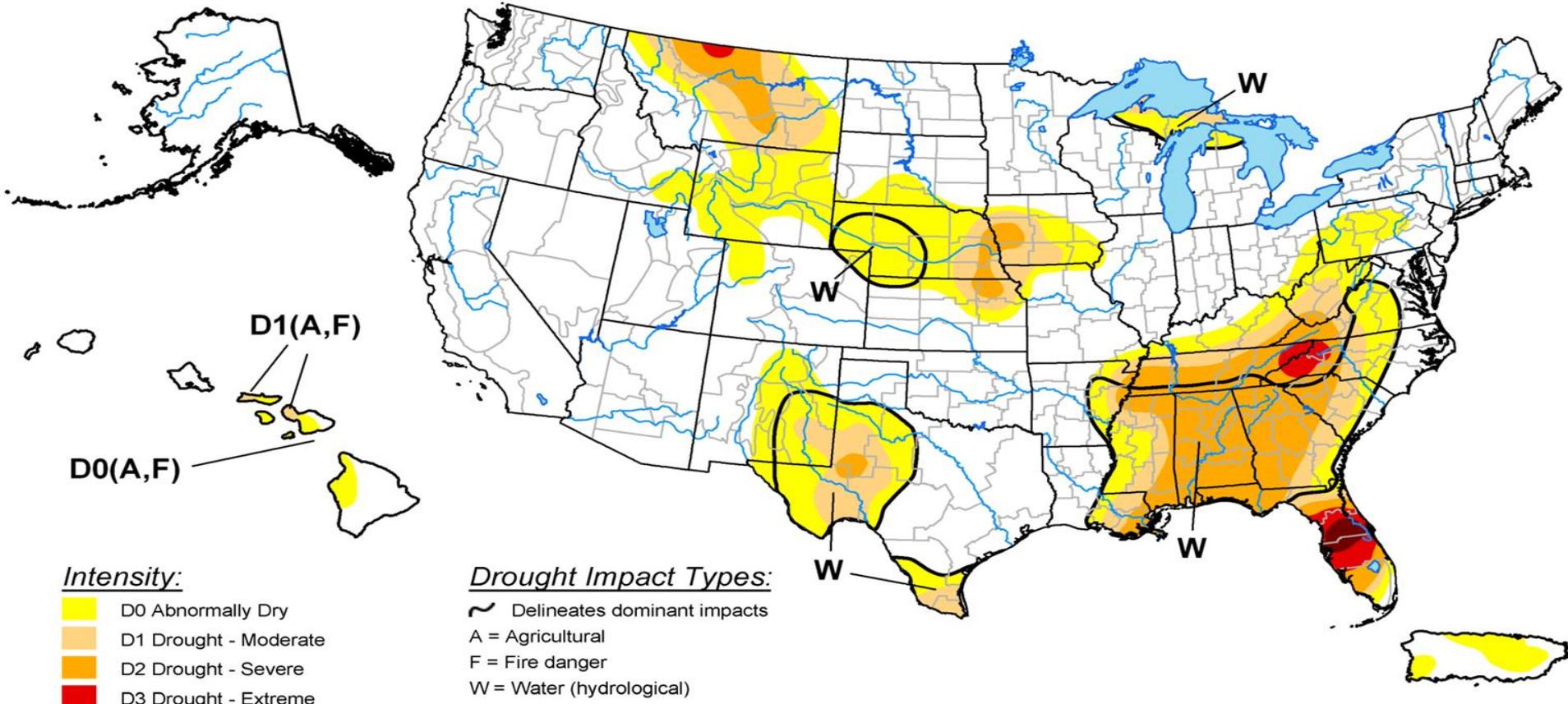
2013

2015

U.S. Drought Monitor

December 12, 2000

Valid 7 a.m. EST



December, 2000 – Forecast Component is dropped, D0 goes from “Watch” to “Abnormally Dry” (going into and coming out of drought) & *authors put their names on the map.* **FIRST USDM User Forum hosted by NDMC in Lincoln, NE Objective Blends borne out of this first Forum...**



Released Thursday, December 14, 2000

Author: David Miskus, NOAA/CPC/JAWF

1999

2001

2003

2005

2007

2009

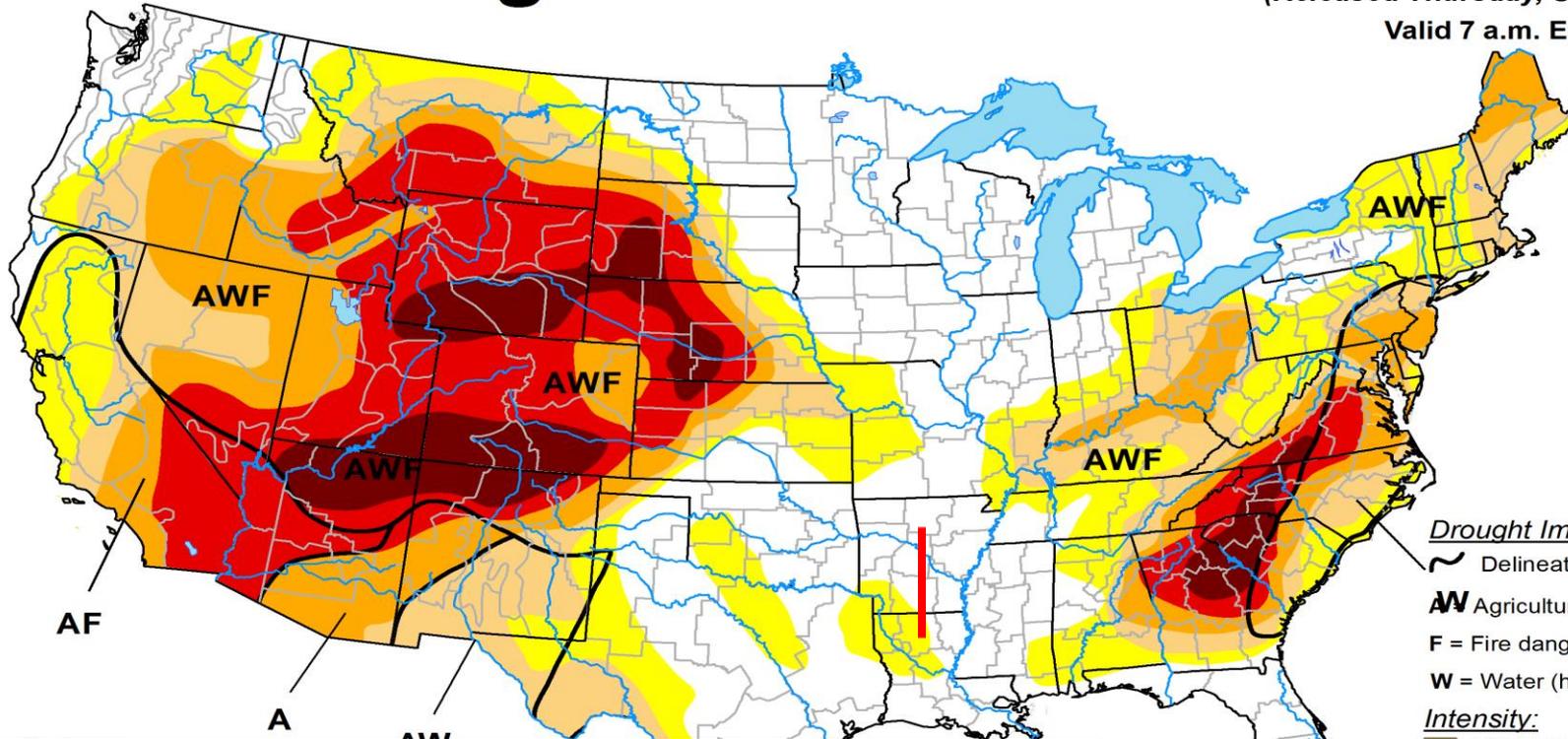
2011

2013

2015

U.S. Drought Monitor

September 3, 2002
 (Released Thursday, Sep. 5, 2002)
 Valid 7 a.m. EST



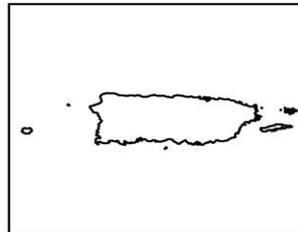
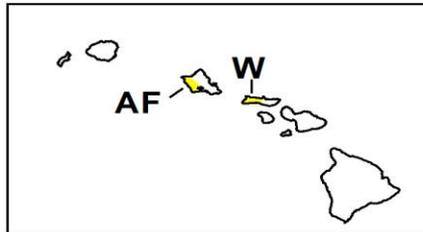
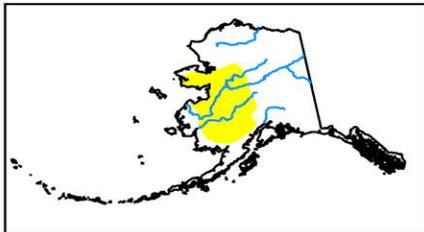
Drought Impact Types:
 ~ Delineates dominant impacts

- AW** Agricultural
- F** = Fire danger
- W** = Water (hydrological)

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

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

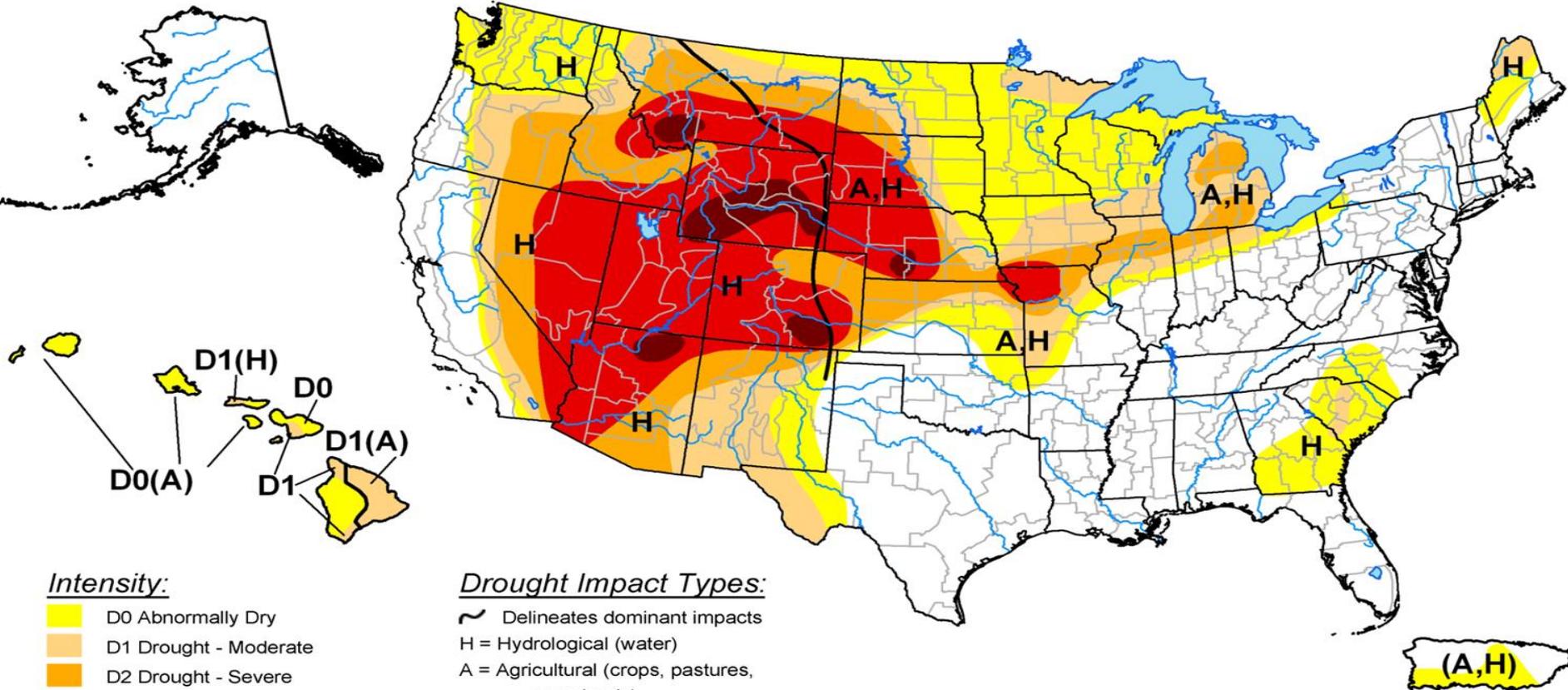
Summer/Fall 2002 – First federal use (USDA) of USDM as a trigger for drought response/relief (Dried Milk) for livestock.



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

U.S. Drought Monitor

February 18, 2003
Valid 7 a.m. EST



Intensity:

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

Drought Impact Types:

- Delineates dominant impacts
- H = Hydrological (water)
- A = Agricultural (crops, pastures, grasslands)

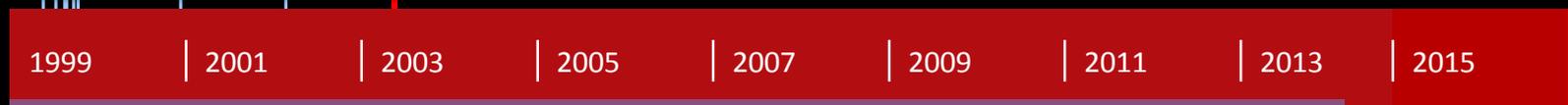
The Fire ("F") Impact type was dropped in early 2003 b/c there is always a fire season and it is hard to weigh the impact of drought on fire.
DROUGHT List Server grows to 150...

ons.
summary



Released Thursday, February 20, 2003

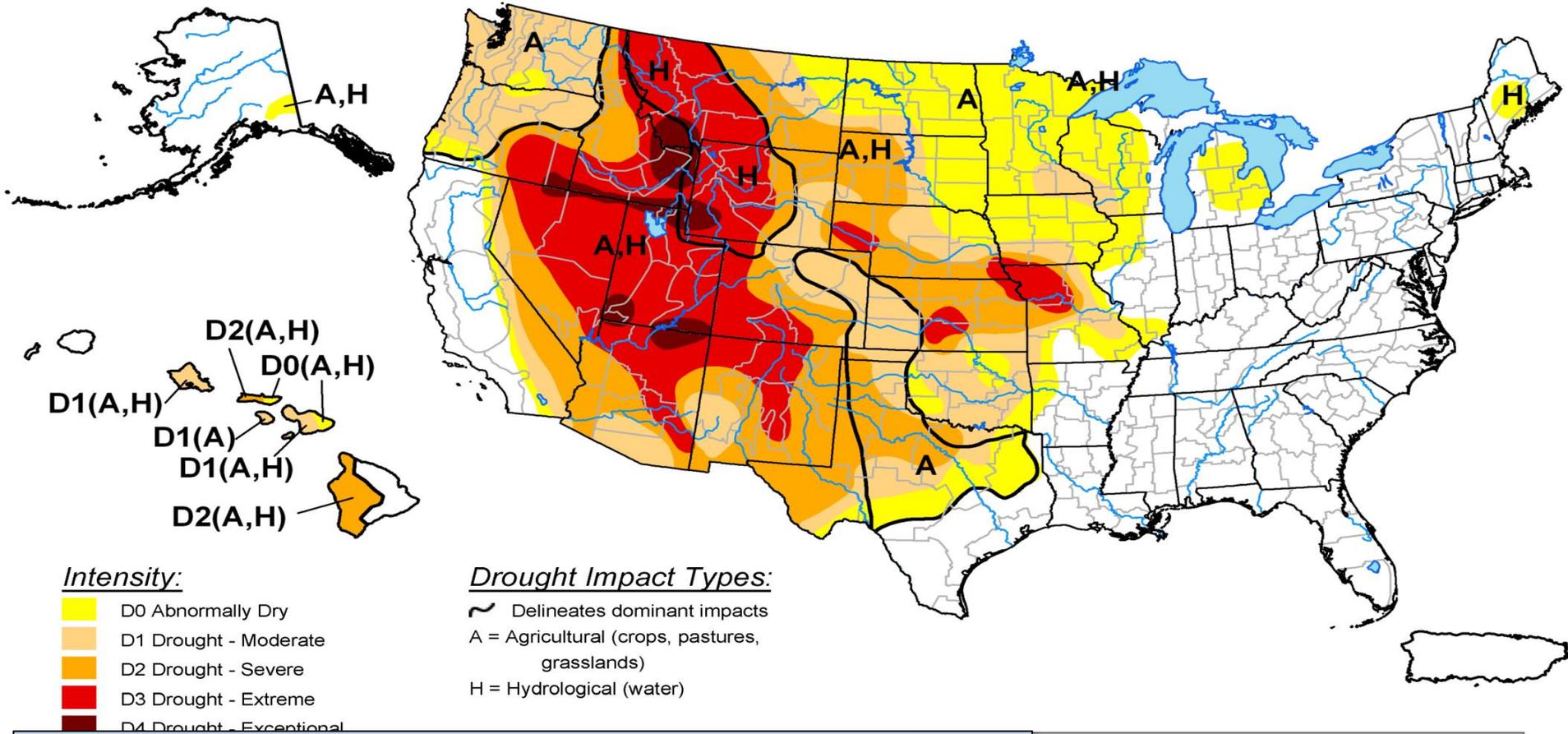
svoboda/Michael Hayes, National Drought Mitigation Center



U.S. Drought Monitor

August 19, 2003

Valid 7 a.m. EST



August, 2003 - authors make a transparent switch from CoreIDRAW to GIS (Geographic Information System) to create the map. There was a steep learning curve, but made the USDM a leader on the GIS front and would pay big dividends down the road.



ed Thursday, August 21, 2003
nkersley/Richard Heim, NOAA/NCDC

1999

2001

2003

2005

2007

2009

2011

2013

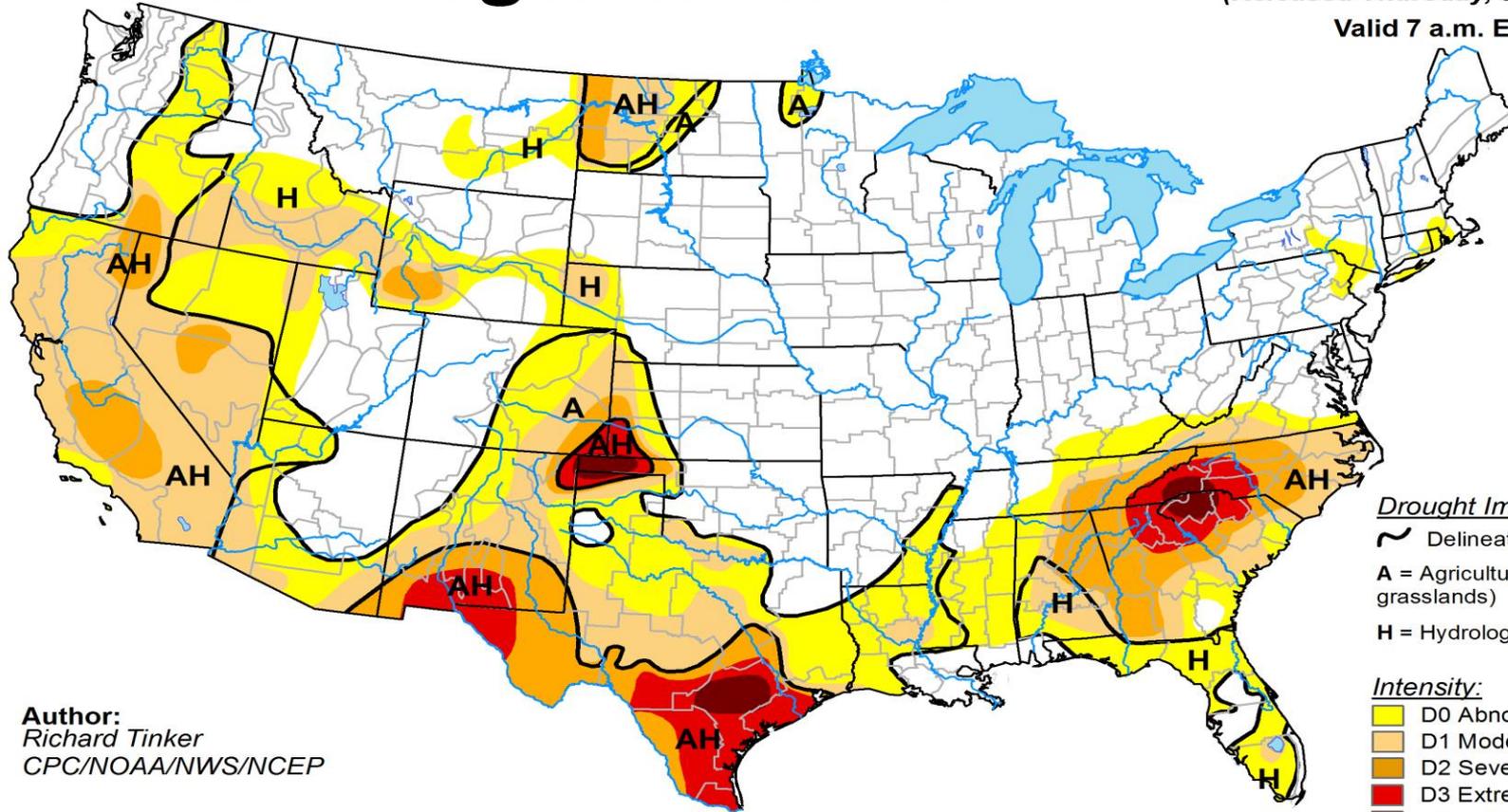
2015

U.S. Drought Monitor

July 1, 2008

(Released Thursday, Jul. 3, 2008)

Valid 7 a.m. EST



Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

Drought Impact Types:

-  Delineates dominant impacts
- A** = Agricultural (crops, pastures, grasslands)
- H** = Hydrological (water)

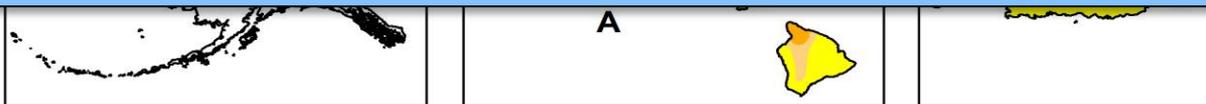
Intensity:

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

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

2008 – USDM written in by Congress as “trigger” within the Farm Bill. First launch of Regional and State (w/ counties) level zoom views and statistics

DROUGHT List Server grows to over 225 experts....



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

1999

2001

2003

2005

2007

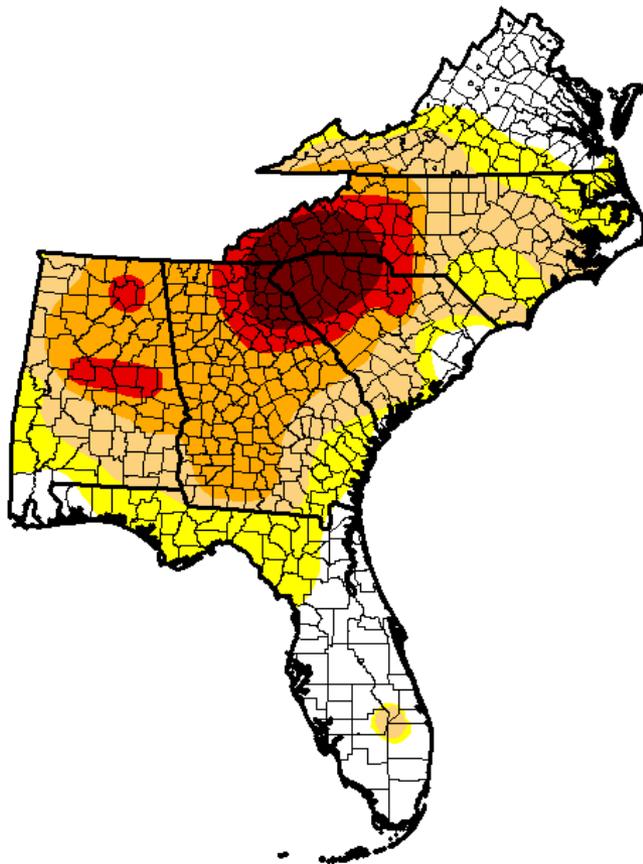
2009

2011

2013

2015

U.S. Drought Monitor Southeast

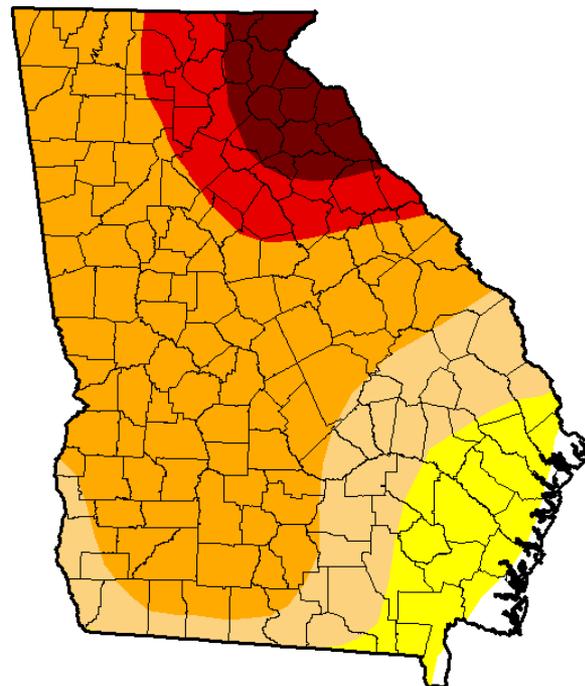


August 5, 2008
(Released Thursday, Aug. 7, 2008)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	22.98	77.02	57.04	35.03	13.83	6.29
Last Week 7/29/2008	22.98	77.02	58.69	34.36	12.23	6.29
3 Months Ago 5/6/2008	26.41	73.59	43.56	23.25	8.93	0.00
Start of Calendar Year 1/1/2008	9.61	90.39	74.26	58.47	40.96	22.00
Start of Water Year	10.38	89.62	76.74	58.97	40.98	15.49

U.S. Drought Monitor Georgia



August 5, 2008
(Released Thursday, Aug. 7, 2008)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	1.95	98.05	87.17	69.71	15.50	6.25
Last Week 7/29/2008	1.95	98.05	87.17	69.71	15.50	6.25
3 Months Ago 5/6/2008	33.70	66.30	43.16	29.92	15.80	0.00
Start of Calendar Year 1/1/2008	2.01	97.99	75.04	65.23	49.44	15.73
Start of Water Year 9/25/2007	24.19	75.81	64.21	52.59	39.36	27.00
One Year Ago 8/7/2007	0.00	100.00	86.01	67.35	47.92	22.87

Intensity:

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

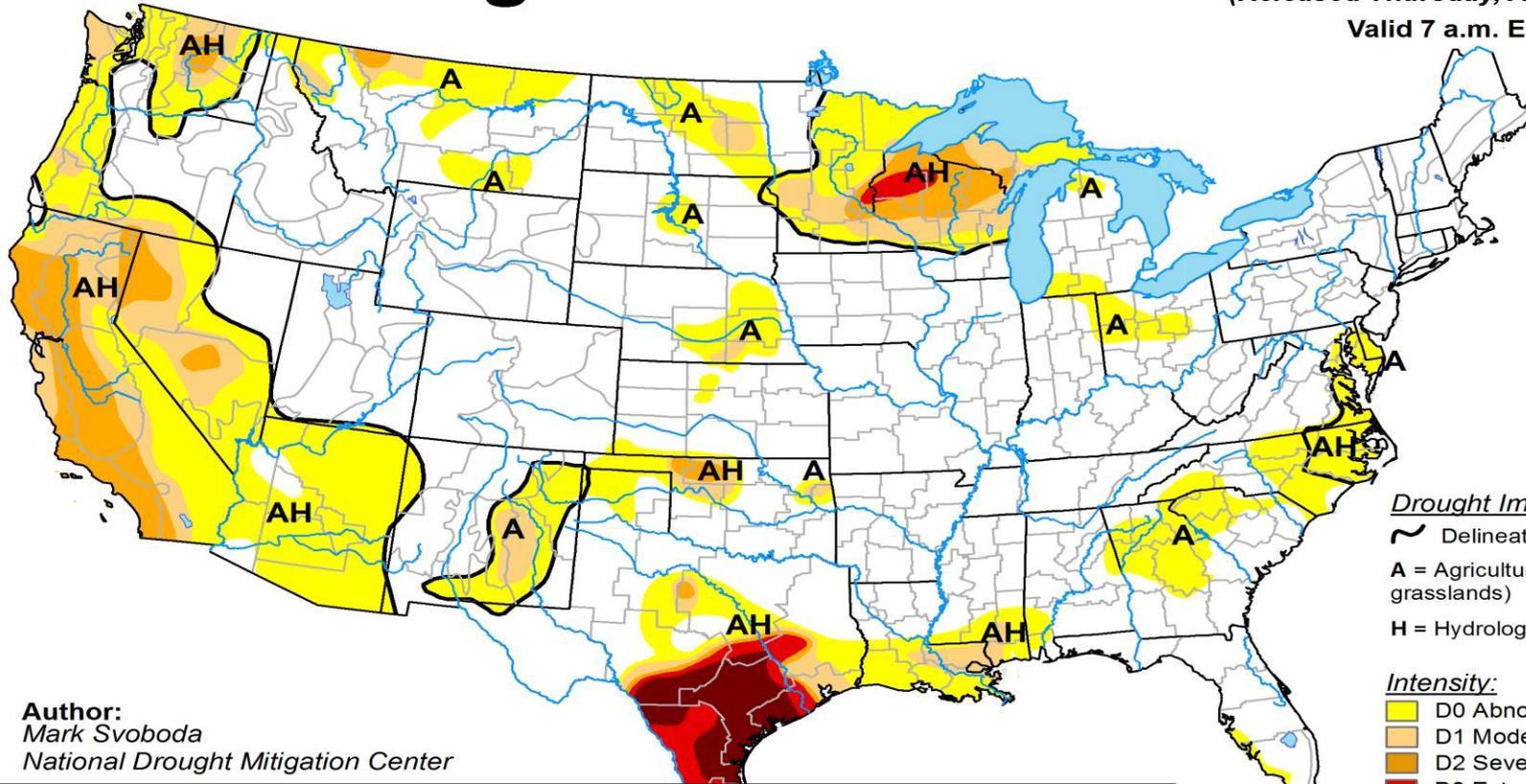
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brian Fuchs
National Drought Mitigation Center



U.S. Drought Monitor

August 4, 2009
 (Released Thursday, Aug. 6, 2009)
 Valid 7 a.m. EST



Author:
 Mark Svoboda
 National Drought Mitigation Center

Drought Impact Types:

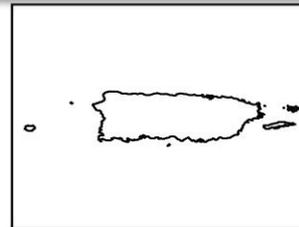
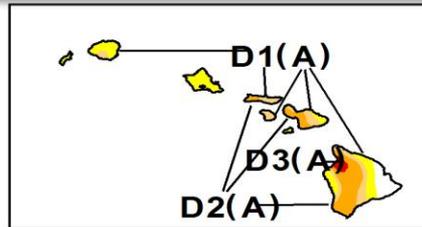
- Delineates dominant impacts
- A** = Agricultural (crops, pastures, grasslands)
- H** = Hydrological (water)

Intensity:

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

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

2009 – USDM celebrates 10th year and 500th map



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

1999

2001

2003

2005

2007

2009

2011

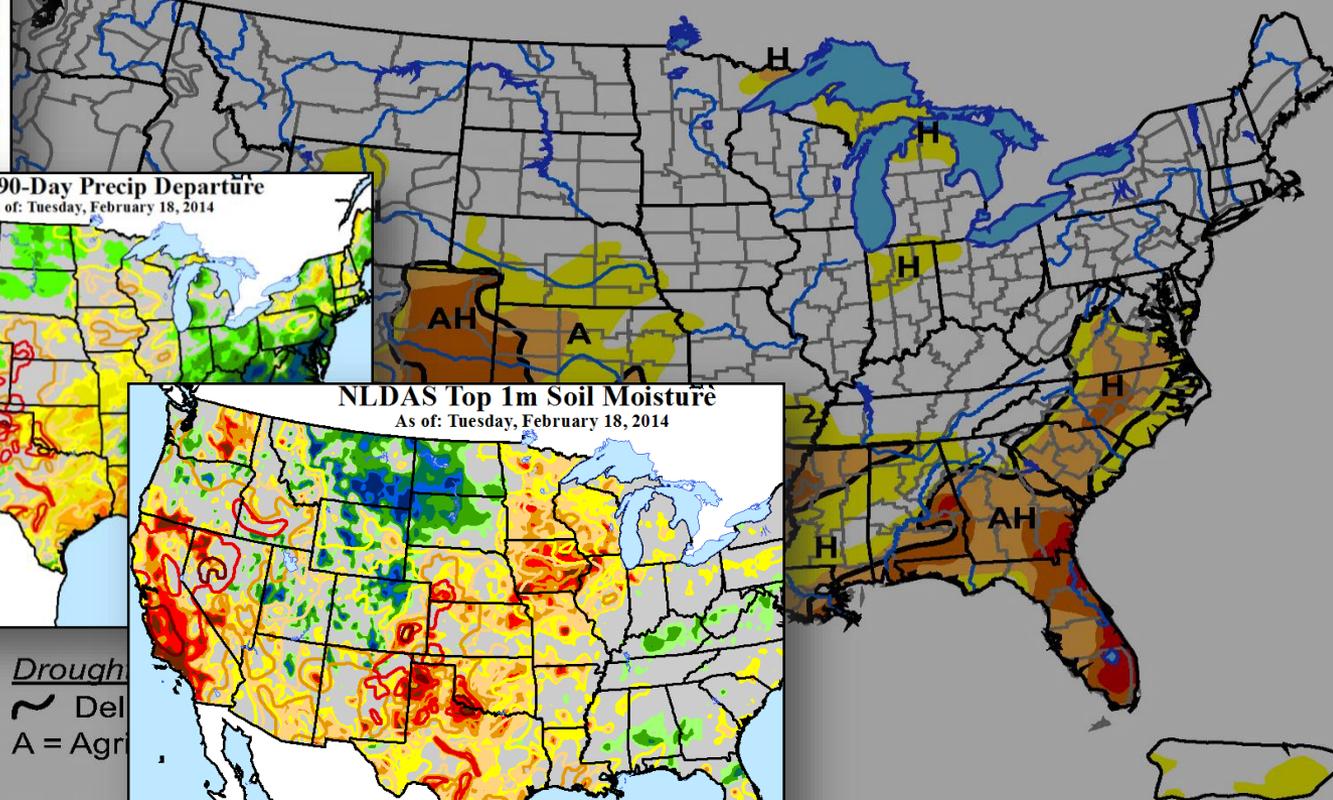
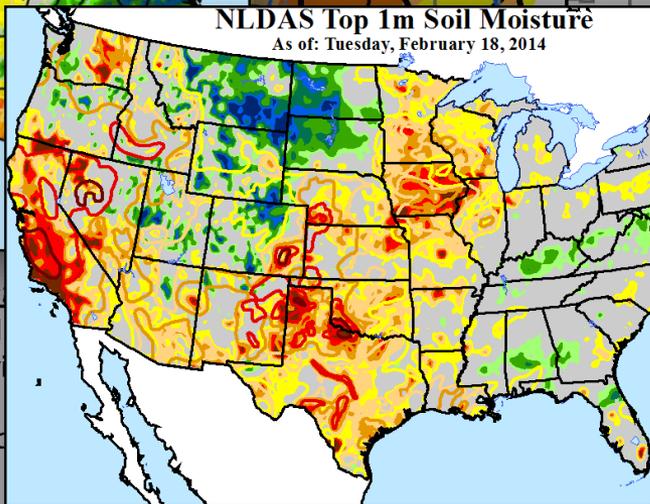
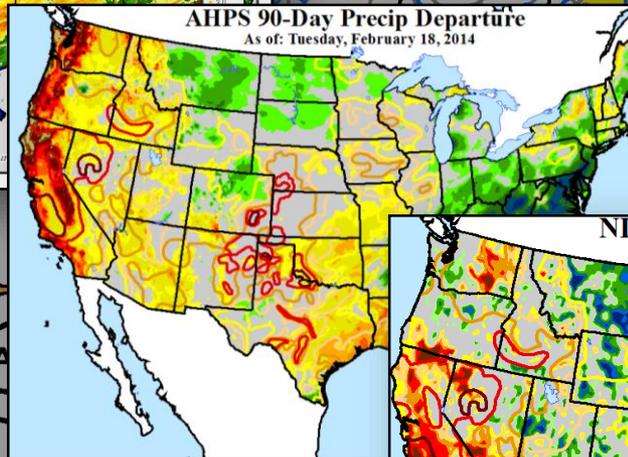
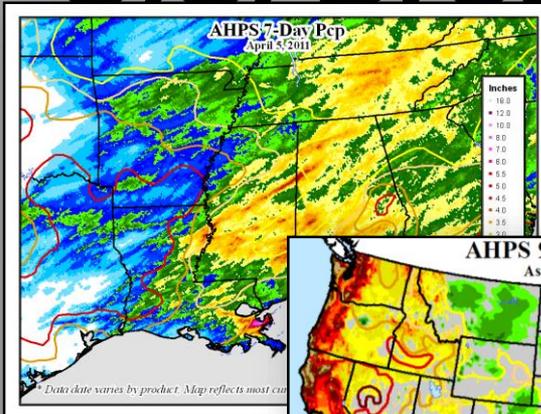
2013

2015

U.S. Drought Monitor

March 22, 2011

Valid 8 a.m. EDT



Intensity:

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

Drought

- Del
- A = Agr
- H = Hyd

2008-2011 - Several authors began **incorporating GIS weather and hydrological data directly into the map-editing process**; consequently, accuracy and detail increase over the next several years – no more “eyeballing” it!



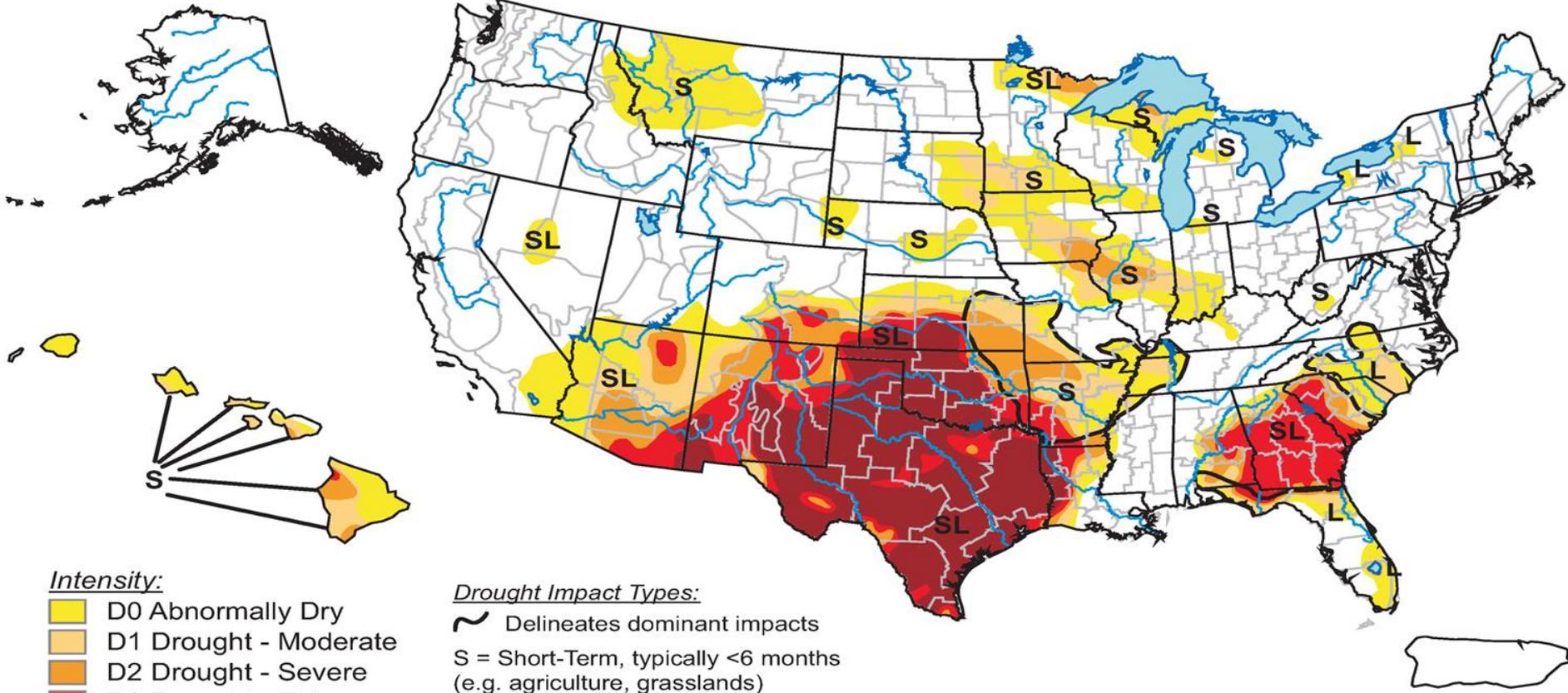
March 24, 2011
Department of Agriculture



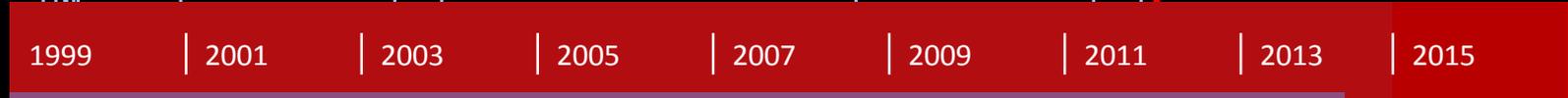
U.S. Drought Monitor

September 27, 2011

Valid 8 a.m. EDT



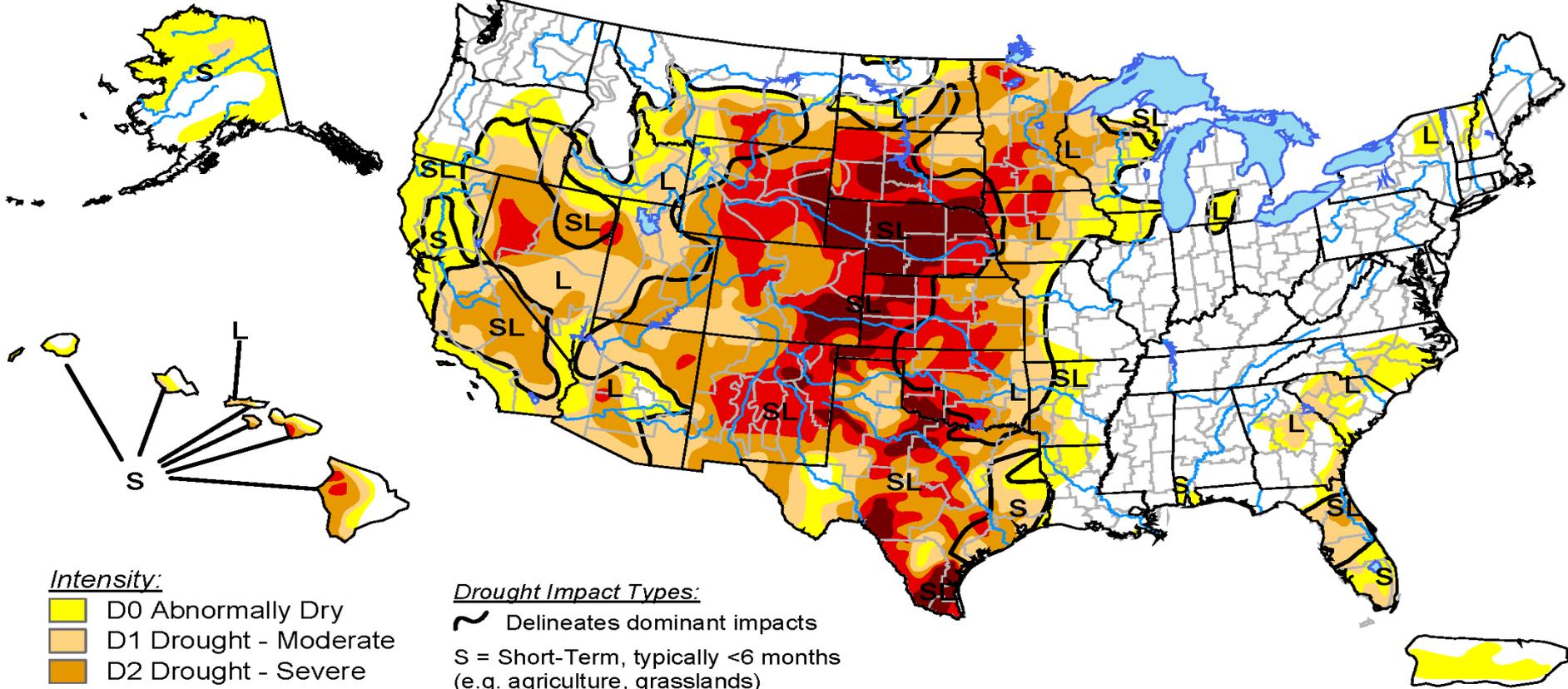
September 29, 2011
NOAA/NESDIS/NCDC



U.S. Drought Monitor

March 26, 2013

Valid 7 a.m. EDT



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme

Drought Impact Types:

- Delineates dominant impacts
- S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months

Early 2013 - the National Drought Mitigation Center took over the final map production so the map is 100% consistent week to week in projection, size, and colors.
(USDM authors still modify drought areas)

December 2013: 750th USDM made



Released Thursday, March 28, 2013
Author: Anthony Artusa, NOAA/NWS/NCEP/CPC

1999

2001

2003

2005

2007

2009

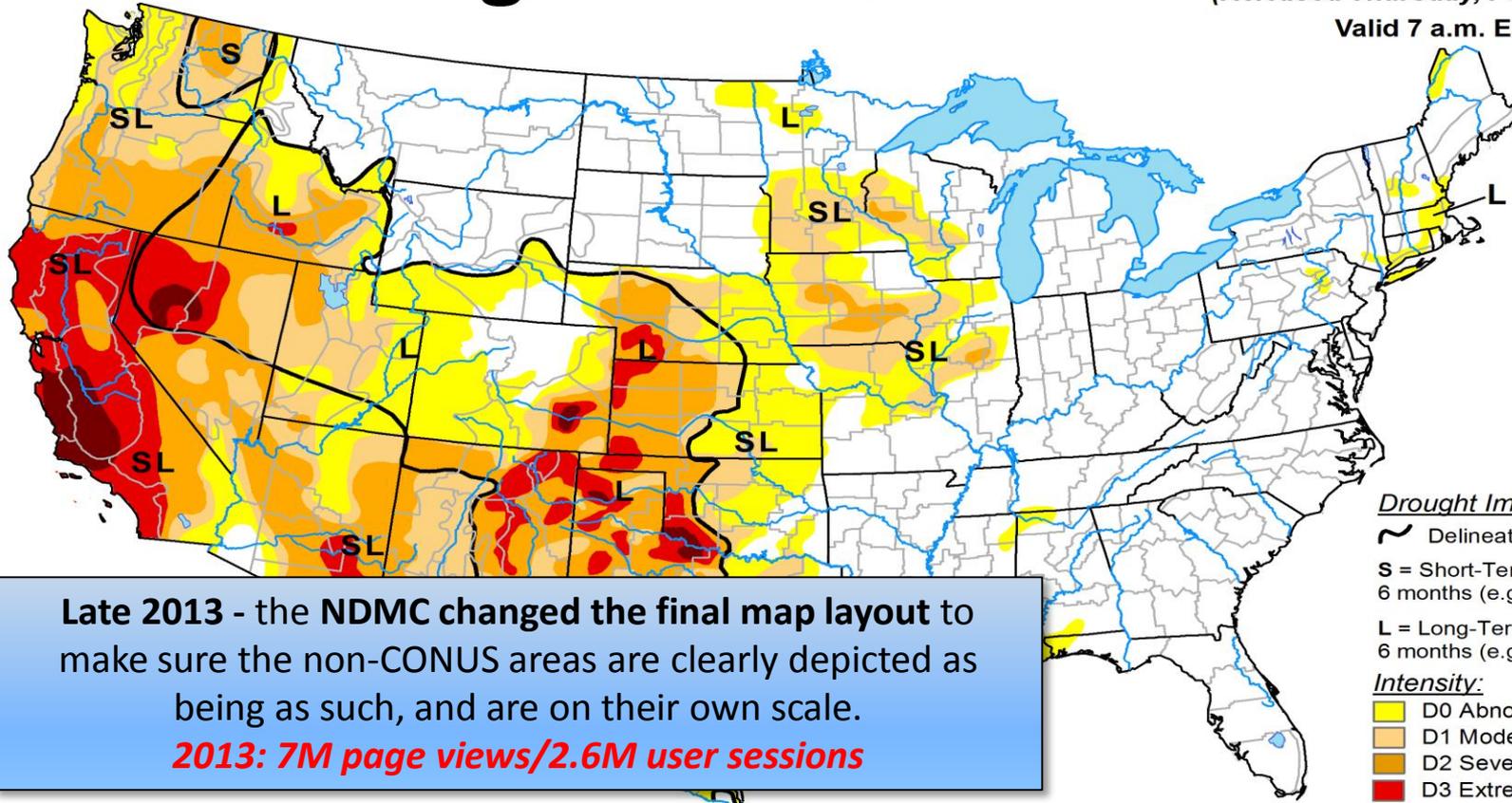
2011

2013

2015

U.S. Drought Monitor

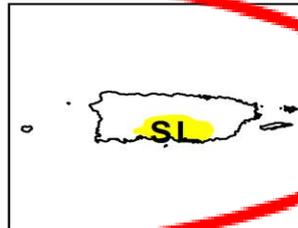
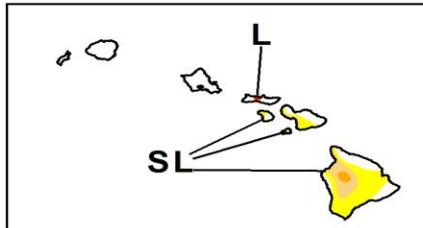
February 18, 2014
(Released Thursday, Feb. 20, 2014)
Valid 7 a.m. EST



Late 2013 - the NDMC changed the final map layout to make sure the non-CONUS areas are clearly depicted as being as such, and are on their own scale.
2013: 7M page views/2.6M user sessions

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

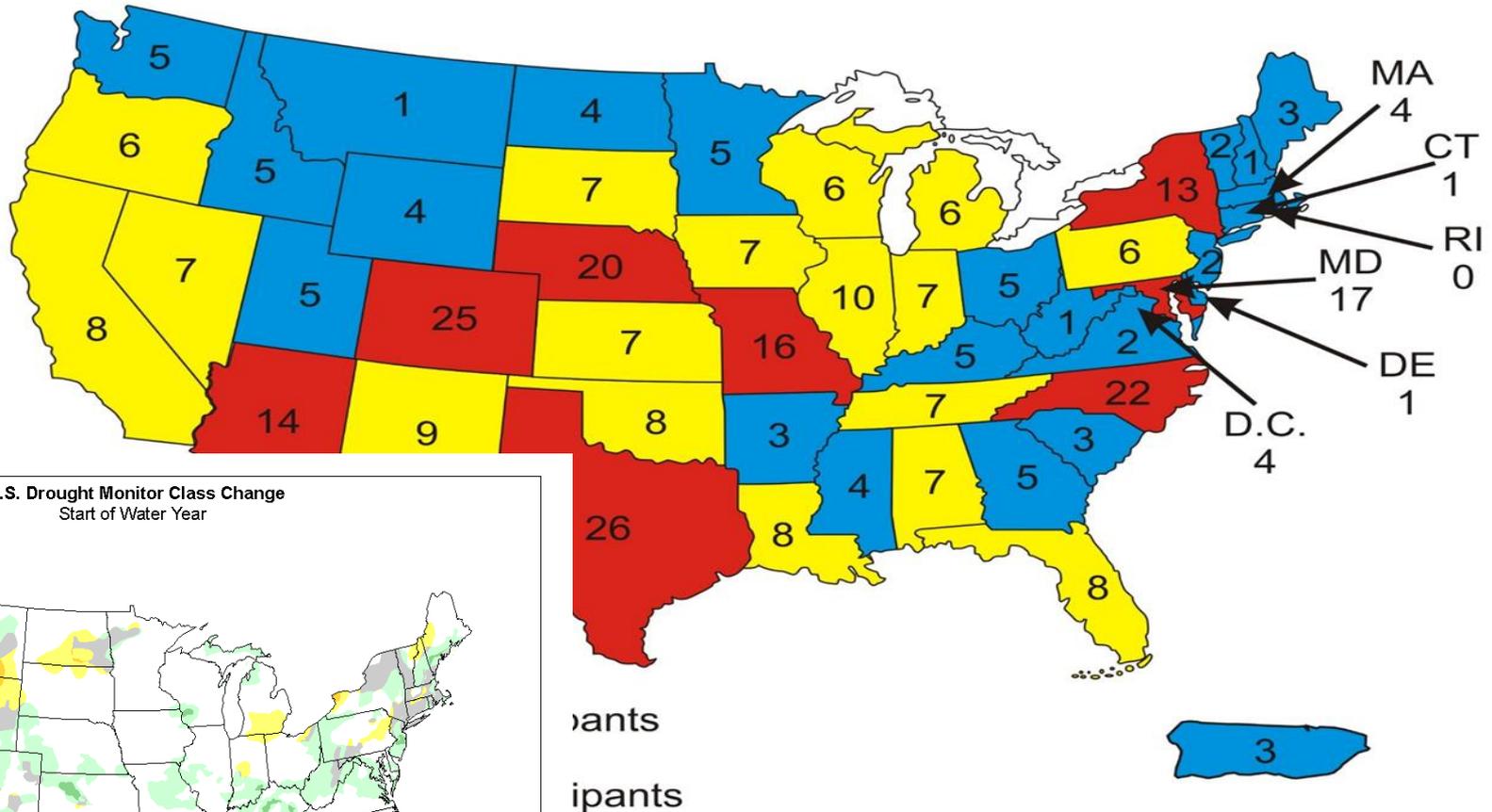
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



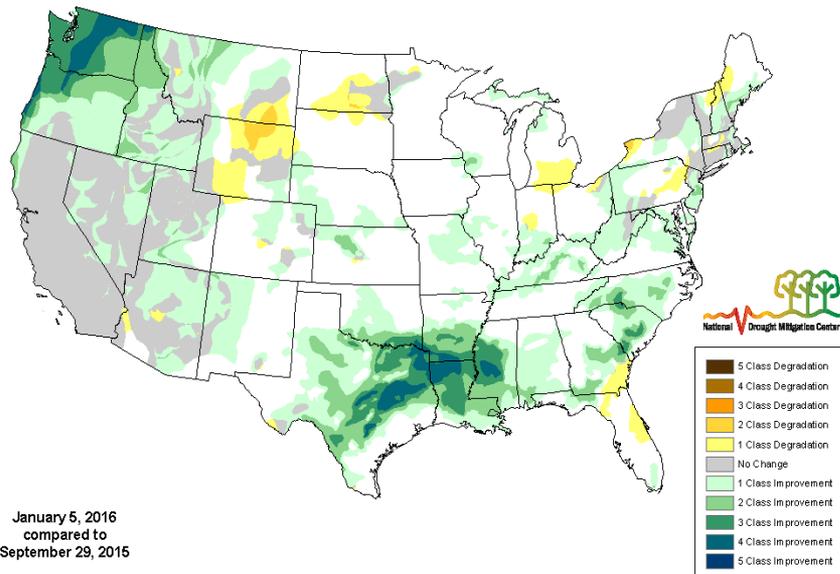
<http://droughtmonitor.unl.edu/>

USDM Listserve Subscribers

(as of August 20, 2015)



U.S. Drought Monitor Class Change
Start of Water Year



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2015 – Robust suite of web mapping services are available. **361 participants** on the USDM list server.
2015: 7.7M page views/3.5M user sessions



USDM Next Steps



- Continue **interactions** with local drought task forces, **State Climate Offices**, **WFOs/RFCs**, **Regional Climate Centers**, **University Extension** agents, **USDA Climate Hubs**
 - Foster new basin/state interactions
 - 2017: ~425 USDM List Serve participants
 - **NIDIS RDEWS** basin briefings/outlooks...more coming?
 - **MO Basin/PacNW-Columbia/ Midwest**, others??
- Continue to encourage and incorporate **new/enhanced/innovative products via GIS**:
 - **ACIS** gridded **SPI-SPEI/sc-PDSI**
 - **Gridded Objective Indice Blends + new regional/seasonal blends (2017)**
 - Augment with more emerging satellite products (**ET-based: ESI, EDDI, QuickDRI, relative humidity, vapor pressure deficit**)
 - **NLDAS, Composite Drought Indices, Soil Moisture**
 - **Uber Drought DSS-Tool?**
- **Integrate U.S. Virgin Islands?**

Please visit the USDM website for more information:

<http://droughtmonitor.unl.edu>

Thanks!

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