

# The United States Drought Monitor Process: History, What it is, and How is the map made?

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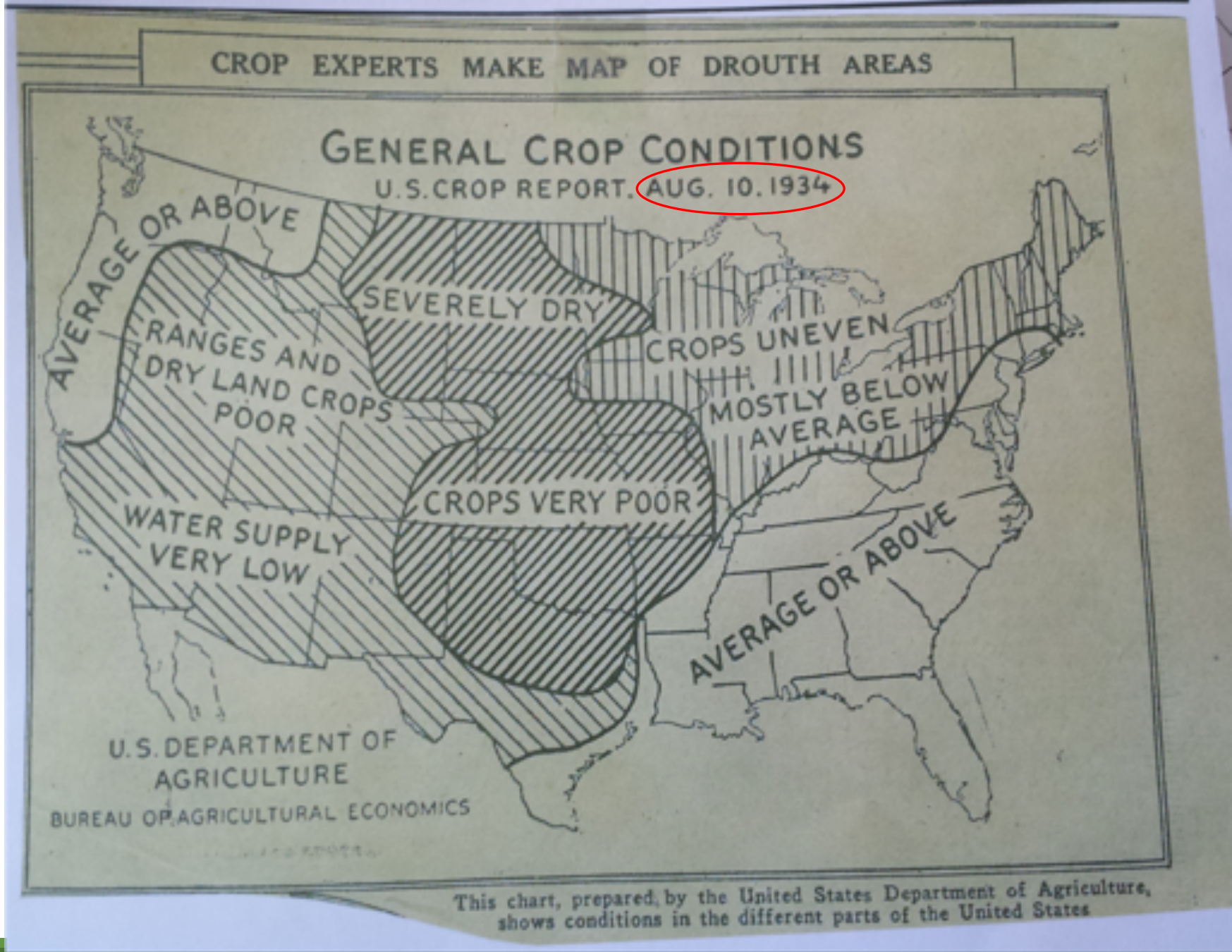


# Outline

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- \* Overview of the United States Drought Monitor Process (PPT)
- \* Tour of the United States Drought Monitor website (live)
- \* Tour of the NDMC's Drought Risk Atlas tool (live)
- \* Q and A

Scientists have been trying to monitor and map drought conditions for quite some time



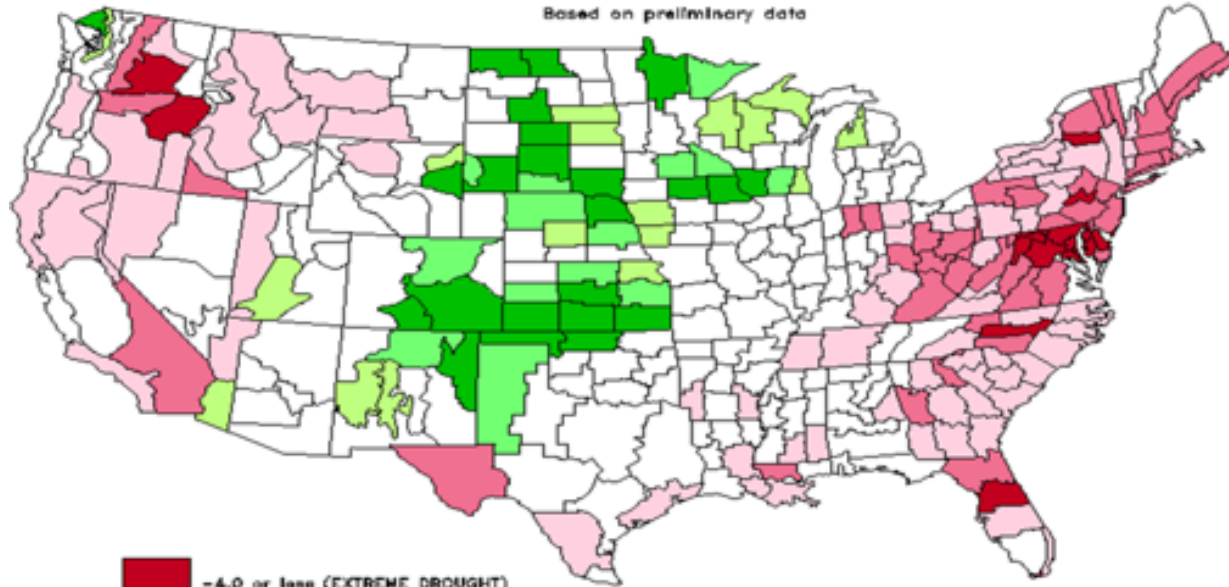
# The USDM has continuously evolved from past efforts to monitor drought to early efforts of the USDM

Single Index/Indicator such as the PDSI

Hybrid Approach (made in Corel Draw)

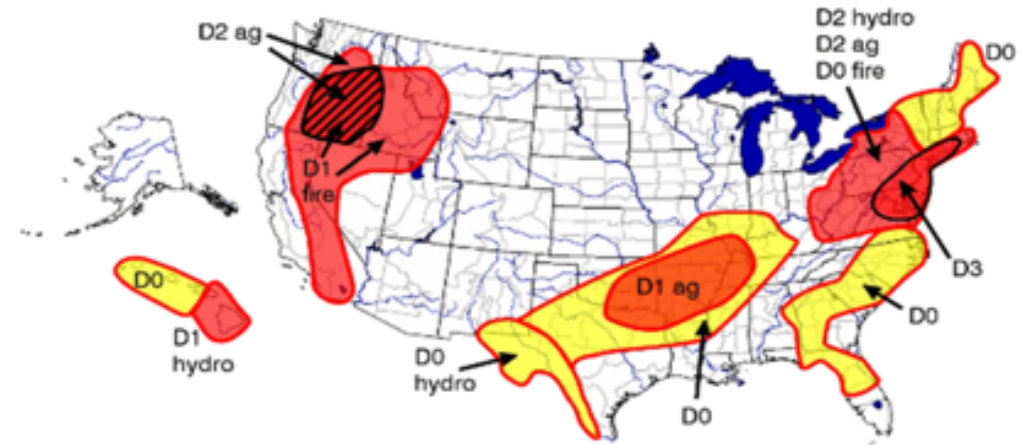
DROUGHT SEVERITY INDEX BY DIVISION  
(LONG TERM PALMER)

AUG 7, 1999  
Based on preliminary data



CLIMATE PREDICTION CENTER, NOAA

## 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

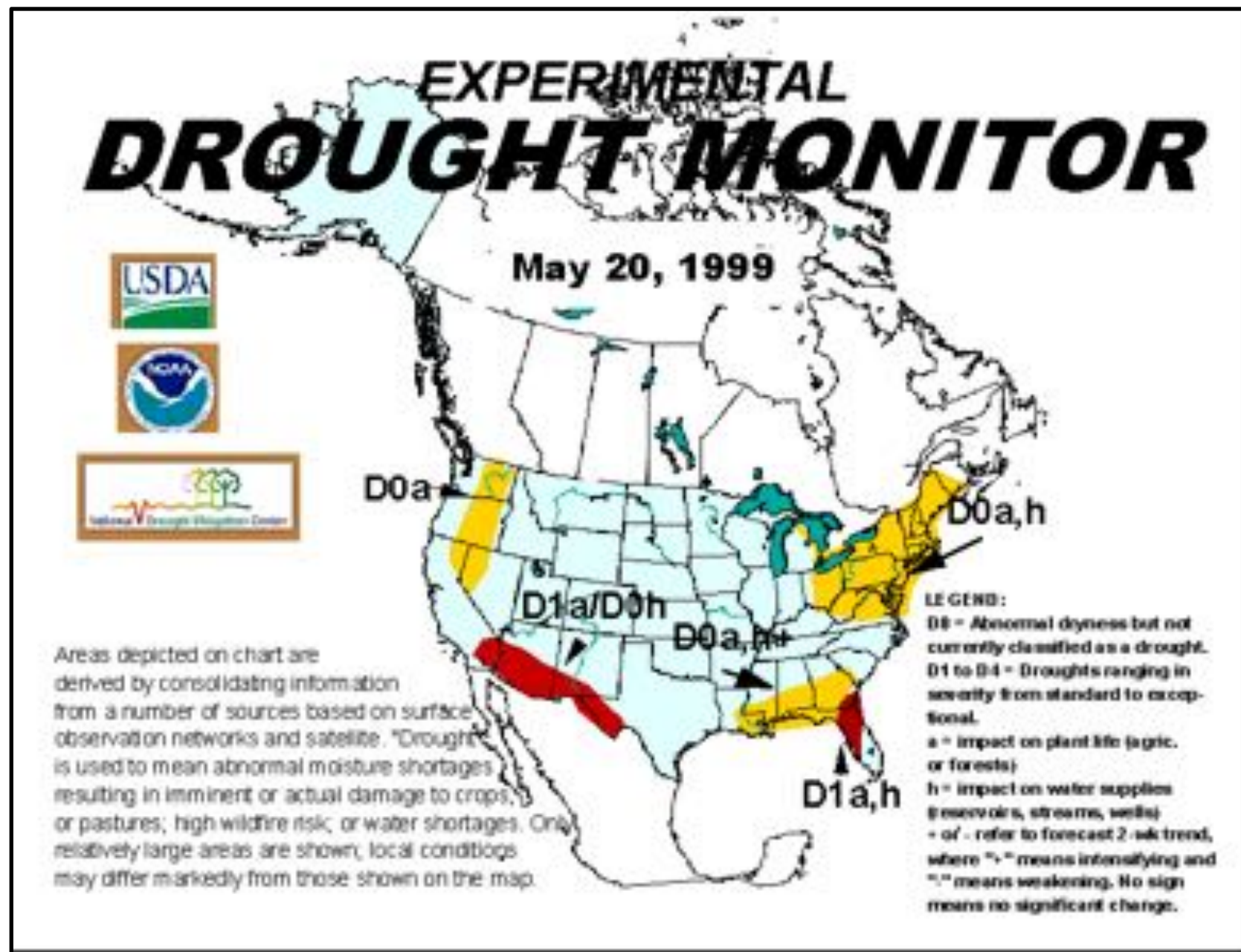


1999

The **very first** U.S. Drought Monitor!!

**Collaborative effort** between the NDMC, NOAA and USDA

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!** 😊



August 11, 1999

The revised map was presented to senior-level government officials at a

Secretarial White House Briefing.

They liked it so much...

August 11, 1999 (revised as of 12:00 pm CDT)  
**Experimental U.S. Drought Monitor**



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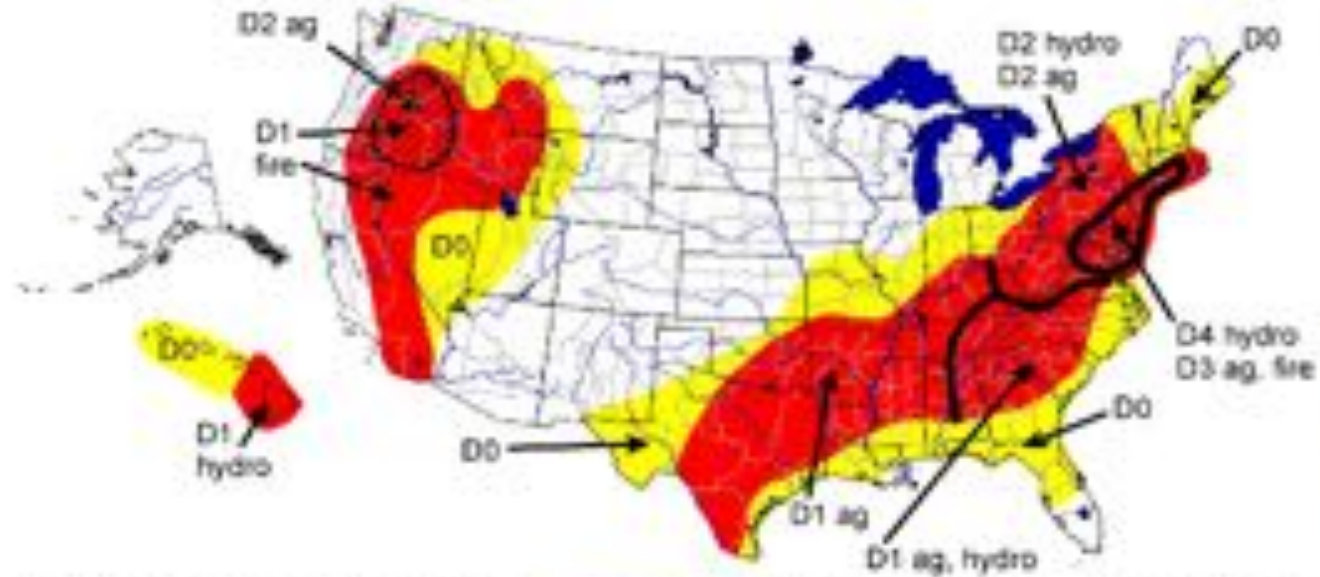
**August 18, 1999**

...the following week, it went operational, making this **the first “official” U.S. Drought Monitor!**

This might have been the **fastest Experimental to Operational** product in government history!

**~24 experts make up the DROUGHT listserver**

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

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**Crosshatching (red with black lines)** = Overlapping drought type areas

**Drought type:** Used when impacts differ  
Ag = agricultural (crops, grasslands)  
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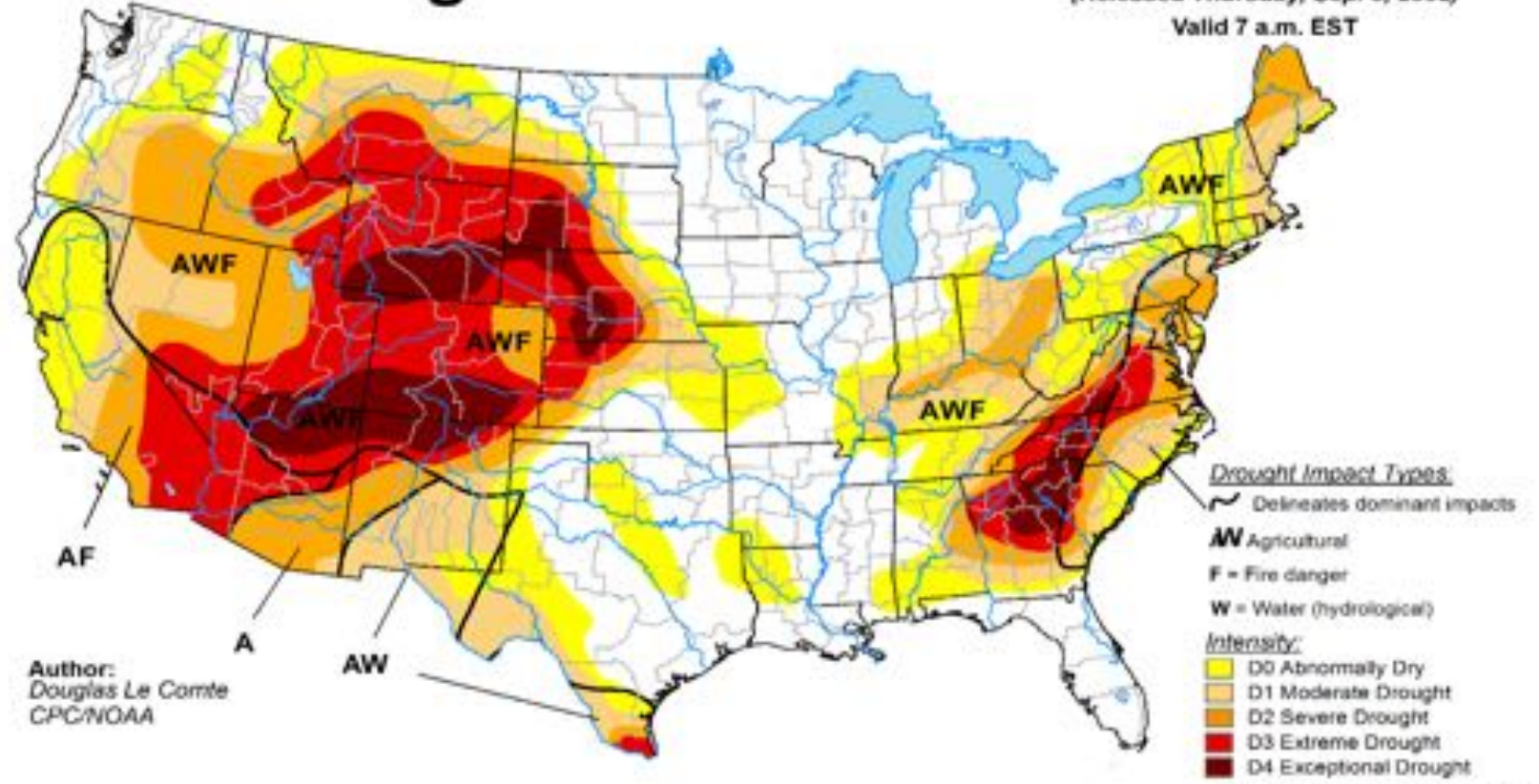


# Summer/Fall 2002

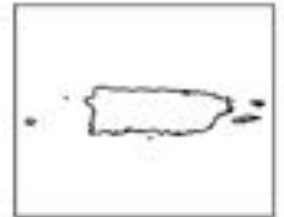
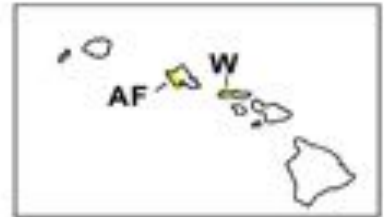
First federal use (USDA) of USDM as a trigger for drought response/relief (Dried Milk) for livestock.

## U.S. Drought Monitor

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



Author:  
Douglas Le Comte  
CPC/NOAA



USDA  
National Drought Mitigation Center  
http://droughtmonitor.unl.edu/





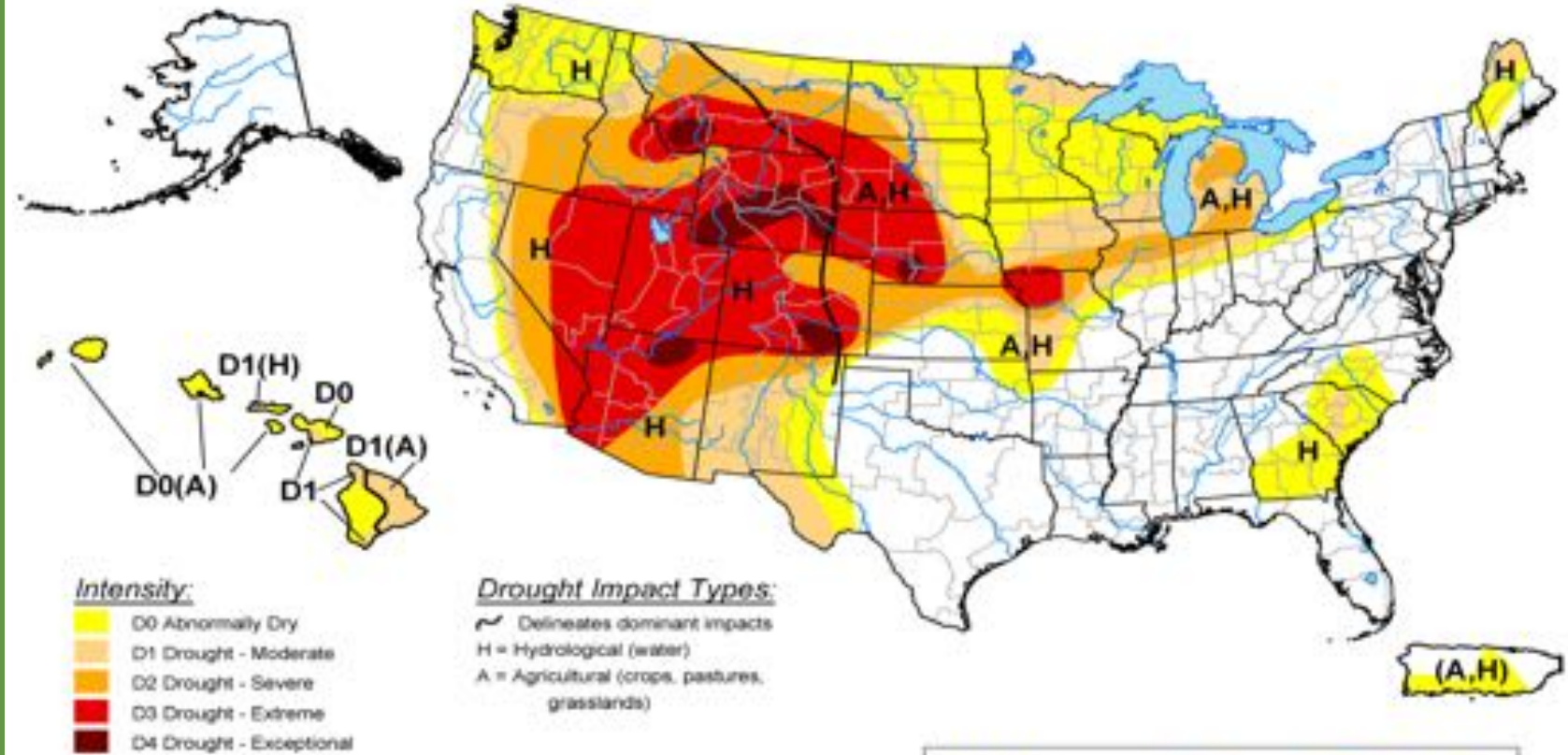
2003

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...**

# U.S. Drought Monitor February 18, 2003

Valid 7 a.m. EST



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



Released Thursday, February 20, 2003

<http://drought.unh.edu/dm> Mark Svoboda/Michael Hayes, National Drought Mitigation Center

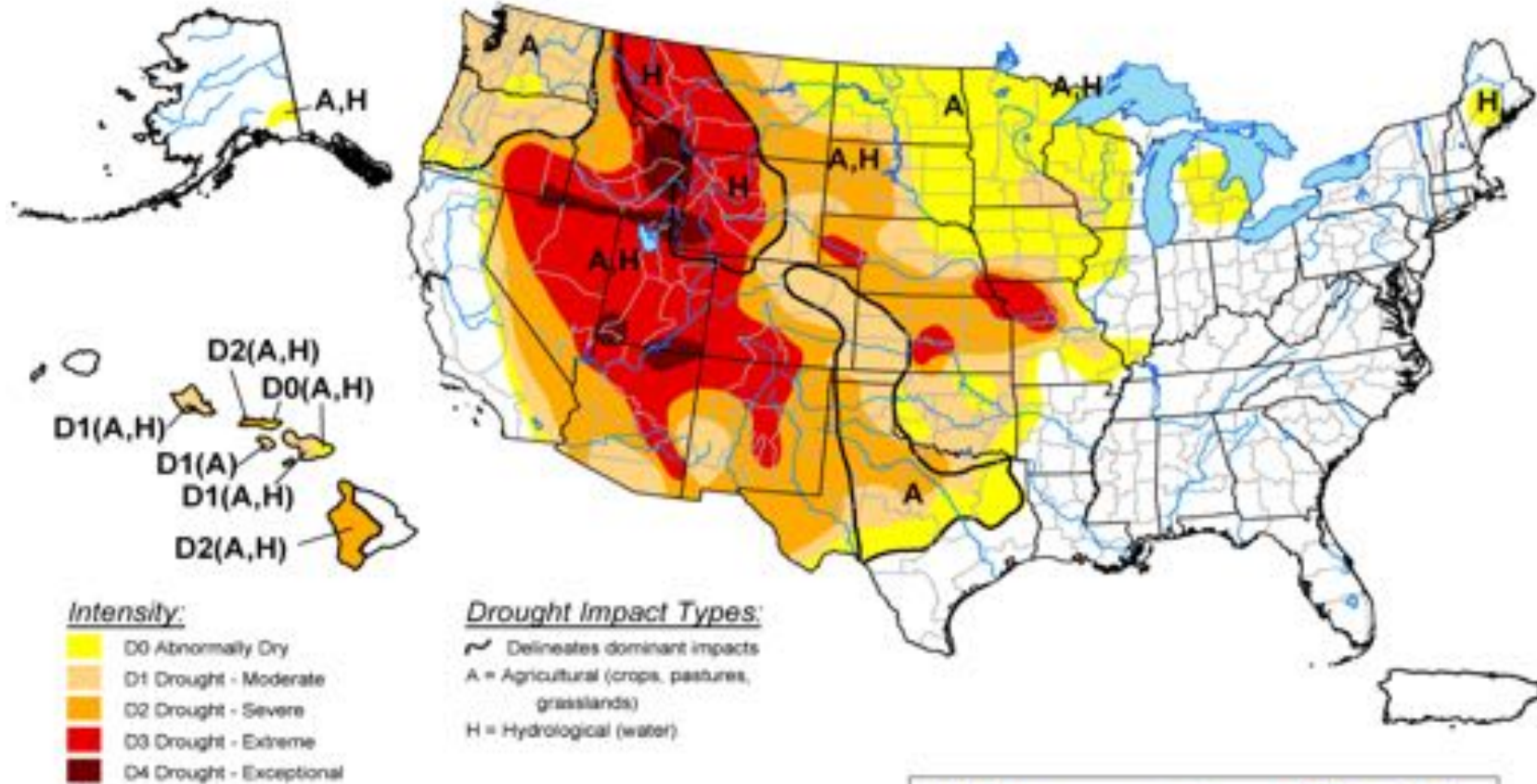


# August 2003

USDM Authors make a transparent **switch from CorelDRAW to GIS** (Geographic Information System) to create the map. There was a steep learning curve, but it made the USDM a leader on the GIS front and would pay big dividends down the road in regards to timeliness and accuracy.

## U.S. Drought Monitor

August 19, 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
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

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



Released Thursday, August 21, 2003

<http://drought.unl.edu/dm>

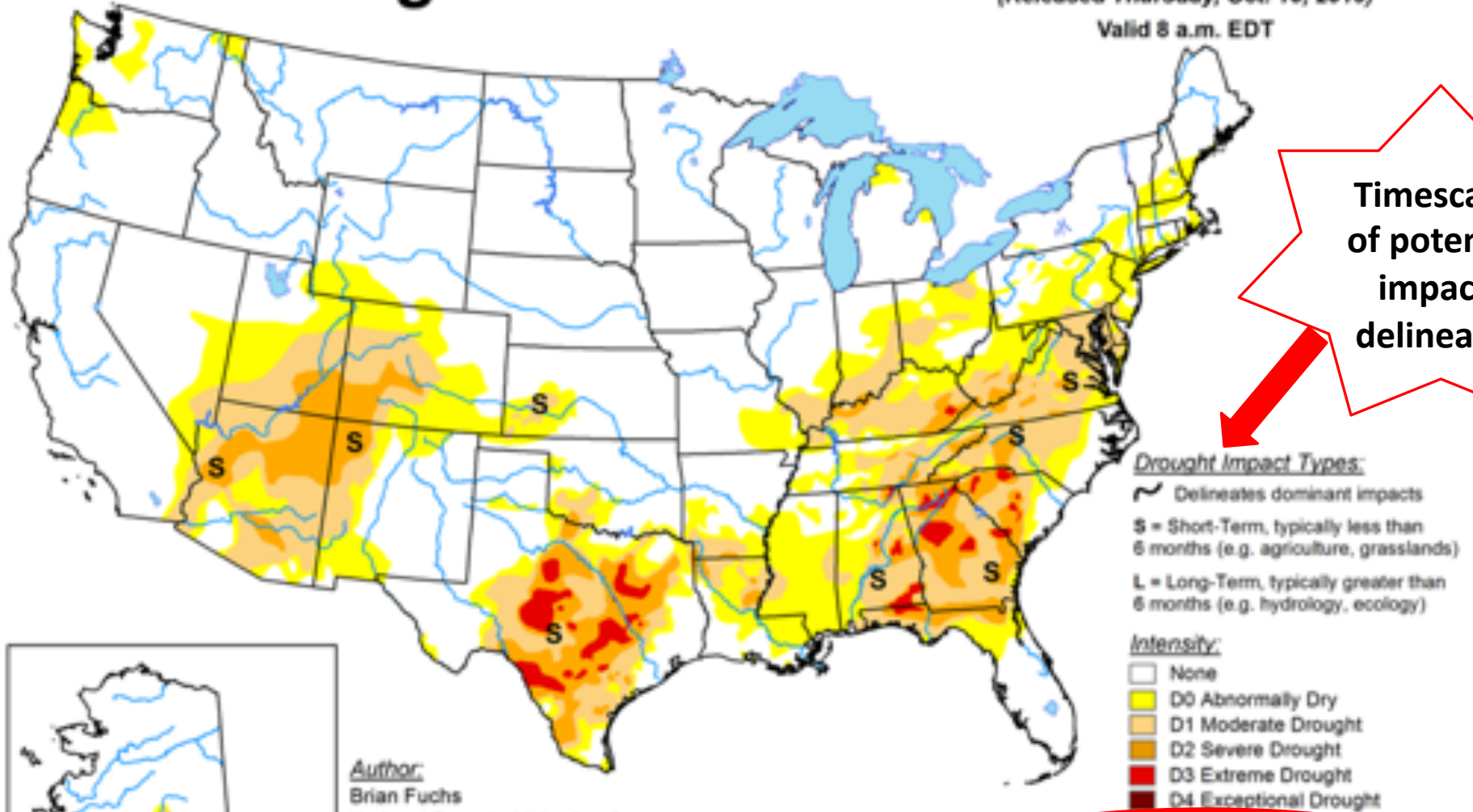
Author: Candace Tankersley/Richard Heim, NOAA/NCDC





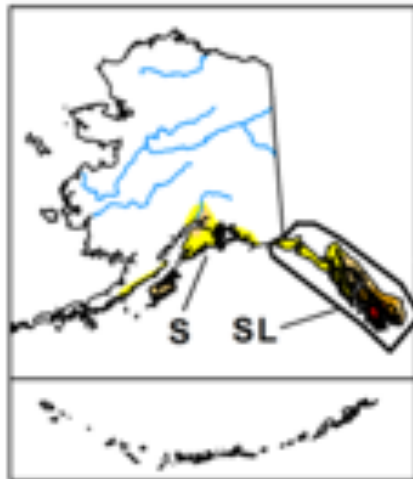
# U.S. Drought Monitor

October 8, 2019  
(Released Thursday, Oct. 10, 2019)  
Valid 8 a.m. EDT

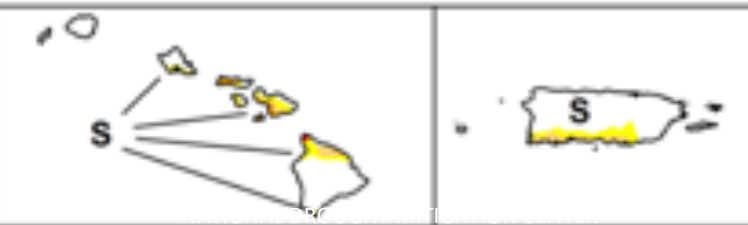


Timescales of potential impacts delineated

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

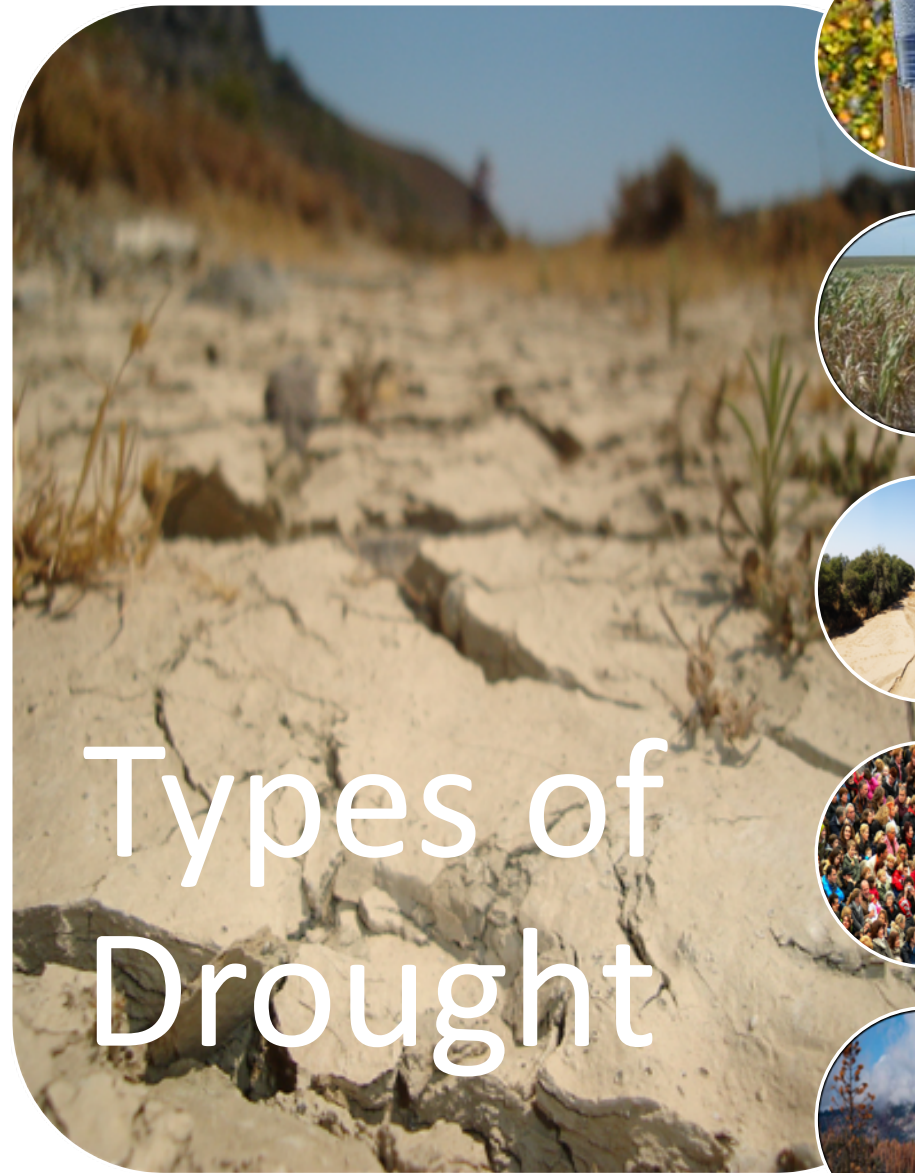


droughtmonitor.unl.edu

The map is...

An attempt to represent all the different types of drought on one map

Each one of us has a different perspective of what drought is as drought means different things to different people



# Types of Drought



Meteorological



Agricultural



Hydrological



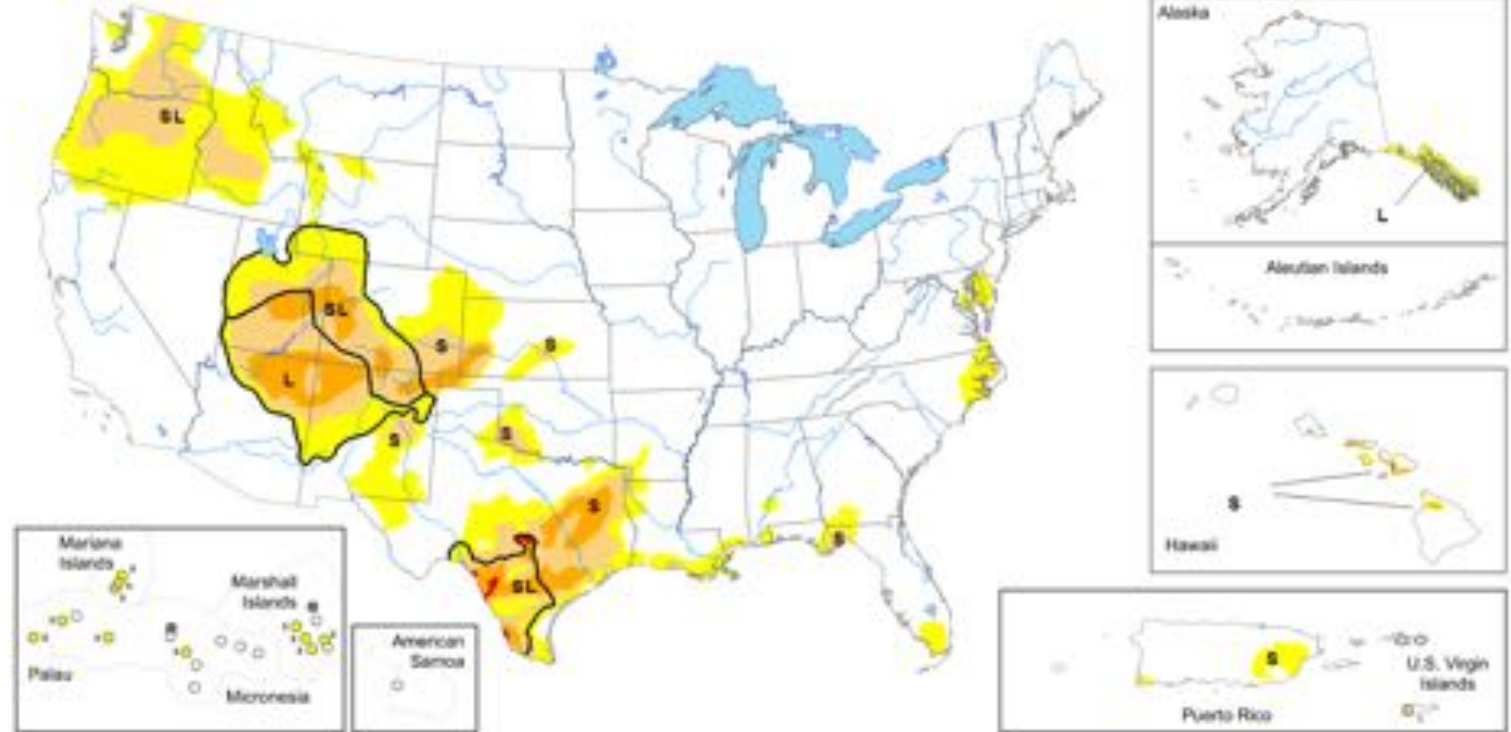
Socio-economic



Ecological

Map released: January 23, 2020

Data valid: January 21, 2020



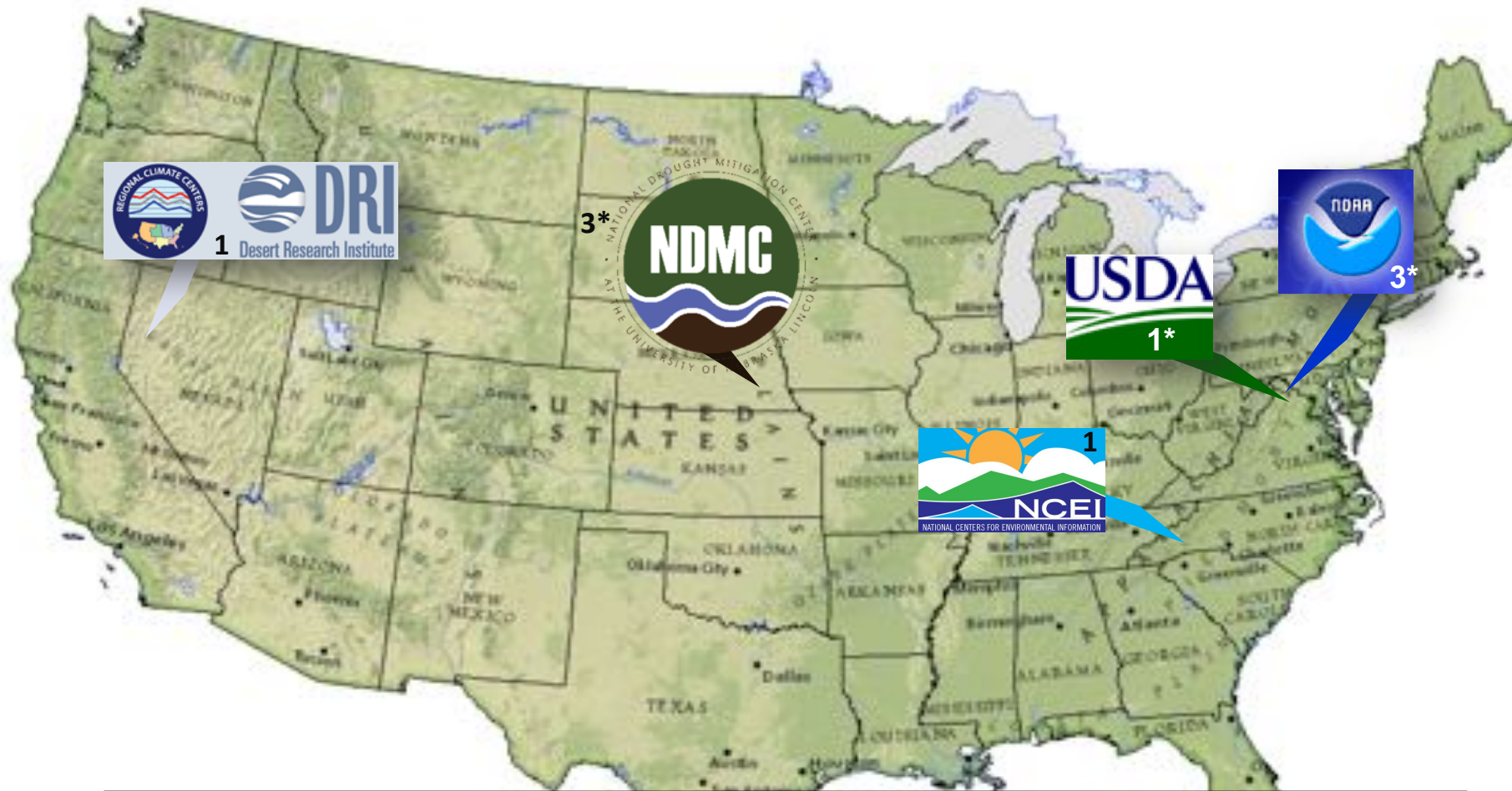
United States and Puerto Rico Author(s):  
Richard Heim, NOAA/NCEI

U.S. Affiliated Pacific Islands and Virgin Islands Author(s):  
Ahira Sanchez-Lugo, NOAA/NCEI

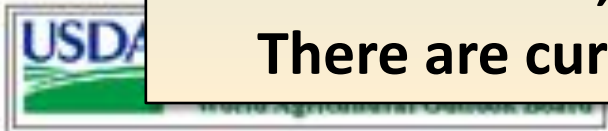


# The United States Drought Monitor

- Hosted by the NDMC as part of a 3-way partnership with NOAA and USDA
- Over 12.5 million hits a year (more during significant drought events)
- Used in several USDA programs
- Used by the IRS for tax deferrals
- Many others !








**Requirement: Authors must work at a regional or national “center”, government or academia/research**  
**There are currently 9\* authors, and all are volunteers**



# US Drought Monitor Approach

## Intensity:

	D0 Abnormally Dry	} Not Drought
	D1 Moderate Drought	
	D2 Severe Drought	} 4 Drought intensities
	D3 Extreme Drought	
	D4 Exceptional Drought	

- Assessment of **current** conditions and **current** impacts for all types of drought
- Identifying **impacts** using “**S**” for short-term impacts and “**L**” long-term impacts or “**SL**” for a combination of both
  - “**S**”-generally 6 month time scales or less
  - “**L**”-generally greater than 6 month time scales
- Incorporate **local expert** input
  - Accomplished via email and impact reports
  - Validation of Objective Indicators
- Authors try to be as **objective** as possible (using the percentiles methodology) and the “**Convergence of evidence**” approach
  - The physical data, drought indices/ indicators **must** support the depiction on the map
  - Impact data validates physical data
  - The U.S. Drought Monitor has the final call on all decisions



# U.S. Drought Monitor Approach

## “Convergence of Evidence”



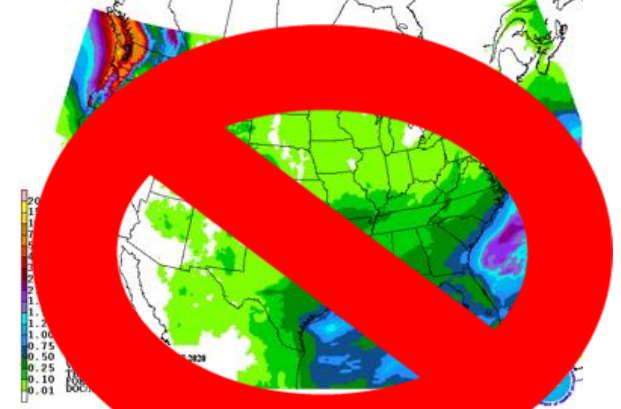
- Many types of drought “information” can be collectively analyzed for all types of drought, depicted on a single map
  - *Determining if the majority of information is ‘converging’ (telling the same story)* about the accuracy, or inaccuracy, of the drought as depicted by the U.S. Drought Monitor
  - Several dozen inputs are considered (equally) in any given week
- Authors need to *look at 100% of the data, BUT don’t believe in any one piece of data input 100%* in making a decision
  - No single input carries more weight than another, authors do not “cherry pick” the best or worst indicators to show the depiction
- *Multiple indicators and many types of information are part of the analysis*
  - These data will identify different climatic and hydrologic parameters which are needed to understand the complete picture of a drought indicator’s performance and how they interact in each part of the country
- Impacts are the “ground truth”, yet are not monitored to the same extent in which other data are....you can’t measure what you don’t monitor!



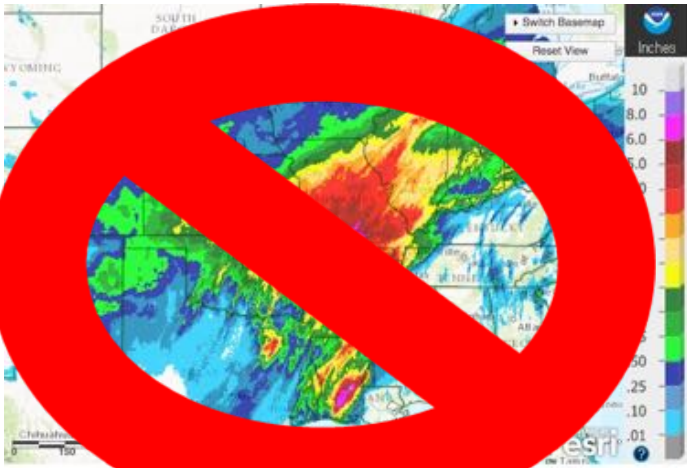
The USDM is not a model



The USDM is not a model that runs when the map is being created



The USDM is a forecast

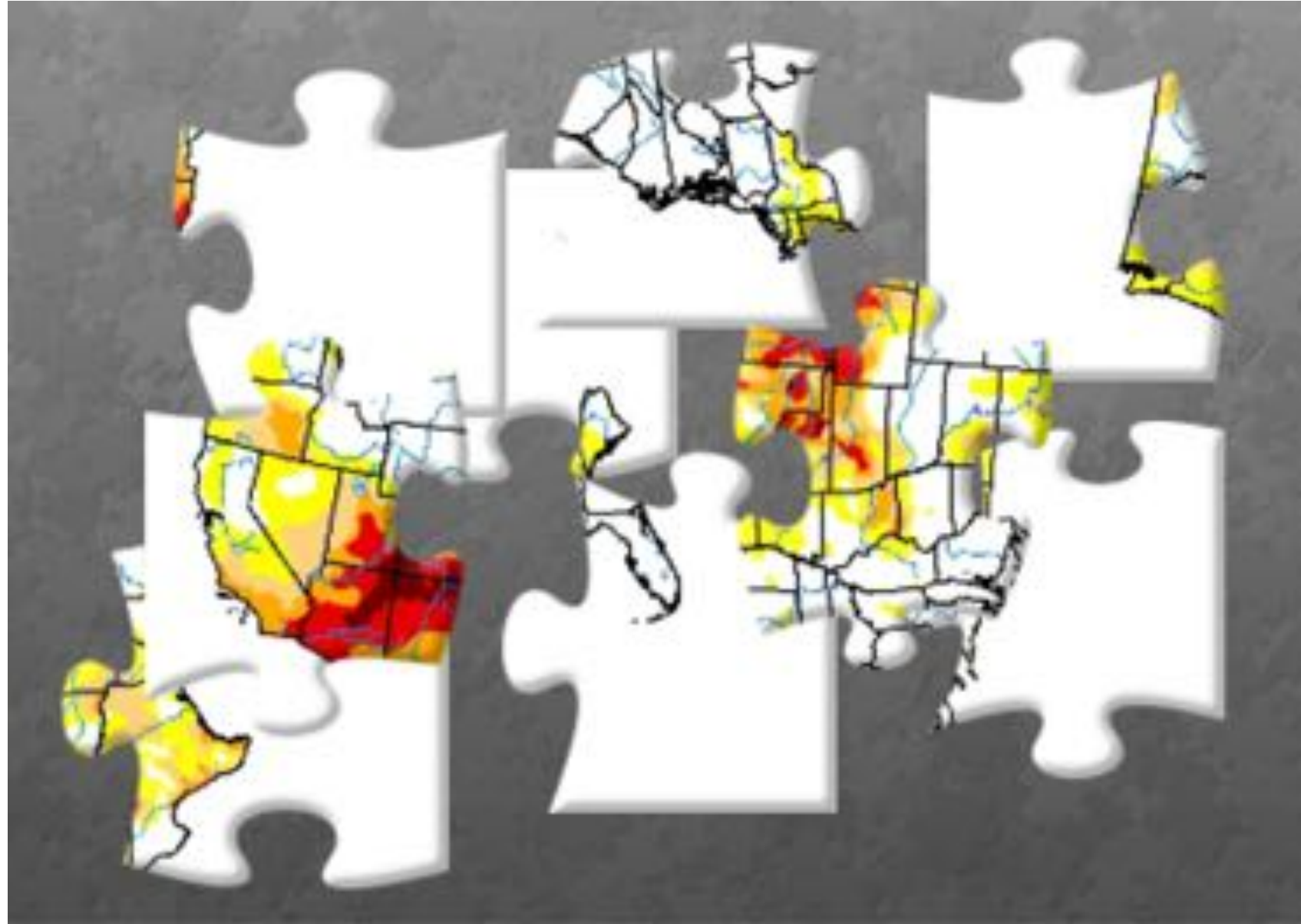


The USDM is not a precipitation map



The USDM is not a declaration

USDM Data: All  
the pieces of the  
drought puzzle







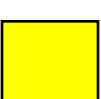
# Percentiles and the U.S. Drought Monitor

Every input can be put into percentiles to compare current data to historical records

## Advantages of percentiles:

- Can be applied to any parameter used in the drought analysis
- Can be used for indicators of any length of data record
- Indicators of various periods of record can be analyzed side by side
- Puts drought in historical perspective:

**How many occurrences in a given period of time**

D4: Exceptional Drought		( <i>1<sup>st</sup>-2<sup>nd</sup></i> percentile)
D3: Extreme Drought		( <i>3<sup>rd</sup>-5<sup>th</sup></i> percentile)
D2: Severe Drought		( <i>6<sup>th</sup>-10<sup>th</sup></i> percentile)
D1: Moderate Drought		( <i>11<sup>th</sup>-20<sup>th</sup></i> percentile)
D0: Abnormally Dry		( <i>21<sup>st</sup>-30<sup>th</sup></i> percentile)

Intensity is based on historical likelihood

## Data values ranked from highest to lowest

100	99	98	97	96	95	94	93	92	91
90	89	88	87	86	85	84	83	82	81
80	79	78	77	76	75	74	73	72	71
70	69	68	67	66	65	64	63	62	61
60	59	58	57	56	55	54	53	52	51
50	49	48	47	46	45	44	43	42	41
40	39	38	37	36	35	34	33	32	31
30	29	28	27	26	25	24	23	22	21
20	19	18	17	16	15	14	13	12	11
10	9	8	7	6	5	4	3	2	1

Normal

Unusually  
Dry

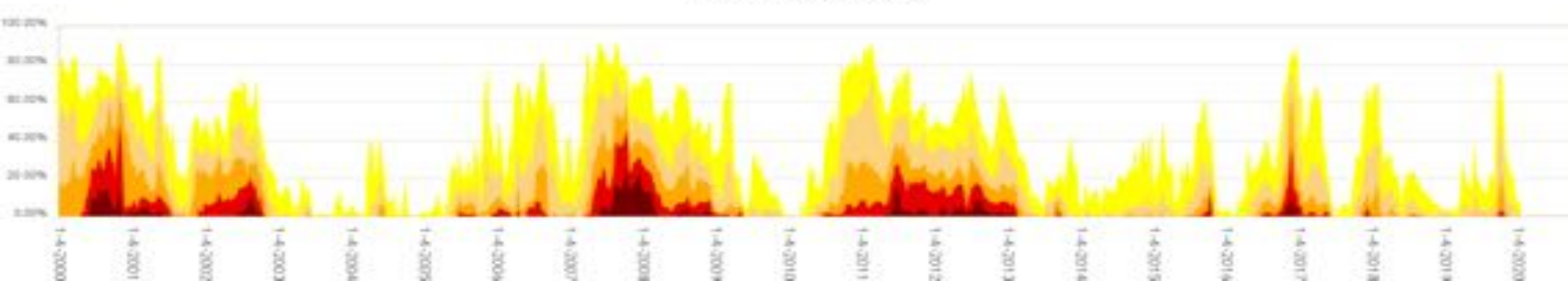
Moderate  
Drought

Severe  
Drought

Extreme  
Drought

Exceptional  
Drought

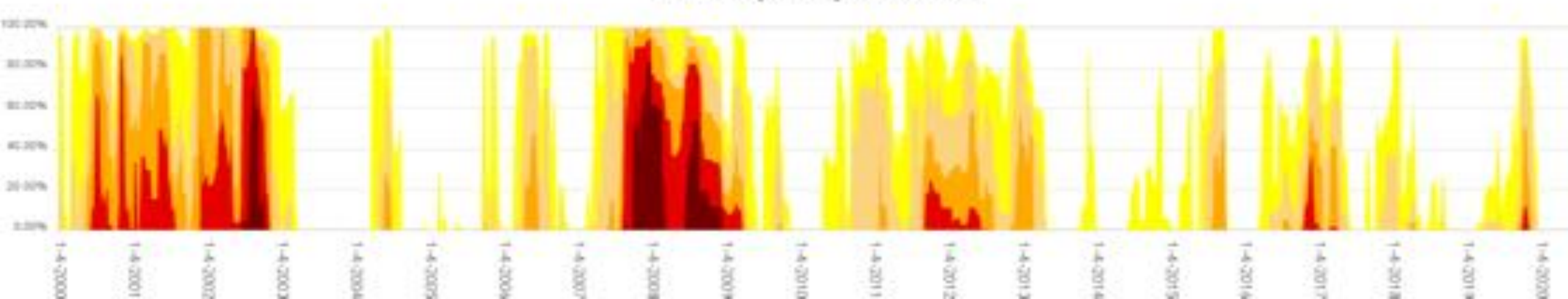
## Southeast Percent Area



**The drought categories are associated with historical occurrence/likelihood (percentile ranking)**

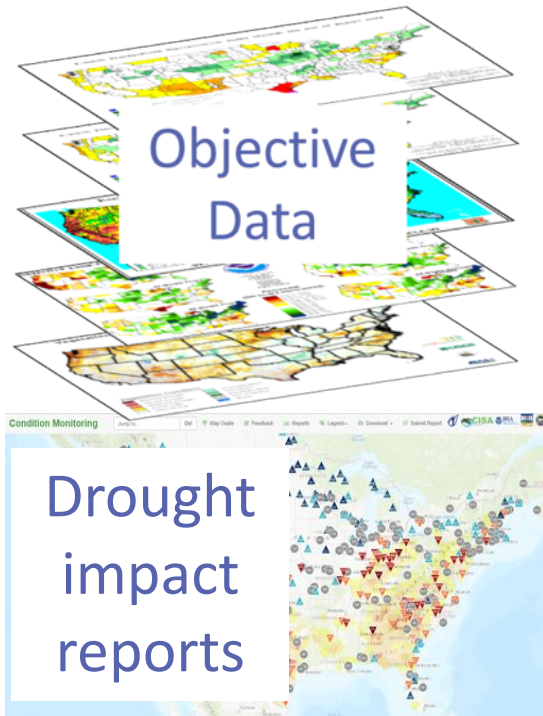
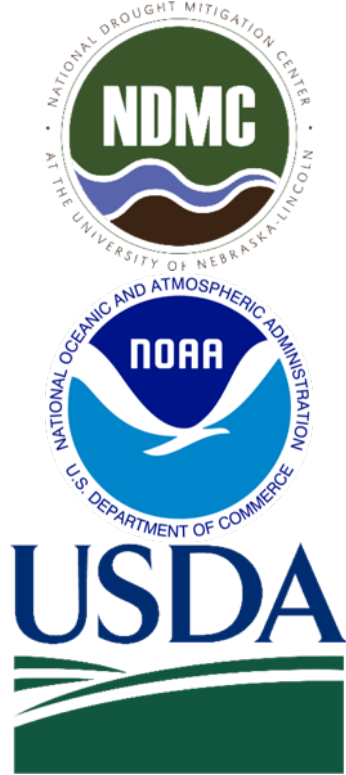
**It is not anecdotal or subjective, like “It’s really, really dry!!” ....or, “I don’t remember it ever being this dry, we have to be D3!!”**

## 030501 (Santee) Percent Area

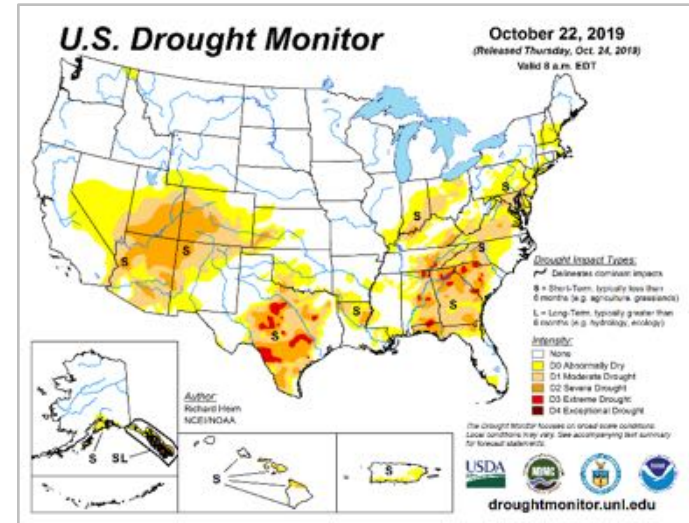


How is all of this done?





Total: 414 (does not include 1 participant from Canada and 2 participants from Brazil)



Methods & standards

Inputs

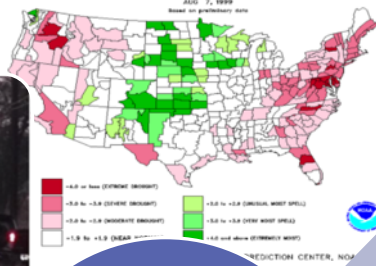
Production

Distribution of final map

# The map is a participatory process

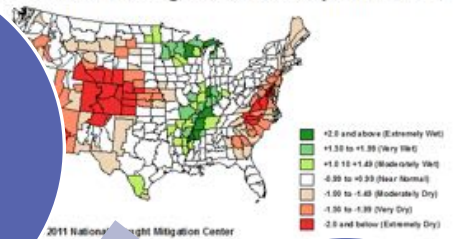
A hybrid approach of combining the attributes of dozens of inputs to tell the “story” about drought in a region



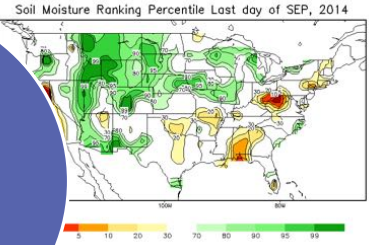


Drought Indices such as SPI/PDSI

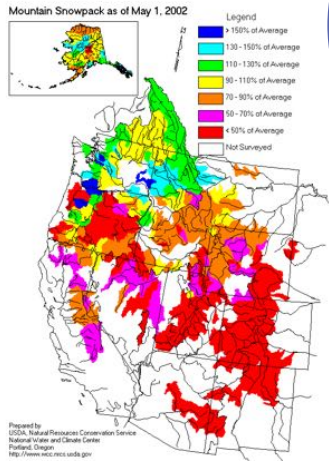
12-month SPI through the end of September 2002



Soil Moisture: both modeled and measured

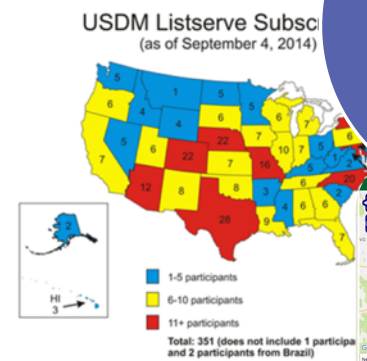


Precipitation and Snow

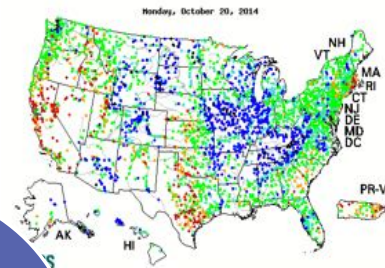


Most of the information analyzed each week falls into one of these categories. Authors now use roughly **40-50 unique indicators** while creating the U.S. Drought Monitor map, but not all areas are represented equally by all pieces of data.

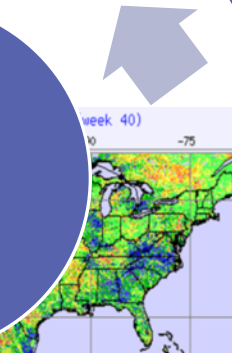
Expert Local Input and Impacts



Streamflow, Reservoirs, and Wells



Remote Sensing



# Data drives the editing

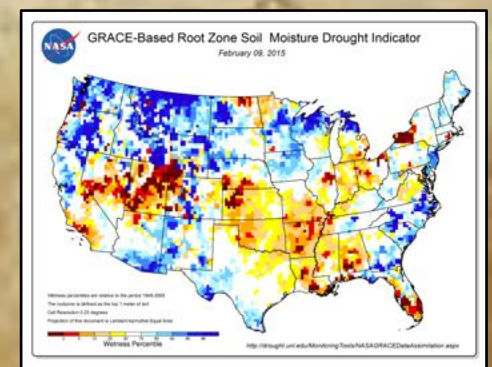
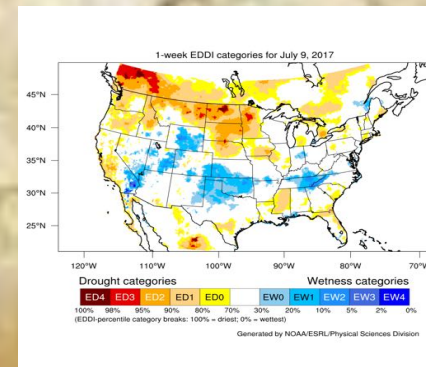
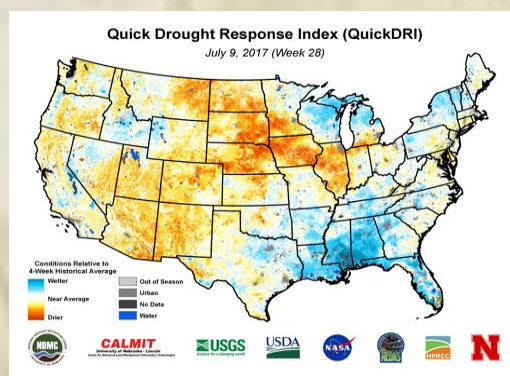
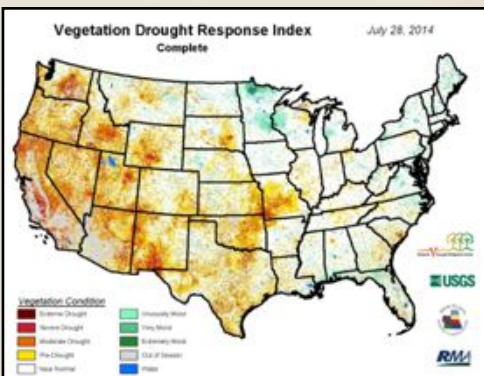
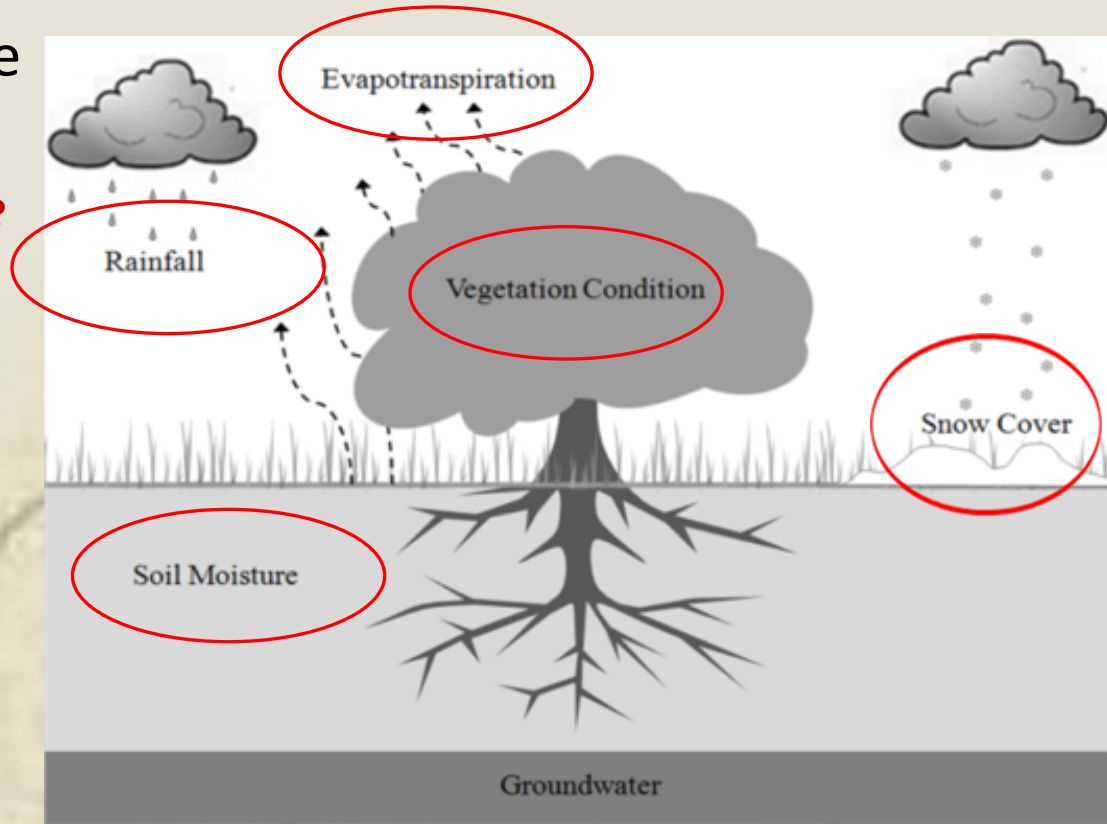


# Emerging Satellite-based Observations and Products

Over the past 10+ years, a number of satellite remote sensing-based tools and **products characterizing different parts of the hydrologic cycle that influence drought conditions** allowing new composite drought indicators to be developed.

## Examples

- Evaporative Stress Index (ESI)
- Quick Drought Response Index (QuickDRI)
- Evaporative Demand Drought Index (EDDI)
- GRACE soil moisture and groundwater anomalies
- Vegetation Drought Response Index (VegDRI)



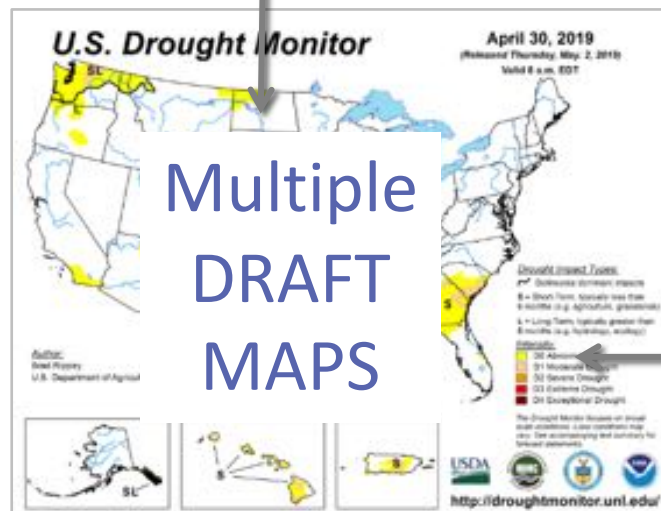
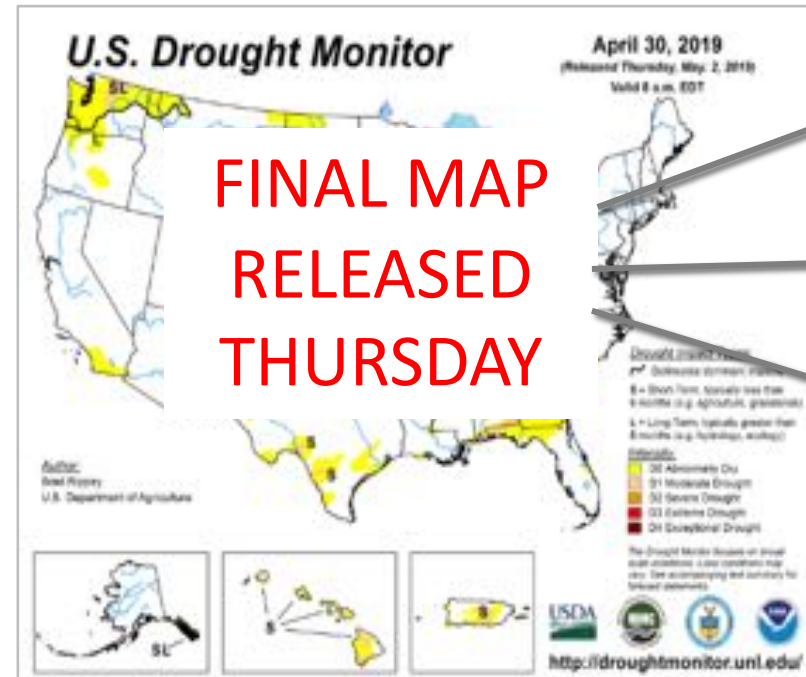
# USDM

## Convergence of Evidence

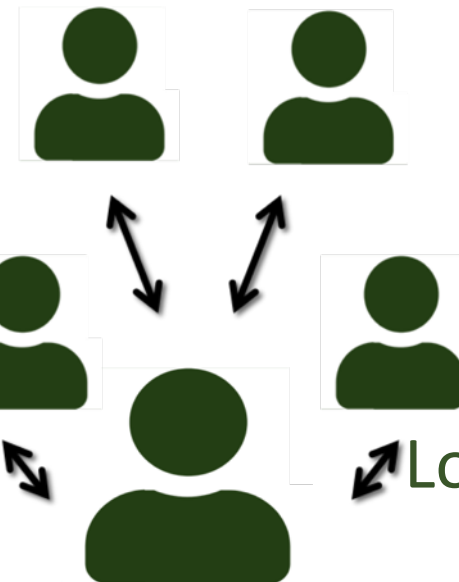
Objective data:  
Ending at  
8am Central  
each week

Author's rotate  
every 2 weeks

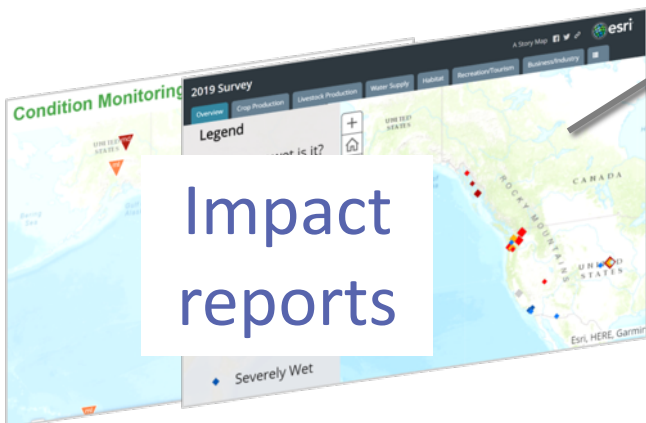
**FINAL MAP  
RELEASED  
THURSDAY**



Multiple  
DRAFT  
MAPS

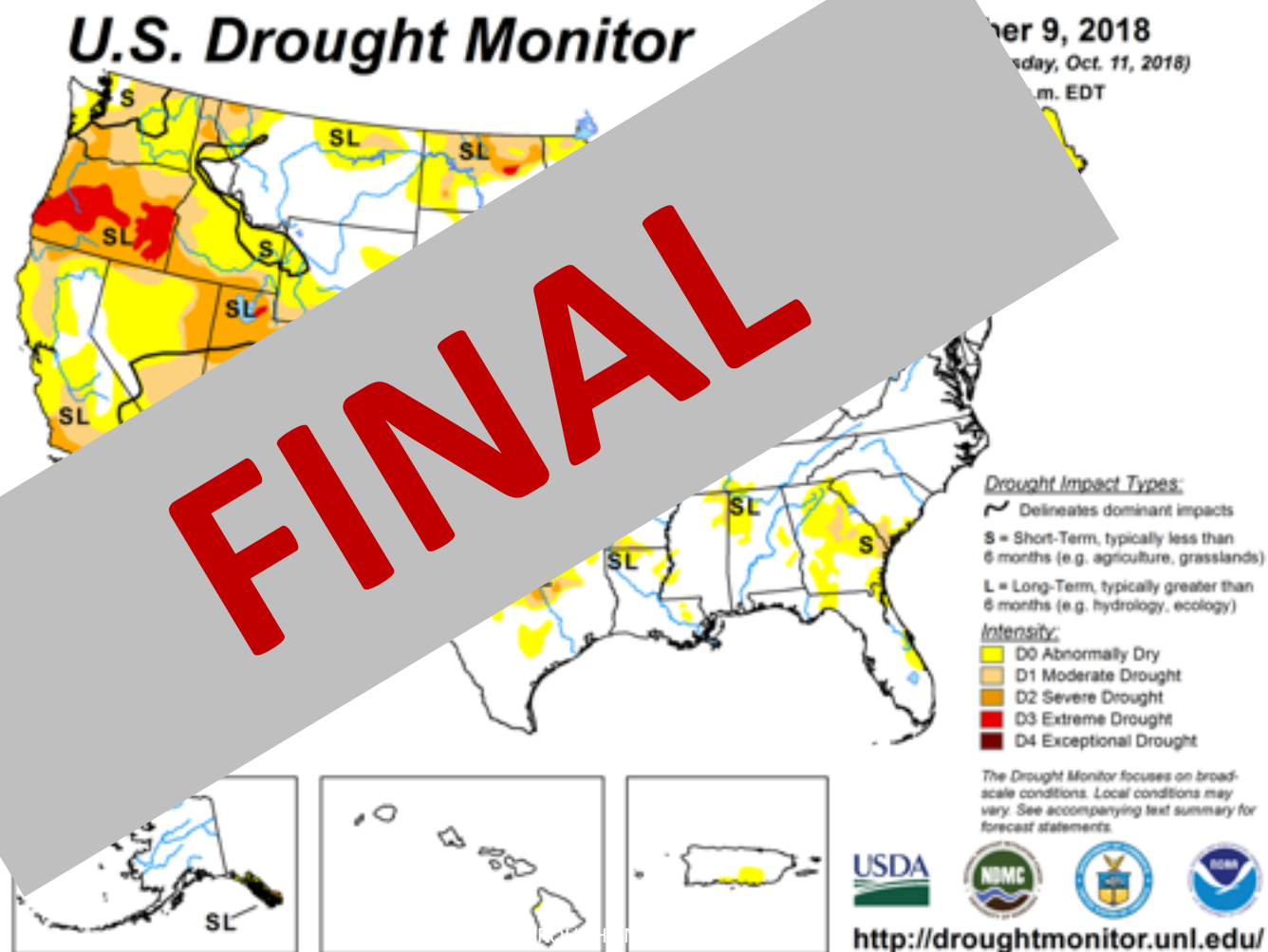


Local experts



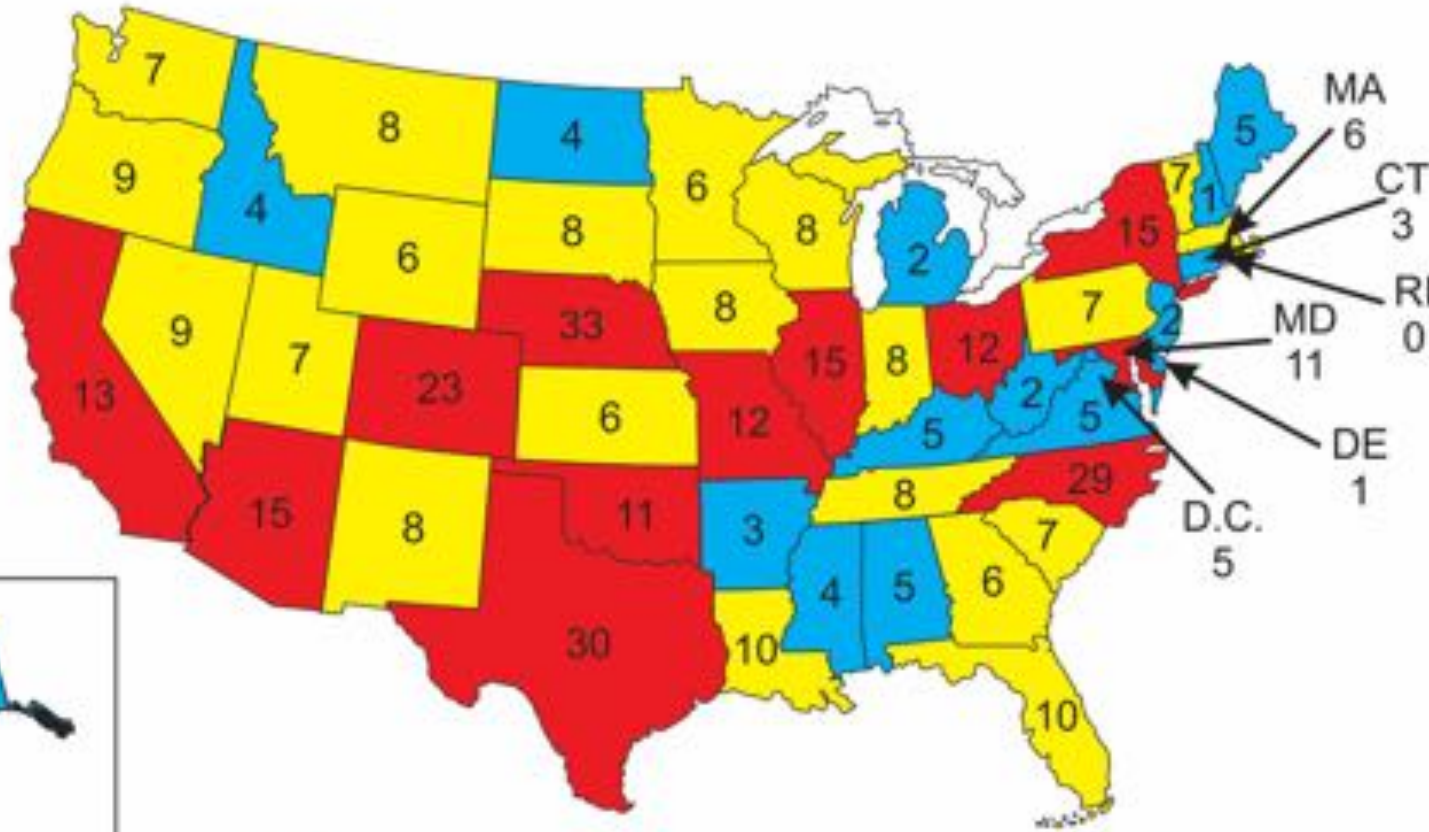
Impact  
reports

Once the map is completed and published for the week, the map is final and no changes will be made retroactively!



# USDM Listserv Subscribers

(as of September 13, 2019)



- 1-5 participants
- 6-10 participants
- 11+ participants

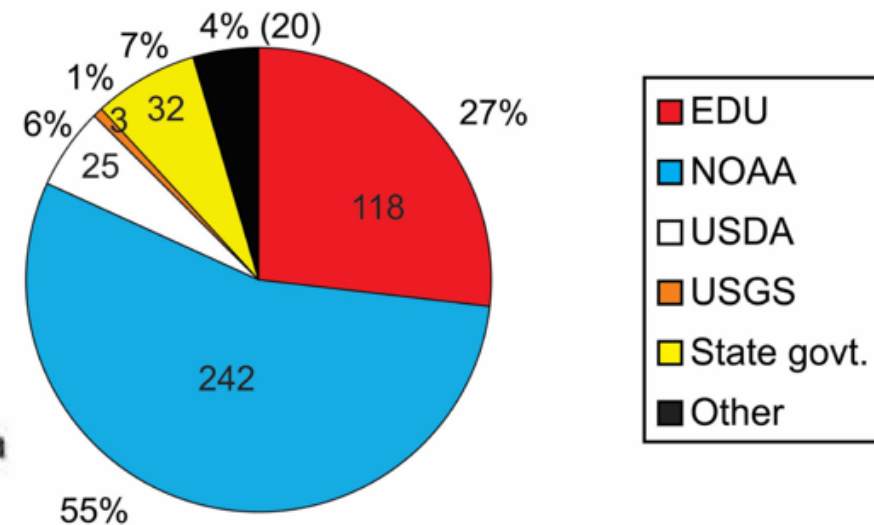
**Total: 440 (does not include 2 participants from Canada and 2 participants from Brazil)**

**We want YOU !**



## USDM Listserv Subscribers

(as of September 13, 2019)



# Some Examples of Decision Making and Policy Using the USDM

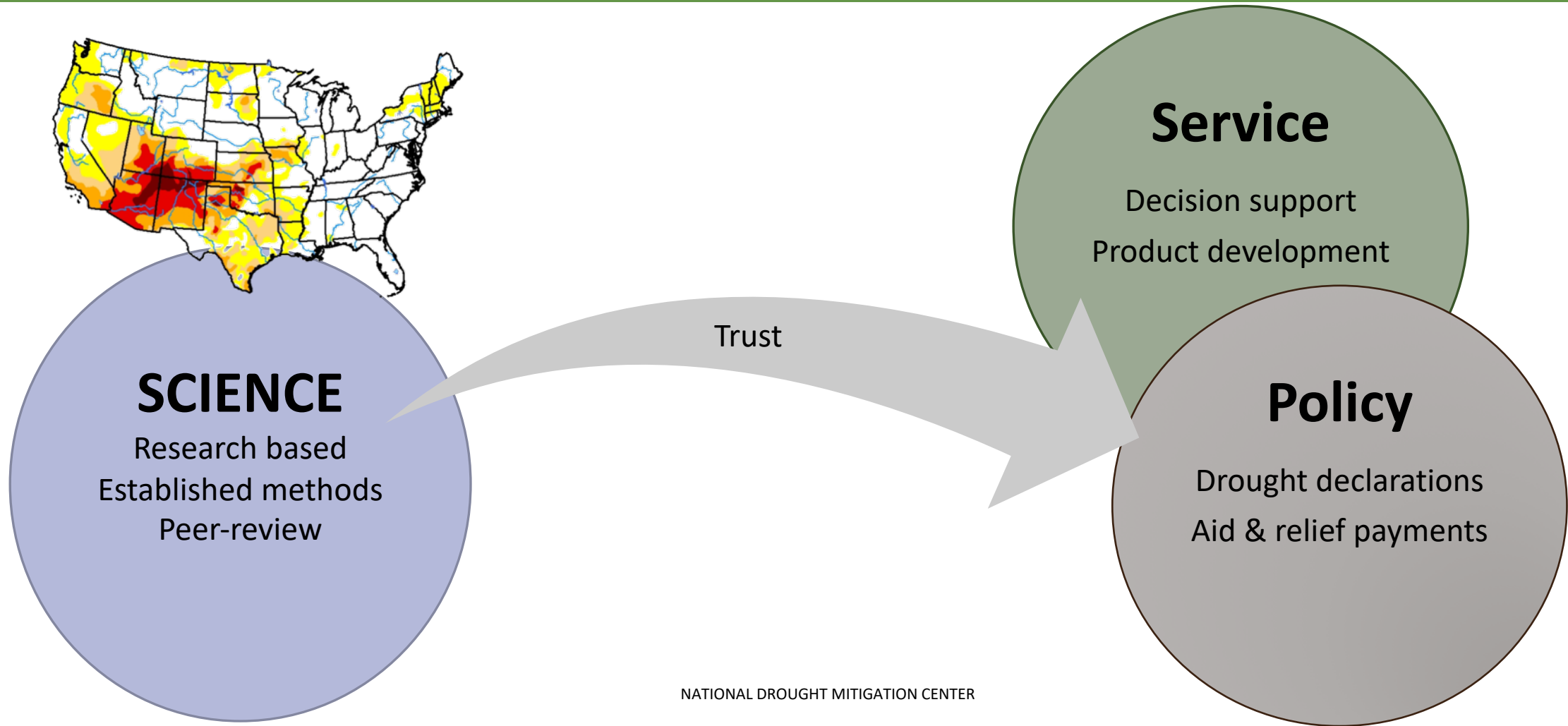
## *(Science before Policy)*

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### *Policy:*

- **2008/2014 Farm Bill**
  - USDA Farm Service Agency, Natural Resources Conservation Service, Risk Management Agency
- **Internal Revenue Service**
  - Livestock tax deferral program
- **U.S. Department of Agriculture**
  - Secretarial ***“Fast Track”*** Drought Designations
  - Livestock Forage Disaster Program (LFP) **\$7.2 Billion in payouts so far**
- **NOAA National Weather Service**
  - Drought Information Statements
- **Environmental Protection Agency**
  - Water quality monitoring
- **Centers for Disease Control and Prevention**
  - Public health
- **Bureau of Land Management**
- **Several States use in their monitoring/plans**
- **Many others**

The map is **NOT**.... created for any one policy or use.





# What is next.....

- ❖ We will continue to listen to users
- ❖ Continue to work with partners o
- ❖ USDM change maps services will
- ❖ Transition to operational “Objecti  
what CPC is currently doing with c
- ❖ Transition to an on-line ESRI base  
map
  - ❖ First for the Authors
  - ❖ Next for the USDM community
- ❖ New “potential impacts” tables b  
data collected in the Drought Impa
- ❖ Continue to develop tools, maps,  
funding allows
- ❖ Allow the USDM to change as dat

Category	Impact
D0	Row crop growth is stunted, irrigation begins early
	Brush fires increase
D1	Peach size is reduced; non-irrigated corn shows severe stress
	Fire risk increases; tree pests increase
	Water use is high; creeks, streams, and lakes are low
	Voluntary conservation of water and energy is requested
D2	Cattle are lighter, producers are selling calves early and feeding cattle earlier
	Number of fires increases, and fires are more intense
	Fisheries are impacted; duck hunting areas close
	Boating recreation is compromised
D3	River and lake levels are low; saltwater intrusion occurs; hydroelectric power production is reduced
	Hay is scarce and expensive; owners are giving away horses
	Soil moisture is low, winter crops are slow to germinate
	Burn bans begin
	Small aquatic species are stressed
D4	Mandatory water restrictions are implemented, violators are fined; lake outflow is low
	Producers are hauling water for cattle; auctions see record number of cattle
	Trees are stressed; fish are dying
	Daily life is compromised
	Wells are contaminated or running dry; lakes are extremely low with hazards exposed

# Any Questions ?



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