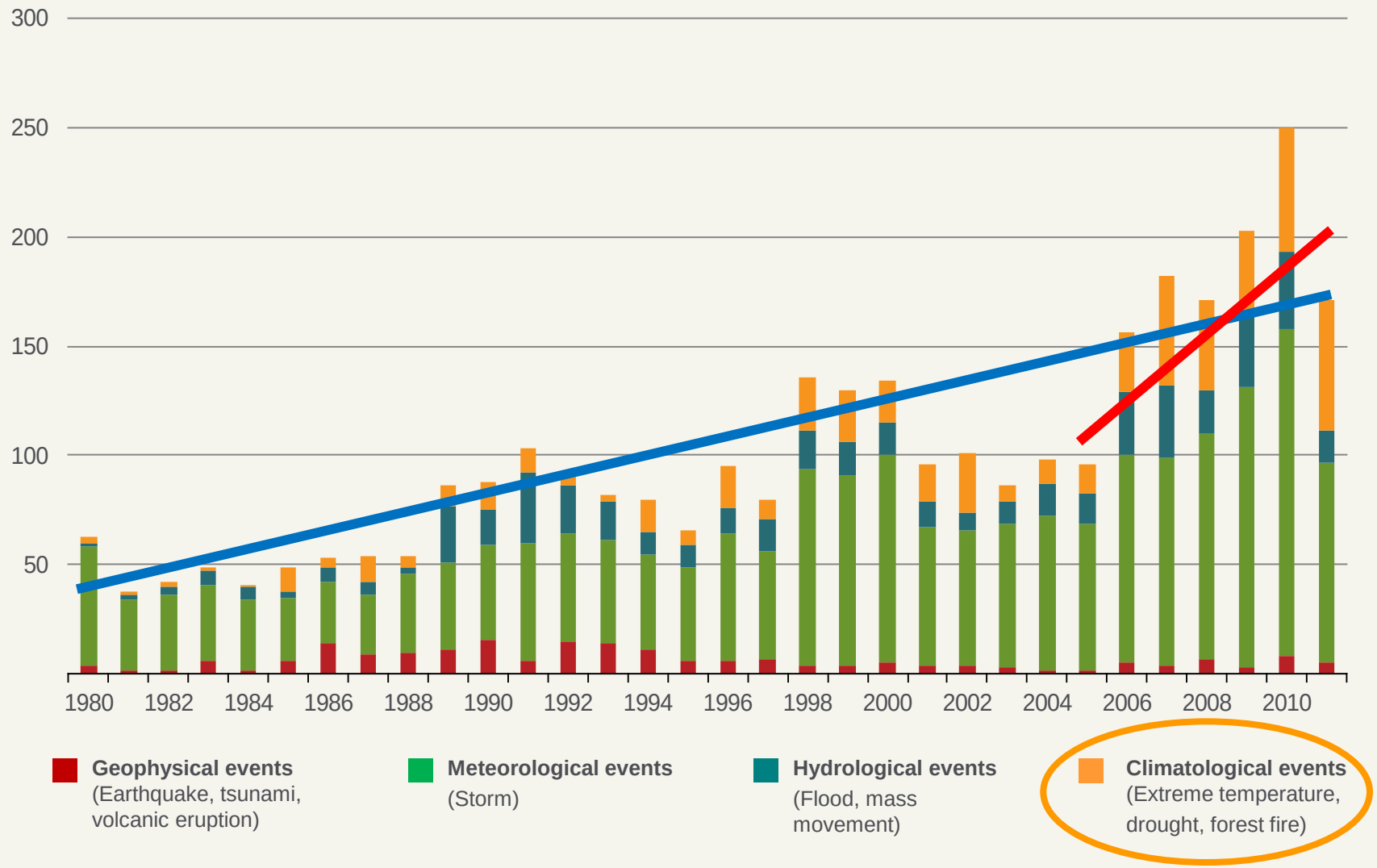
The Role of Drought Information Systems and Risk Management in Preparing for Future Droughts

Michael Hayes and Mark Svoboda
National Drought Mitigation Center
School of Natural Resources
University of Nebraska-Lincoln

Photo: Nicole Wall, NDMC, Platte River, August 2012

Natural Disasters in the U.S. 1980-2011



Source: MR NatCat*SERVICE*

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Context: Why Plan Ahead and Prepare for Natural Disasters?

- Economic losses from disasters worldwide since 2000 are in the range of *$2.5 trillion* (UN, 2013)
  - Considerably higher than previous estimates
  - “Economic losses from disasters are out of control”
- “Losses from floods, earthquakes and drought will continue to escalate” unless action is taken to reduce disaster risks

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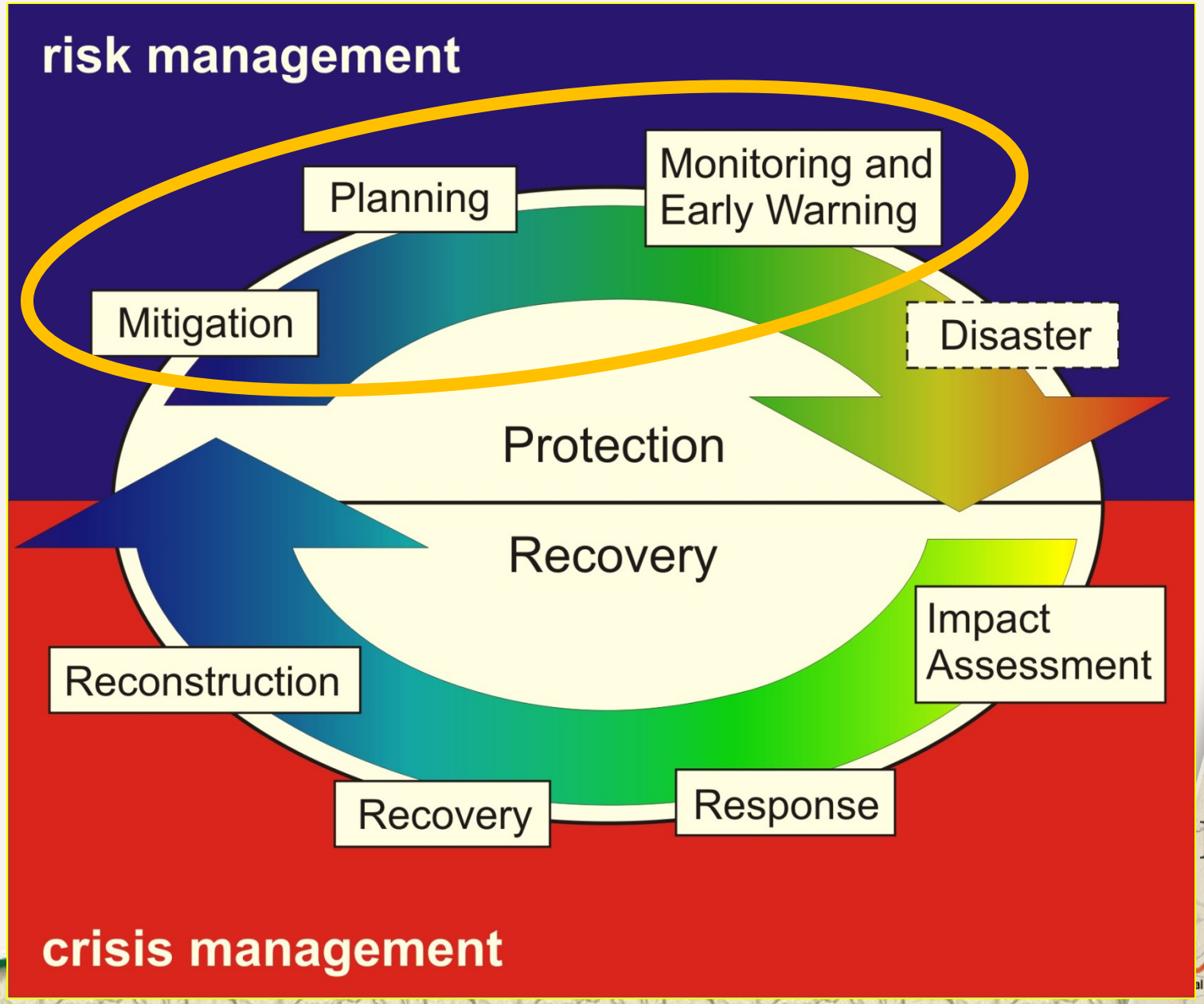
The Cycle of Disaster Management



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Drought Management Legacy: Don Wilhite

"Governments should prepare for droughts by developing and implementing strategies and plans that reduce associated impacts."
-Wilhite and Glantz, 1985

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National Drought Mitigation Center

Founded: ***1995*** at the University of Nebraska-Lincoln by Dr. Don Wilhite.

Mission: To ***lessen societal vulnerability*** to drought by promoting planning and the adoption of appropriate ***risk management*** techniques.

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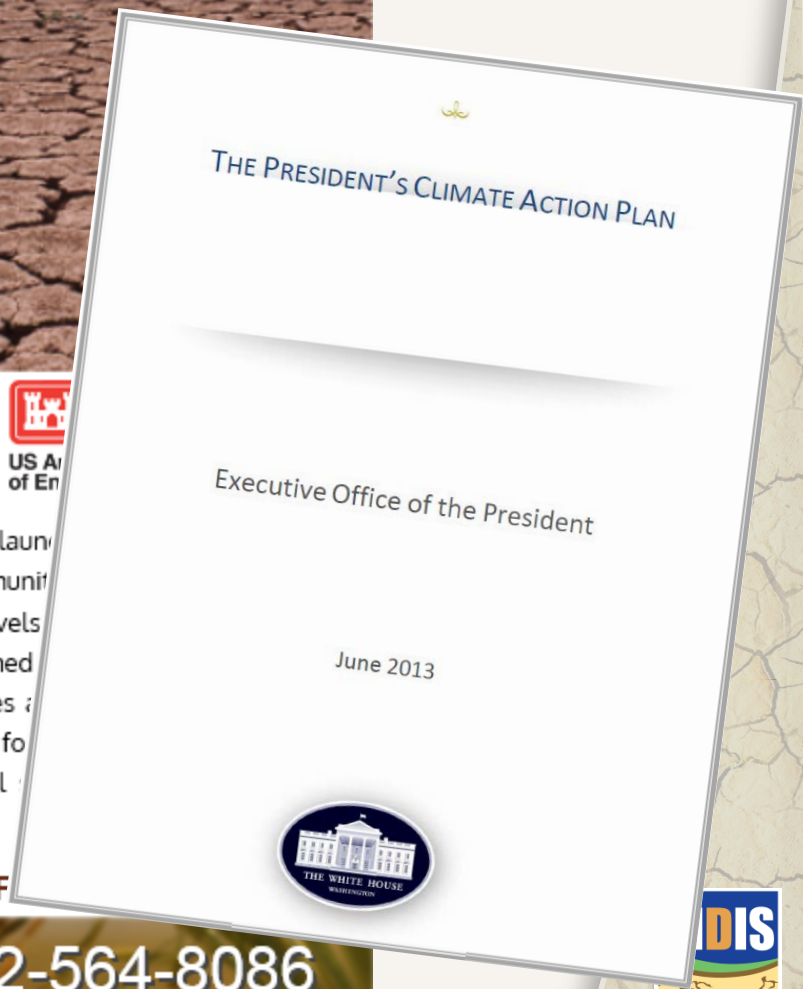
NEW DROUGHT RESILIENCE PARTNERSHIP



FEMA

Nov 15, 2013 - As part of the President's Climate Action Plan, the Administration is laun
Resilience Partnership (the Partnership). The Partnership will make it easier for communit
assistance they need by promoting strong partnership and information sharing at all levels
build on existing efforts to provide States, Tribes and local communities risk-informed
drought preparedness planning. The Partnership aims to align Federal drought polices a
help communities manage the impact of drought by linking information (monitoring, fo
warnings) with drought preparedness and long-term resilience strategies in critical
municipal water systems, energy, recreation, tourism and transportation.

PRESS RELEASE **MORE INF**

CONTACT: Email Us 202-564-8086

DIS

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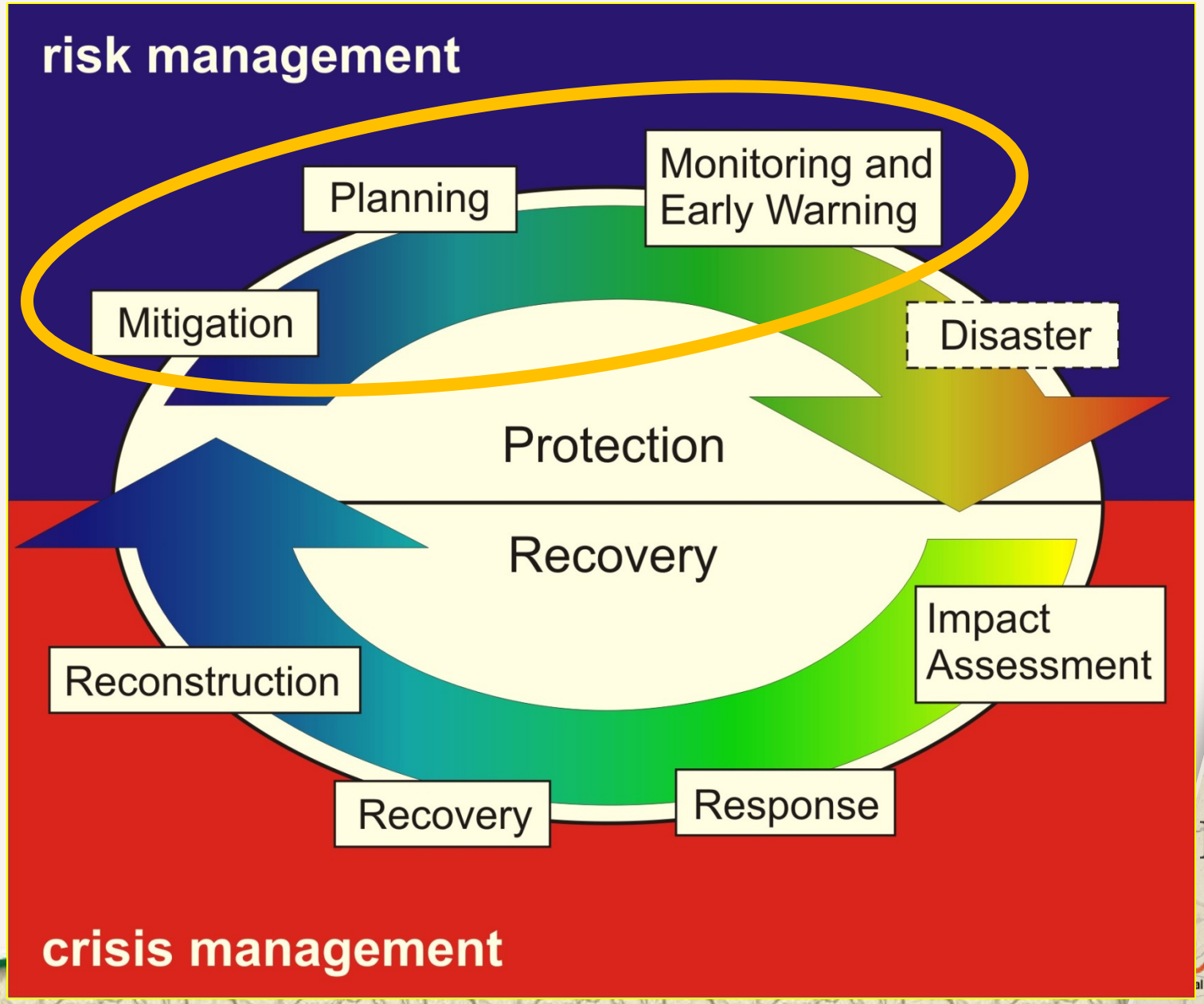
The Cycle of Disaster Management



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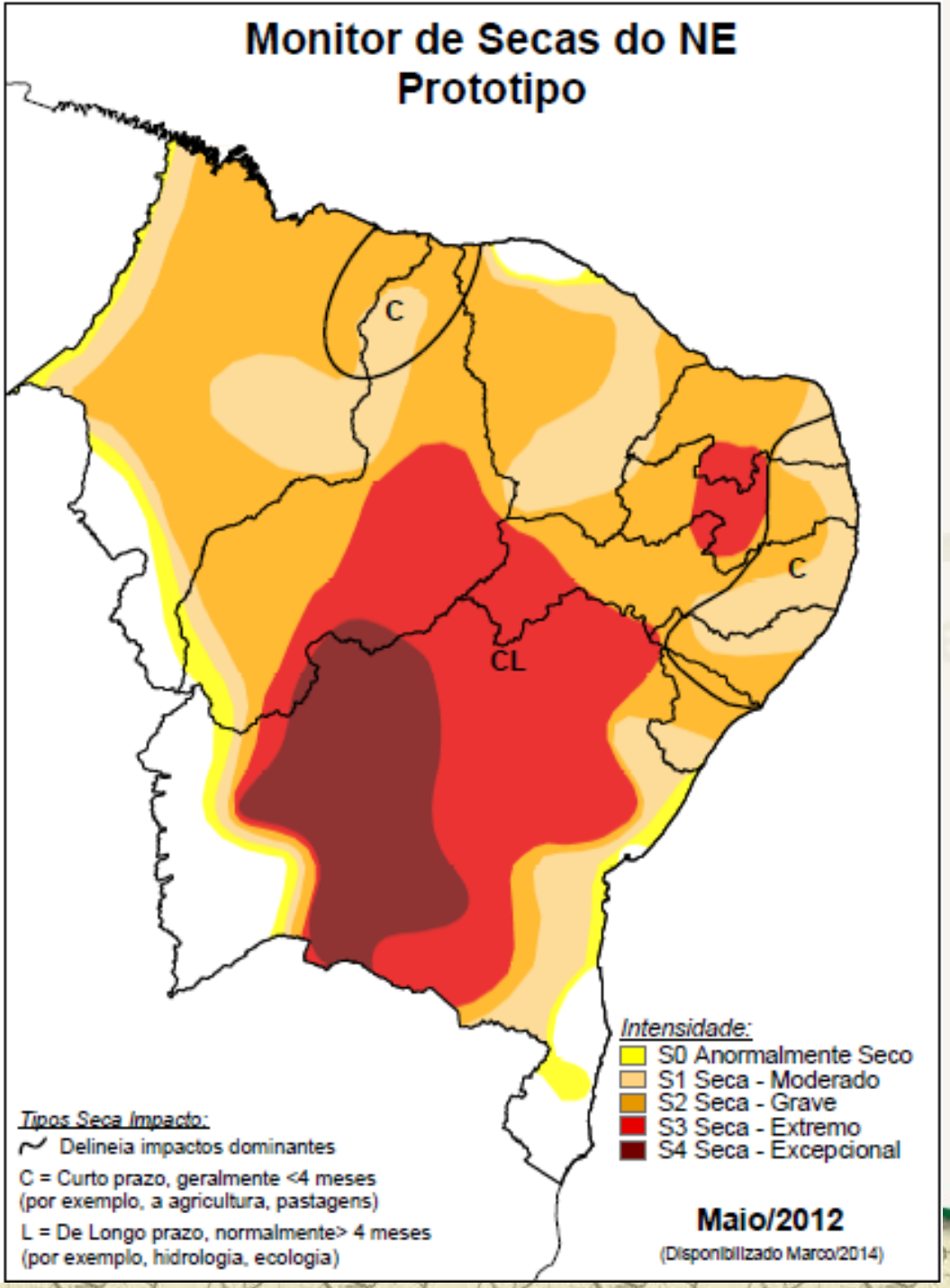
Lessons

- ***Monitoring and Early Warning Information:*** can often be a starting point for the engagement of stakeholders for drought planning and risk management.
  - It is often what the stakeholders know and can relate to
  - Allows trust to develop (between different stakeholders, with the data, making decisions, etc…)
  - Droughts provide “windows of opportunity” for engagement with stakeholders
  - “Cannot manage what is not monitored”

Monitor de Secas do NE
Prototipo



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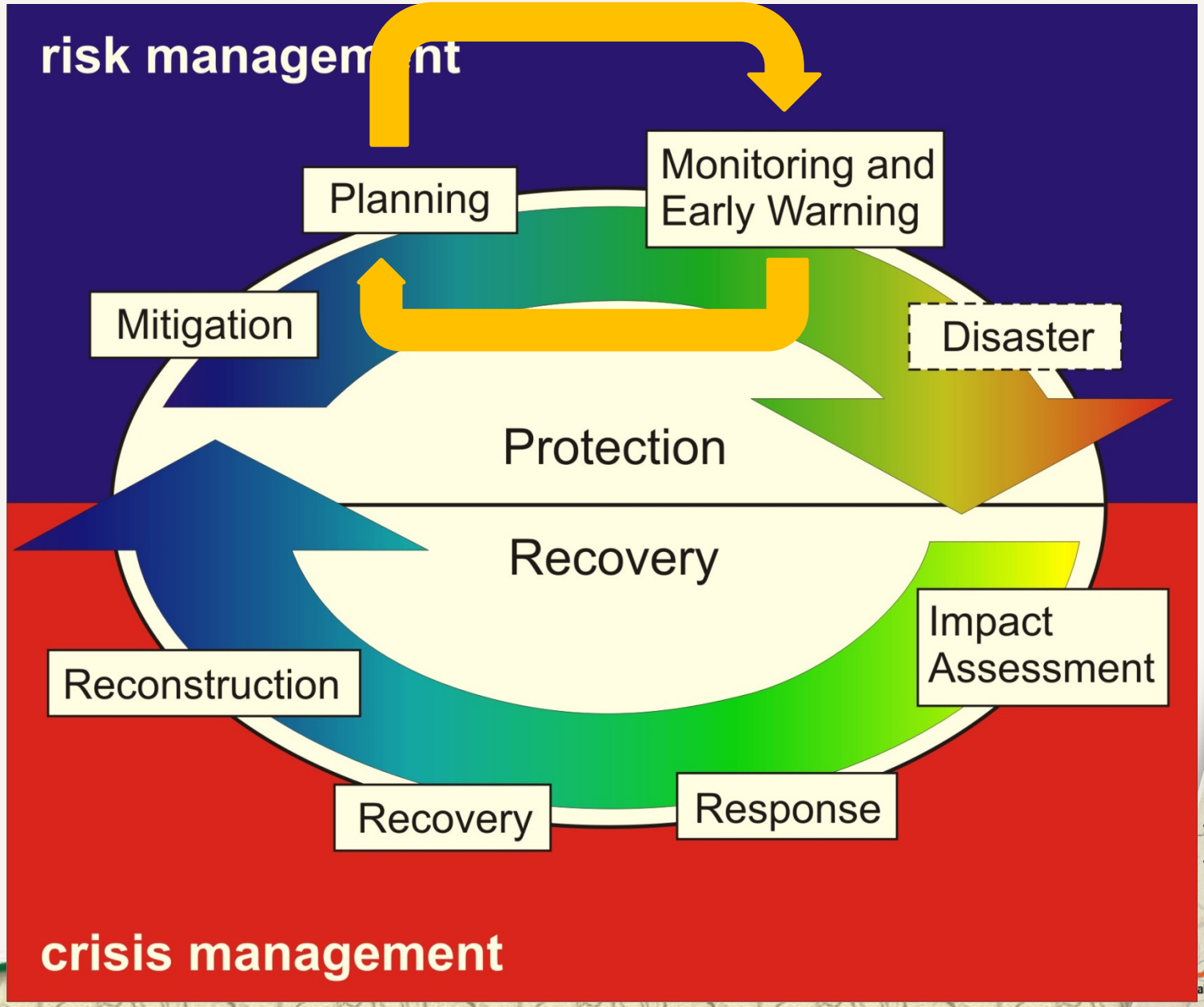
The Cycle of Disaster Management



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Components of Successful Drought Mitigation Planning

- Monitoring, early warning, and prediction
  - Foundation of a drought mitigation plan
  - Indices/indicators linked to impacts and triggers
- Risk and impact assessment
  - Who and what is at risk and why?
- Mitigation and response
  - Pro-active programs and actions to reduce risks
  - Safety net/programs

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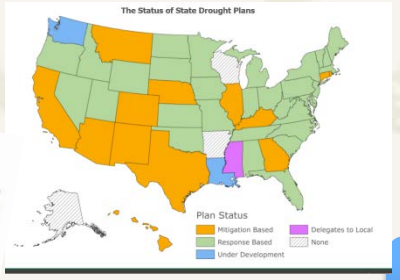
Planning Tools

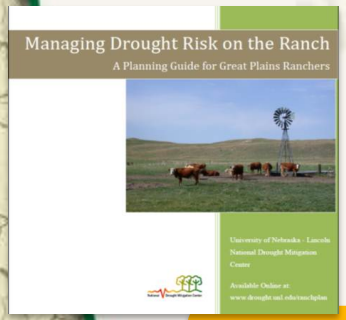
- Planning at ***all scales***
- Planning should start local and involve the ***"locals"***
- Planning is a ***"living"*** process

Nation

Basin



Tribal/ State



Community

Individual

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Lessons

- ***Partnerships and networks are fundamental:*** necessary because of the complexity of drought and for reaching the stakeholders
  - National Integrated Drought Information System (NIDIS)
  - Regional Climate Centers, RISAs, Climate Science Centers, USDA Climate Change Hubs
  - State, local, NGO resources
  - Universities are critical for building the capacity related to research and outreach
    - Extension (Climate Extension Specialists)

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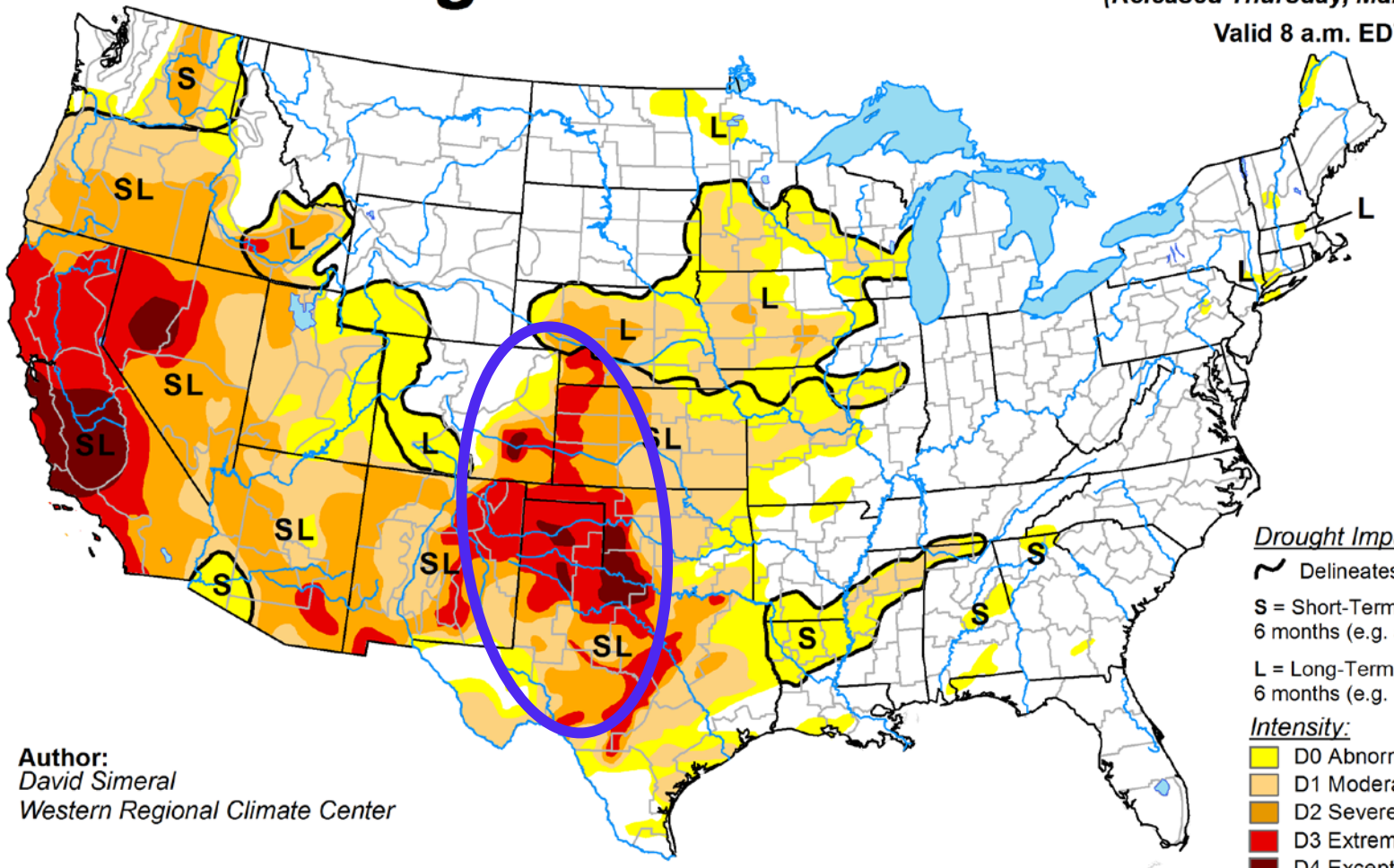
U.S. Drought Monitor

March 25, 2014

(Released Thursday, Mar. 27, 2014)

Valid 8 a.m. EDT



Author:
David Simeral
Western Regional Climate Center

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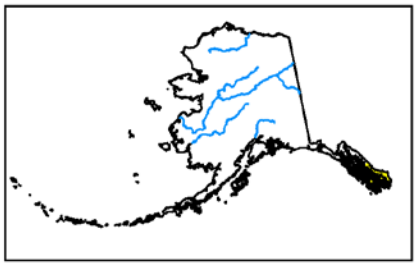
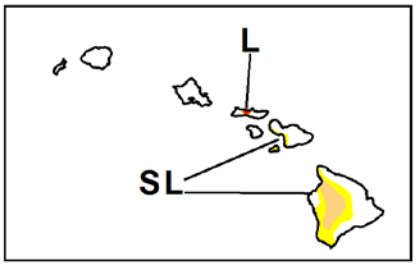
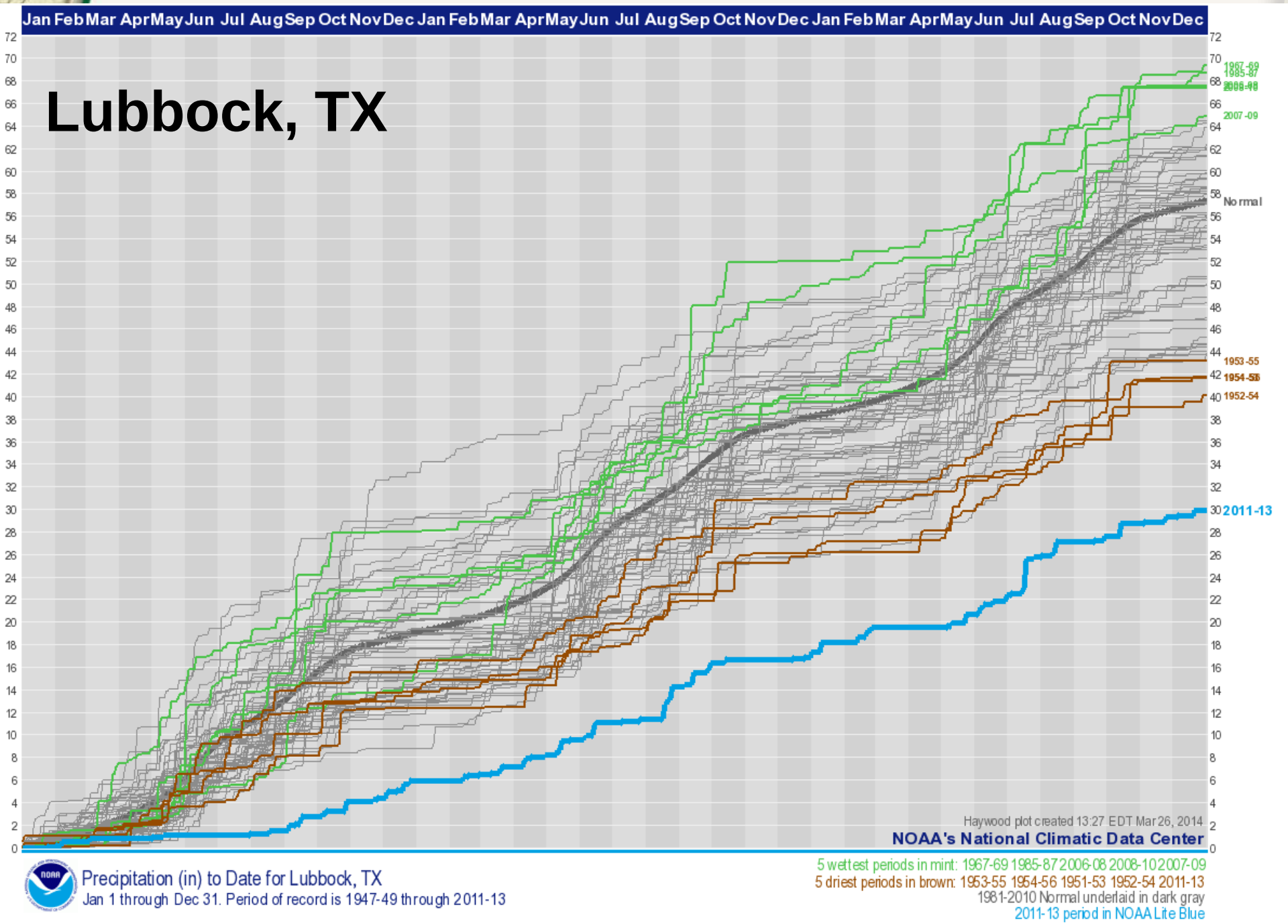
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

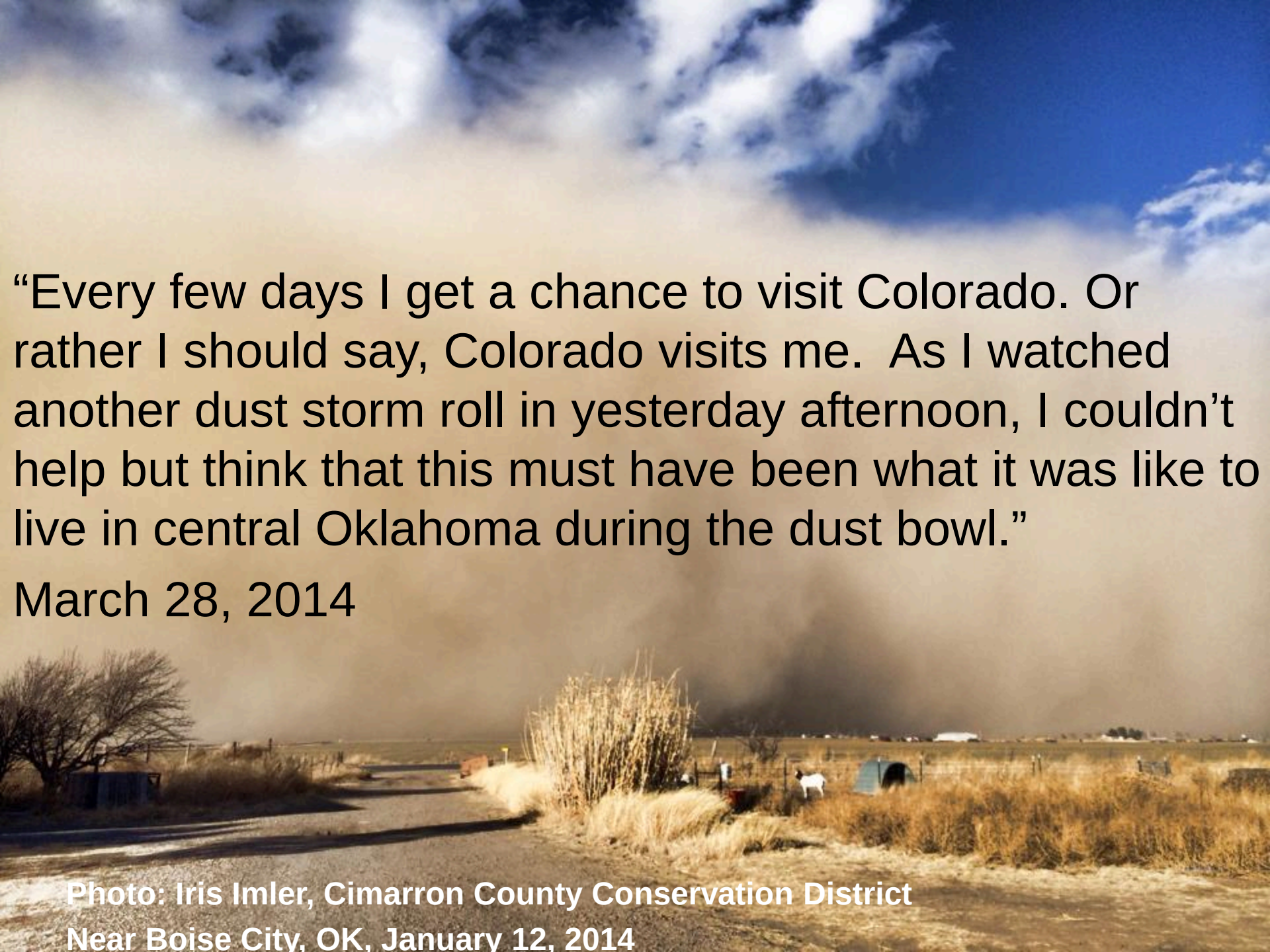




USDA National Drought Mitigation Center

http://droughtmonitor.unl.edu/

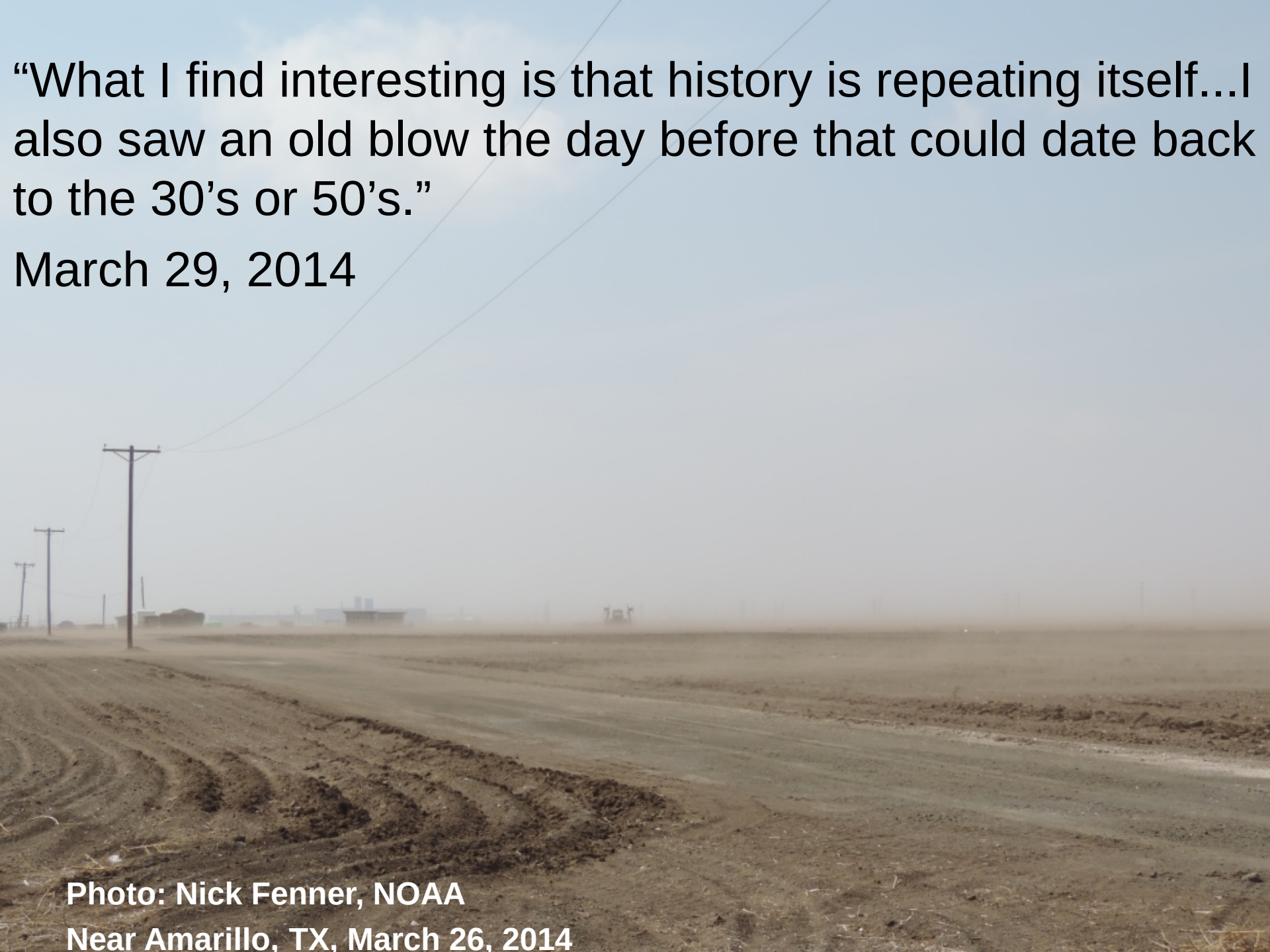

Lubbock, TX
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1967-69
1985-87
2006-08
2007-09
Normal
1953-55
1954-56
1952-54
2011-13
Haywood plot created 13:27 EDT Mar 26, 2014
NOAA's National Climatic Data Center
Precipitation (in) to Date for Lubbock, TX
Jan 1 through Dec 31. Period of record is 1947-49 through 2011-13
5 wettest periods in mint: 1967-69 1985-87 2006-08 2008-10 2007-09
5 driest periods in brown: 1953-55 1954-56 1951-53 1952-54 2011-13
1981-2010 Normal underlaid in dark gray
2011-13 period in NOAA Lite Blue



“Every few days I get a chance to visit Colorado. Or rather I should say, Colorado visits me. As I watched another dust storm roll in yesterday afternoon, I couldn’t help but think that this must have been what it was like to live in central Oklahoma during the dust bowl.”

March 28, 2014

Photo: Iris Imler, Cimarron County Conservation District
Near Boise City, OK, January 12, 2014



“What I find interesting is that history is repeating itself...I also saw an old blow the day before that could date back to the 30’s or 50’s.”

March 29, 2014

Photo: Nick Fenner, NOAA

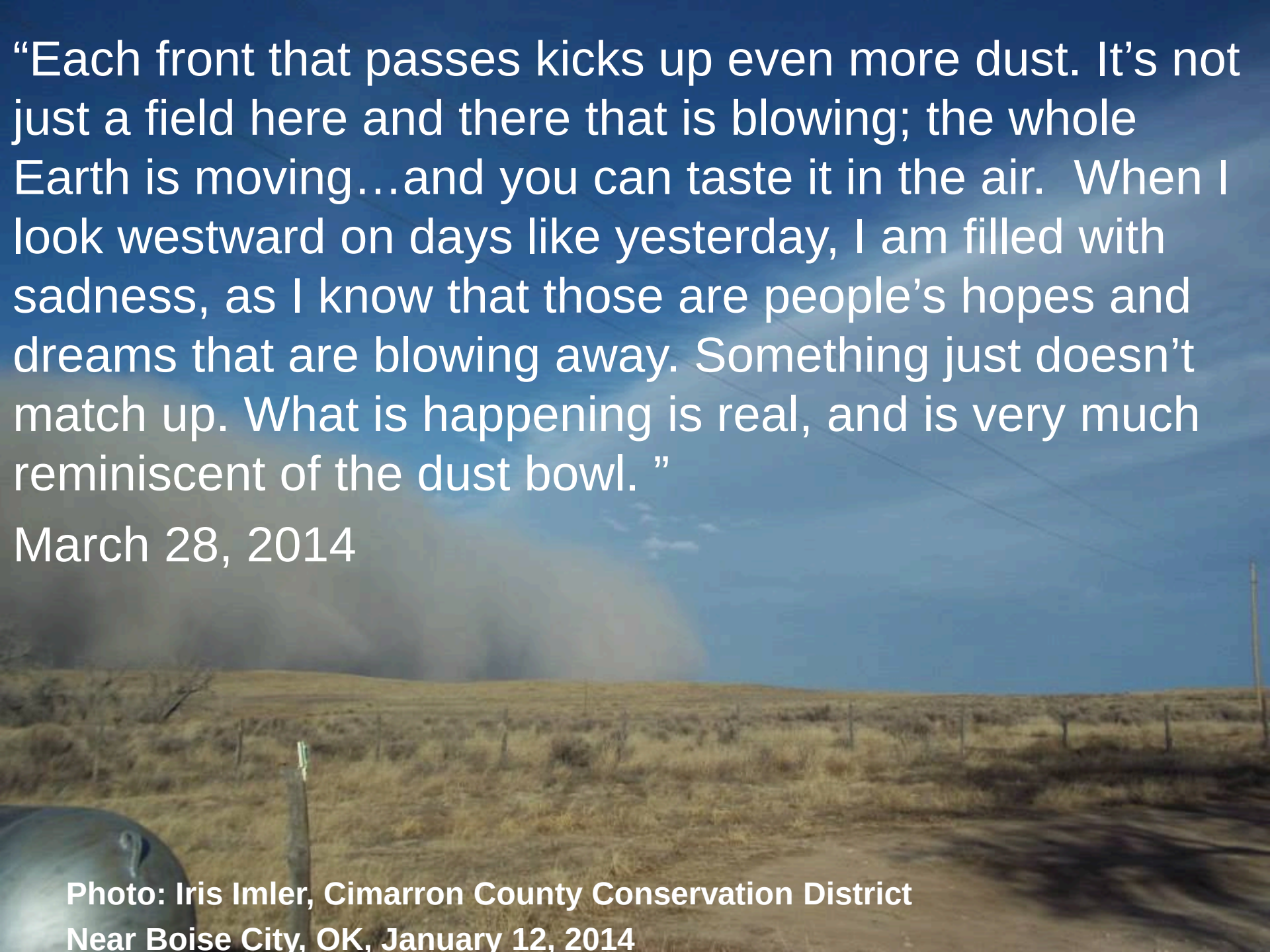
Near Amarillo, TX, March 26, 2014

“The ongoing drought conditions combined with the high winds just continue to hammer away at the fields.”

March 20, 2014

Photo: NRCS/FSA

Near Boise City, OK, March 20, 2014



“Each front that passes kicks up even more dust. It’s not just a field here and there that is blowing; the whole Earth is moving…and you can taste it in the air. When I look westward on days like yesterday, I am filled with sadness, as I know that those are people’s hopes and dreams that are blowing away. Something just doesn’t match up. What is happening is real, and is very much reminiscent of the dust bowl. ”

March 28, 2014

Photo: Iris Imler, Cimarron County Conservation District

Near Boise City, OK, January 12, 2014

Linkages: Drought and Climate

- "Societies will manage climate variability and potential changes in the same way that they manage droughts (for better or worse)."
  - Daniel Connell, Australian National University, 2010
- If we can better prepare for drought, we can better prepare to face many of the potential challenges facing the Great Plains in the future
  - Dedicated efforts of Don Wilhite, NIDIS, NDMC and so many others
  - …Mark Svoboda

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Standard Rainguage

New Nebraska Rainguage

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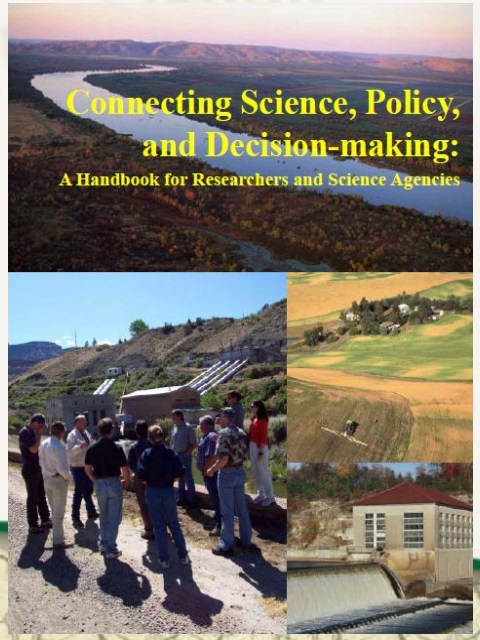
Providing Useful Services and Products: Information Delivery

- *"To increase the impact of scientific information, there should be a focus on **usability**, not just **availability** of information. This means moving to **"value added"** products, where findings are provided in a format that allows for policy applications"*



Taken from: *(Jacobs/NOAA OGP) Connecting Science, Policy and Decision Making: A Handbook for Researchers and Science Agencies*

Components of a Drought Early Warning and Information System

- Monitoring **AND** Forecasting
- Access to **timely** data (including ***impacts***)and "value added" ***information***
- **Synthesis/analysis** of data used to "trigger" set actions within a drought plan
- **Tools** for decision makers
- Efficient **dissemination/communication** (WWW, media, extension, etc.)
- Drought risk assessment and **planning**
- **Education** and Awareness

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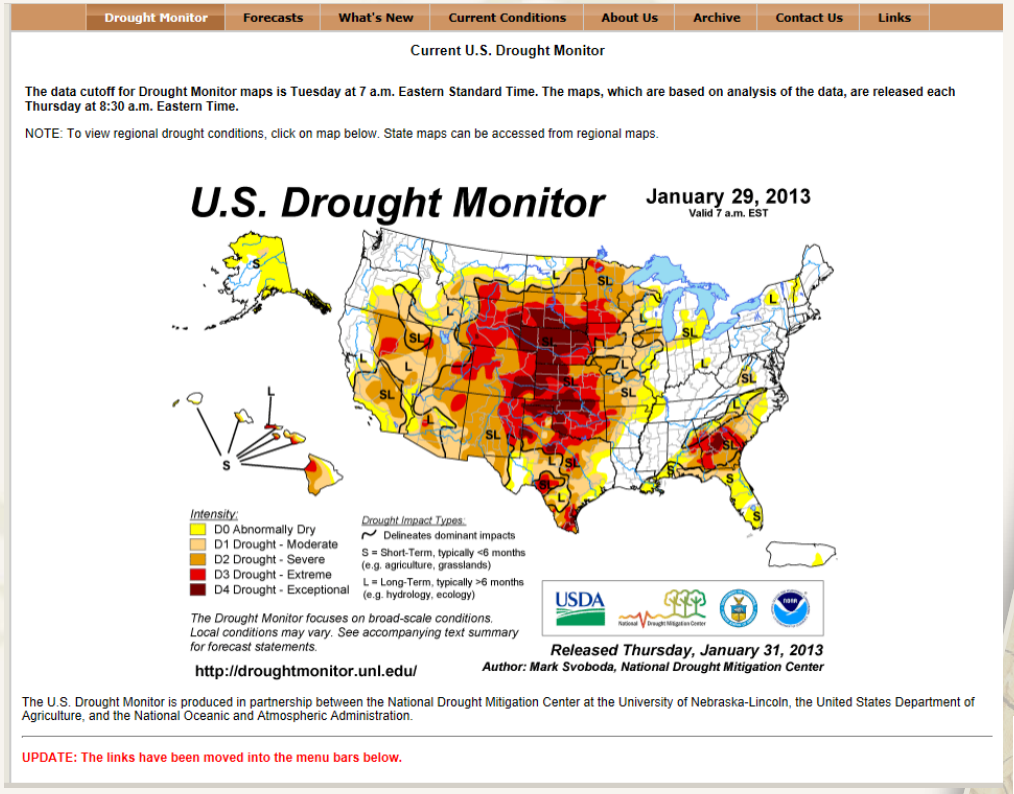
U.S. Drought Monitor (USDM): droughtmonitor.unl.edu

- **State-of-the-art** drought assessment in the U.S. since 1999
  - Collaborative effort between NOAA, USDA and NDMC
- **Composite** indicator blends objective indicators and indices with field input from over **350 experts**
- **Policy implications** in Farm Bill/USDA, IRS, NOAA-NWS and several state drought task forces
- **"Go to source"** for media and the public



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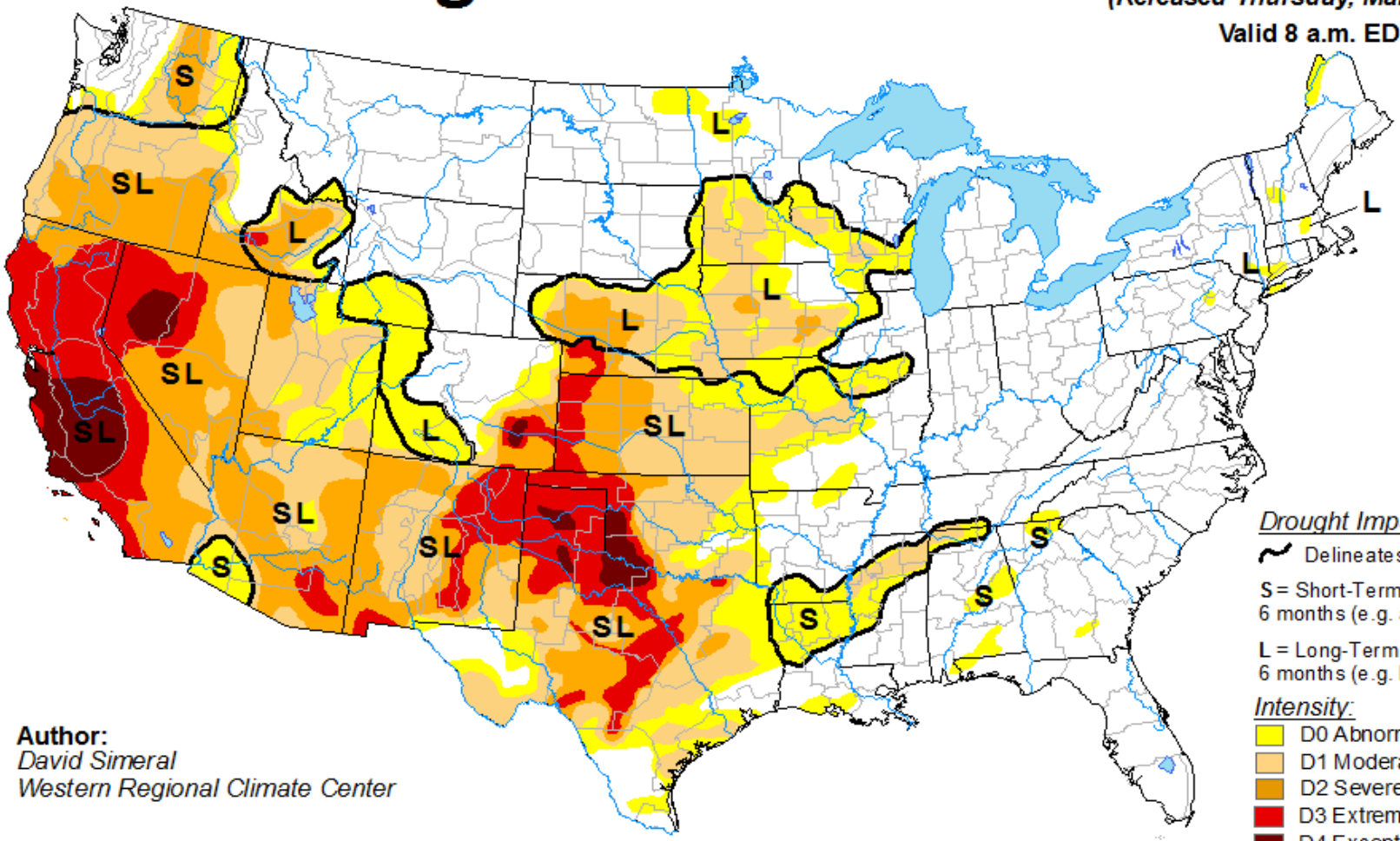

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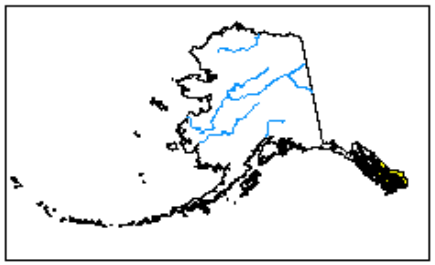

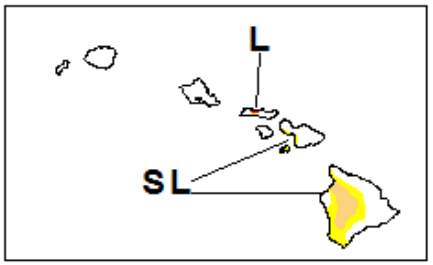

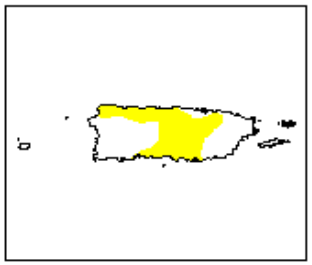

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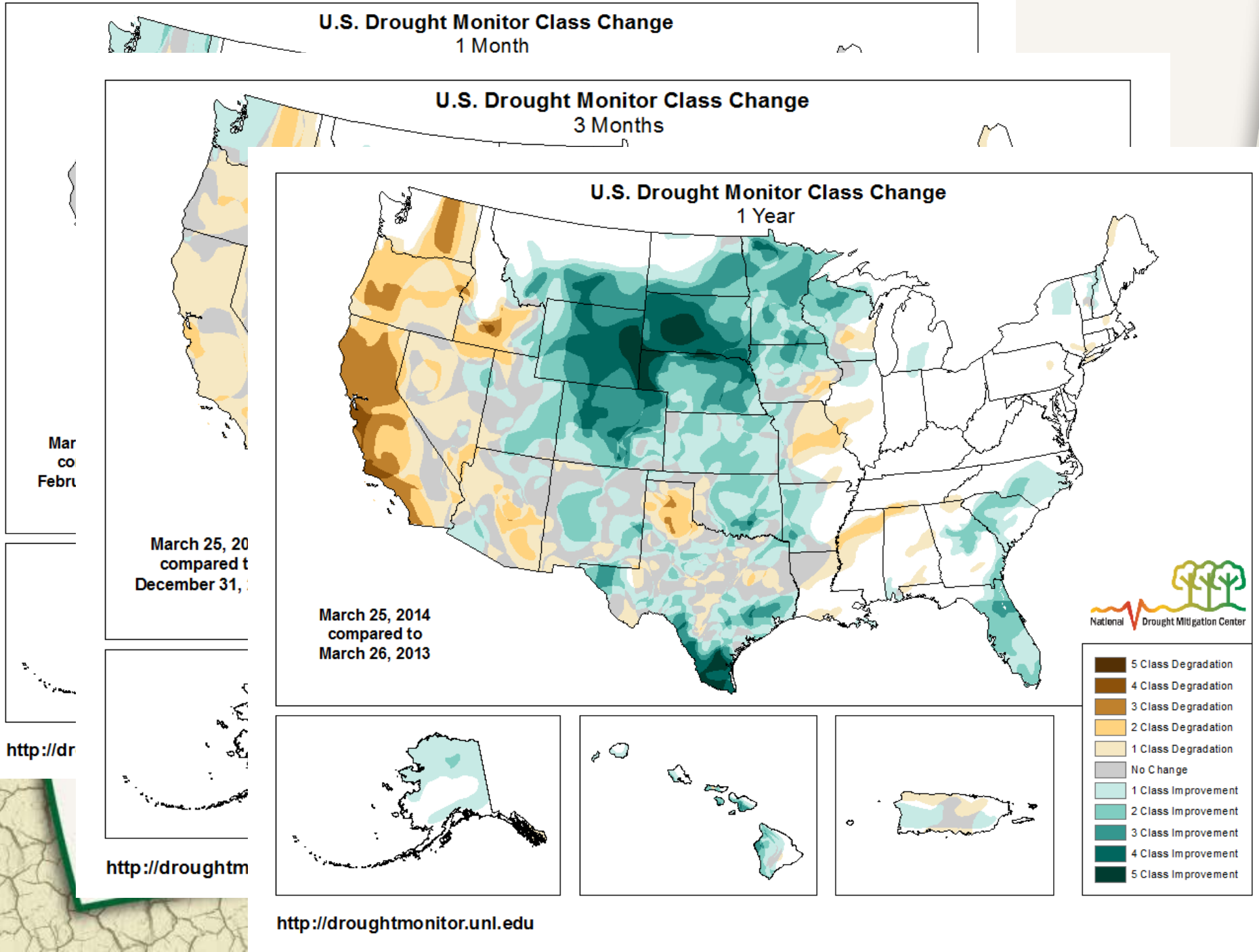
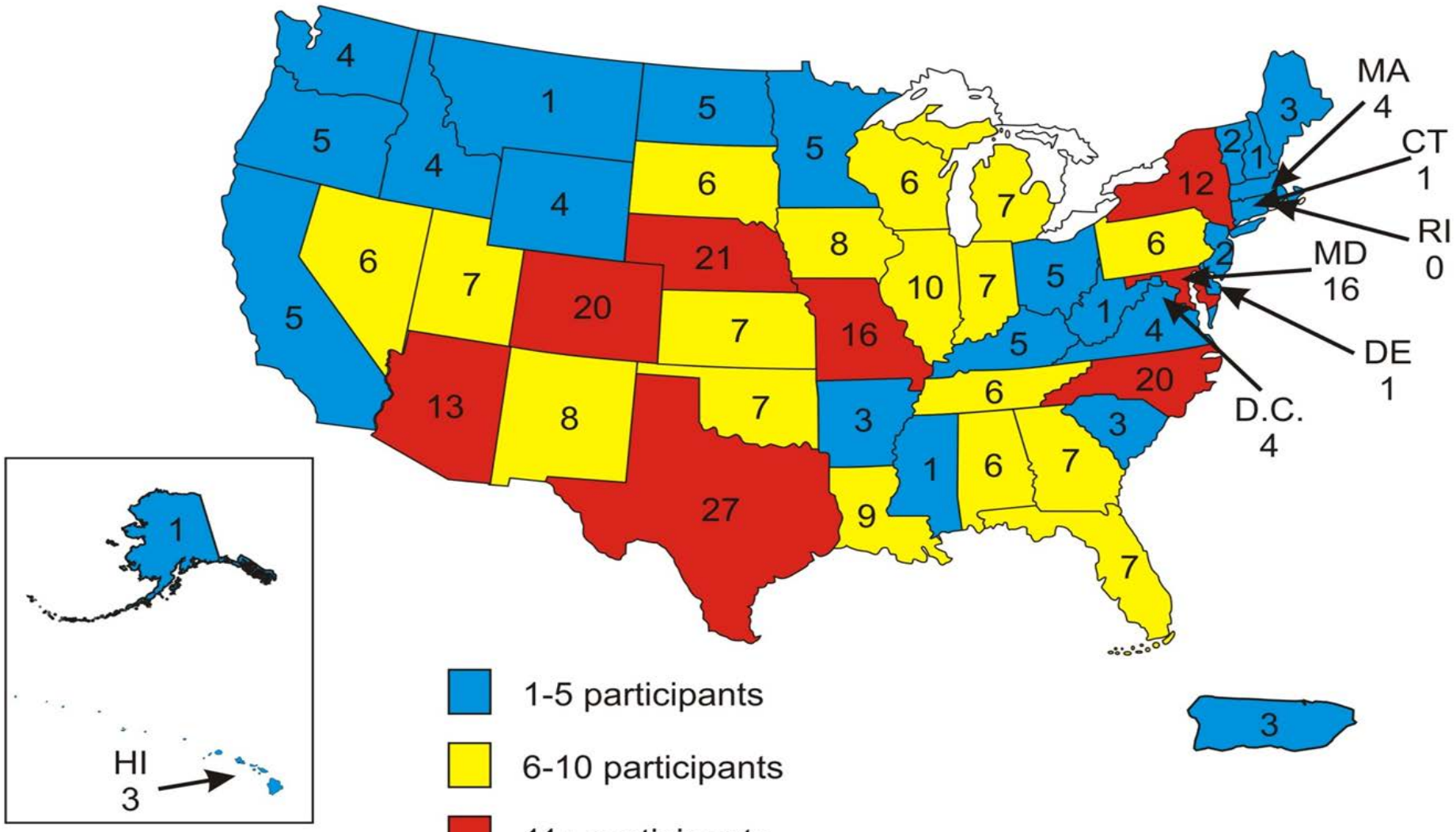
http://droughtmonitor.unl.edu/


U.S. Drought Monitor Class Change
1 Month
U.S. Drought Monitor Class Change
3 Months
March 25, 20
compared t
December 31,
U.S. Drought Monitor Class Change
1 Year
March 25, 2014
compared to
March 26, 2013
National Drought Mitigation Center
5 Class Degradation
4 Class Degradation
3 Class Degradation
2 Class Degradation
1 Class Degradation
No Change
1 Class Improvement
2 Class Improvement
3 Class Improvement
4 Class Improvement
5 Class Improvement
http://dr
http://droughtm
http://droughtmonitor.unl.edu

USDM Listserve Subscribers

(as of November 1, 2013)



Total: 345 (does not include 1 participant from Canada)

North American Drought Monitor

February 28, 2014

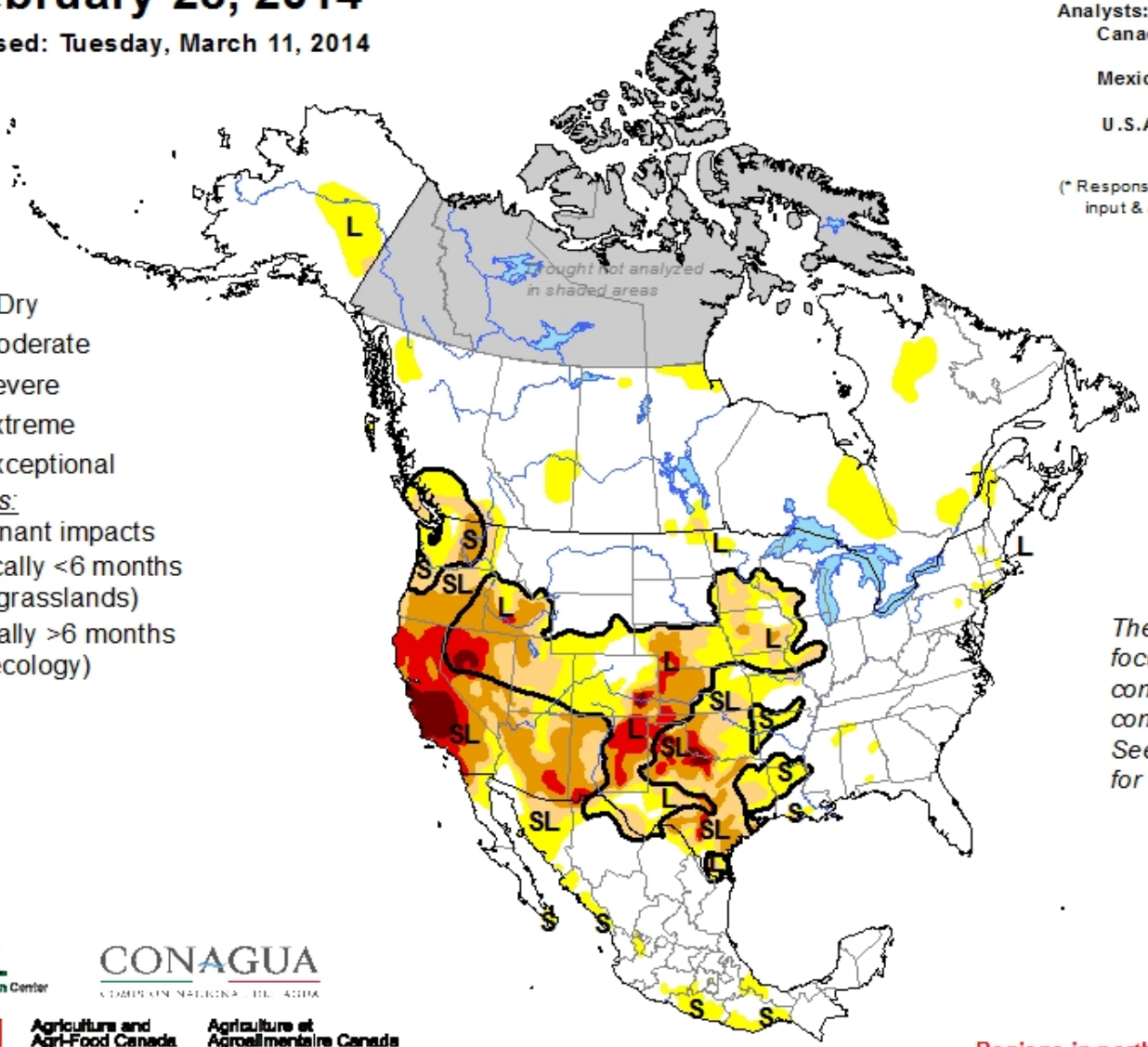
Released: Tuesday, March 11, 2014

http://www.ncdc.noaa.gov/nadm.html

Analysts:

Canada -Trevor Hadwen
Patrick Bell
Mexico - Reynaldo Pascual
Adelina Albanil
U.S.A. - Brad Rippey
Brad Pugh*

(* Responsible for collecting analysts' input & assembling the NADM map)



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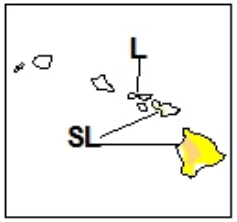

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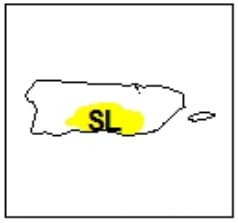


Regions in northern Canada may not be as accurate as other regions due to limited information.

USDA

National Drought Mitigation Center

CONAGUA

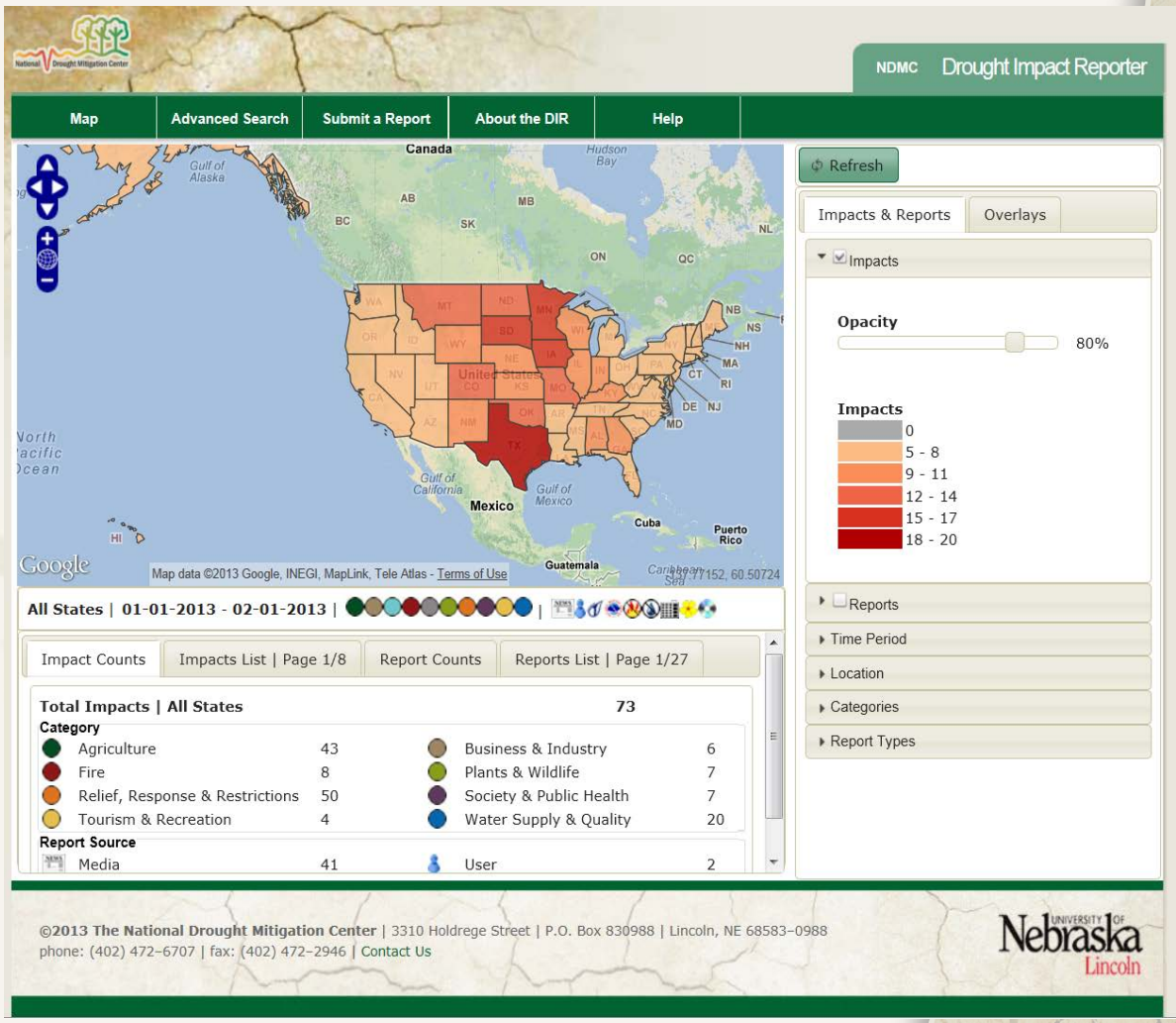
Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada

Environment Canada / Environnement Canada

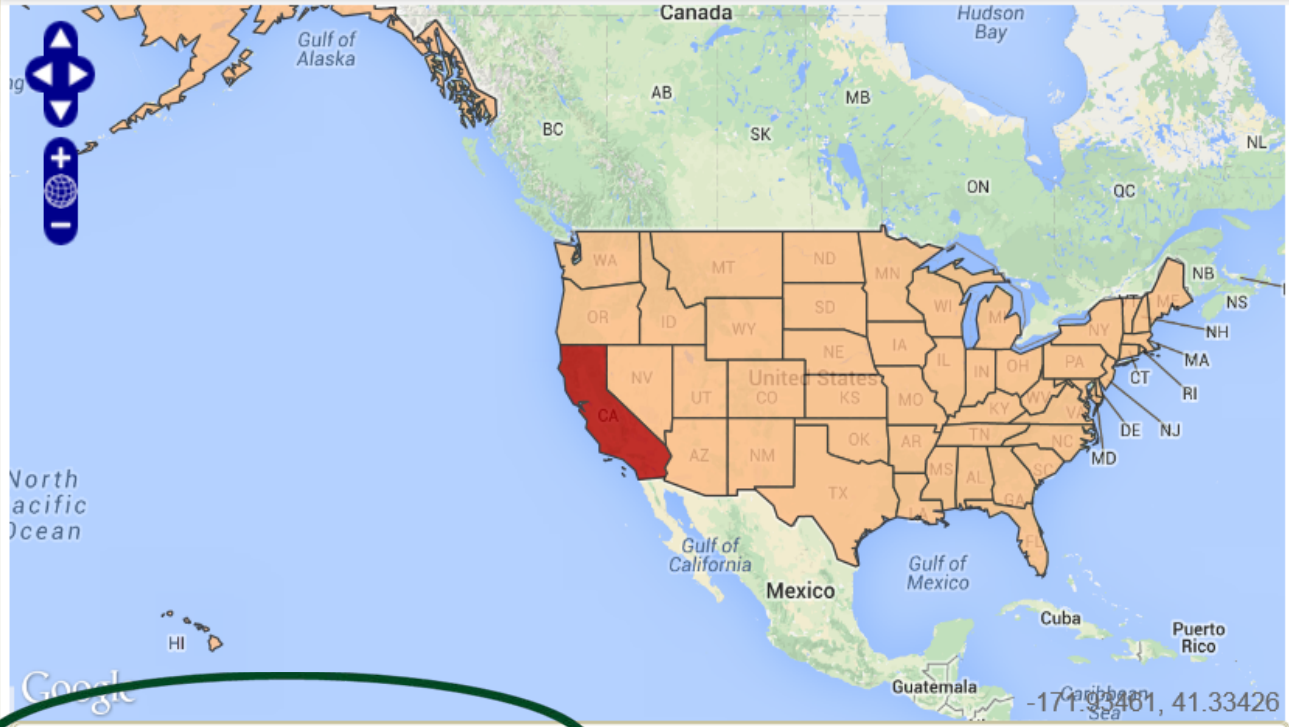
Drought Impact Reporter (DIR):

- On-line since **2005**
- **28,000+** media reports and **18,000+** impacts in our database to date and growing
- Establishing a **"baseline"** of impacts due to droughts over time
  - "Face of drought"
  - Risk/vulnerability
  - Climate change
- ***Ground truth*** indices/RS
- Quantitative **AND** qualitative
- Direct **AND** Indirect

droughtreporter.unl.edu



National Drought Mitigation Center



All States | 01-01-2014 - 04-01-2014 |

Impact Counts | Impacts List | Page 1/31 | Report Counts | Reports List | Page 1/121

Total Impacts | All States 306

Category

Agriculture	76	Business & Industry	37
Energy	5	Fire	34
Plants & Wildlife	69	Relief, Response & Restrictions	135
Society & Public Health	68	Tourism & Recreation	41
Water Supply & Quality	168		

Report Source

Refresh

Impacts & Reports | Overlays

Impacts

Opacity 80%

Impacts
- 0
- 3 - 44
- 45 - 86
- 87 - 128
- 129 - 170
- 171 - 212

Reports

Time Period

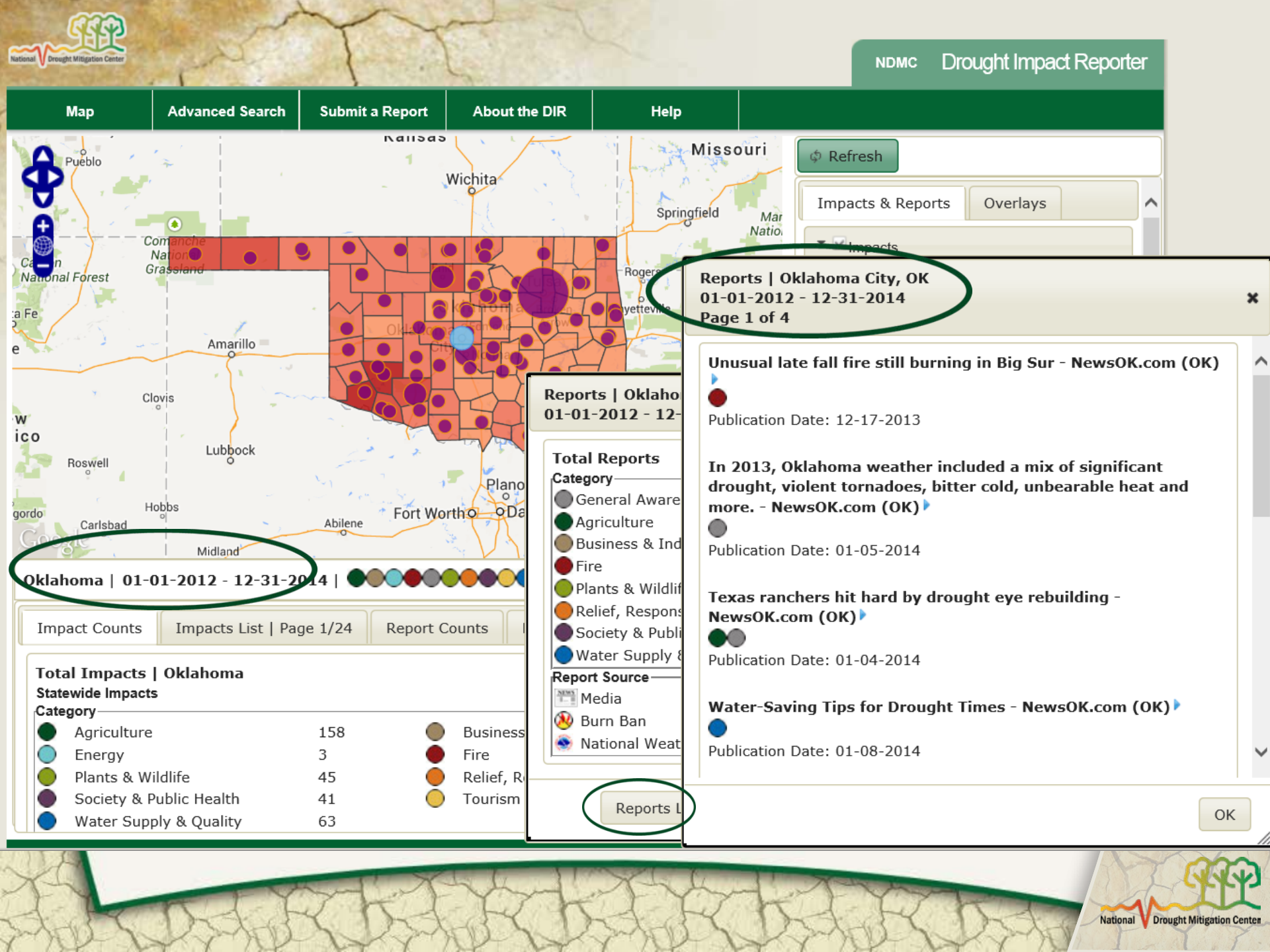
Customize

Start: 01-01-2014

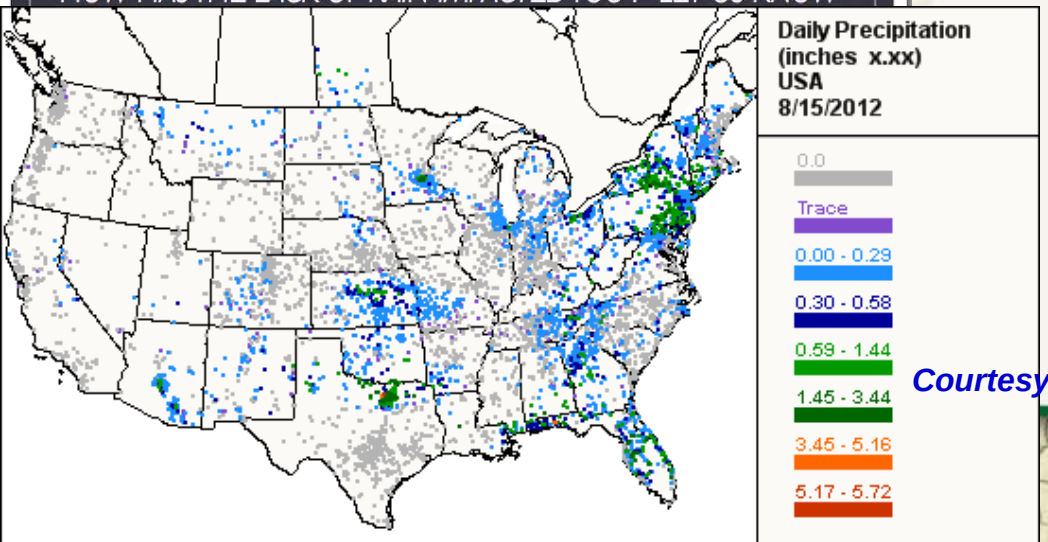
End: 04-01-2014

Location

Categories


NDMC Drought Impact Reporter
Map
Advanced Search
Submit a Report
About the DIR
Help
Refresh
Impacts & Reports
Overlays
Pueblo
Wichita
Springfield
Missouri
Amarillo
Clovis
Lubbock
Roswell
Hobbs
Carlsbad
Abilene
Fort Worth
Midland
Oklahoma | 01-01-2012 - 12-31-2014 |
Impact Counts
Impacts List | Page 1/24
Report Counts
Total Impacts | Oklahoma
Statewide Impacts
Category
Agriculture 158
Energy 3
Plants & Wildlife 45
Society & Public Health 41
Water Supply & Quality 63
Business
Fire
Relief, R
Tourism
Reports | Oklaho
01-01-2012 - 12-
Total Reports
Category
General Aware
Agriculture
Business & Ind
Fire
Plants & Wildlif
Relief, Respons
Society & Publi
Water Supply &
Report Source
Media
Burn Ban
National Weat
Reports L
Reports | Oklahoma City, OK
01-01-2012 - 12-31-2014
Page 1 of 4
Unusual late fall fire still burning in Big Sur - NewsOK.com (OK)
Publication Date: 12-17-2013
In 2013, Oklahoma weather included a mix of significant drought, violent tornadoes, bitter cold, unbearable heat and more. - NewsOK.com (OK)
Publication Date: 01-05-2014
Texas ranchers hit hard by drought eye rebuilding - NewsOK.com (OK)
Publication Date: 01-04-2014
Water-Saving Tips for Drought Times - NewsOK.com (OK)
Publication Date: 01-08-2014
OK
National Drought Mitigation Center

Promoting the “drought impact reporting” idea to volunteers…



* **18,000+ volunteers covering all 50 states and now into Canada!!**

* **CoCoRaHS “Message of the Day”**

* **Monthly e-mail reminders**

* **Guide to reporting drought impacts**

* **Banners on the Web**

Courtesy: Henry Reges, Colorado State University

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Drought Risk Atlas (DRA):

- Launched in March 2014
- ~3000 stations archived
  - 139 clusters/regions developed and analyzed
  - SPI, SPEI, PDSI, sc-PDSI and Deciles through 2012
  - Weekly gridded maps for all parameters back to early 1900s
- Created to answer questions about the characteristics of drought:
  - Frequency/return periods
  - Duration
  - Trends
  - Intensity
  - Spatial extent

- **Open for Business!**
- **Droughtatlas.unl.edu**

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The Drought Risk Atlas will help answer:

- How does the drought *compare* to other droughts *historically*?
- When was the *last time* a drought like this happened?
- *How often* (frequency) does a drought of this magnitude happen?
- Are we seeing *any trends* in drought frequency, duration, severity?
- What did the *spatial footprint* of the last drought look like?

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Let's use the Drought Risk Atlas to help us answer this question:

- **How does the drought of 2012 in central Nebraska, specifically Holdrege, compare to the Dust Bowl years?**

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Climate Data

Options Available for Station Chosen

Selected Atlas Station: **253910 (HOLDREGE)**

Select New Station

Station | Climate | Deciles | SPI | SPEI | PDSI | SC-PDSI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

253910: HOLDREGE

Latitude
40.452

Longitude
-99.38

Elevation (ft)
2320

State
Nebraska

County
Phelps

Climate Division
8

Time Period
1/1/1908 - 12/31/2012

Years on Record
104

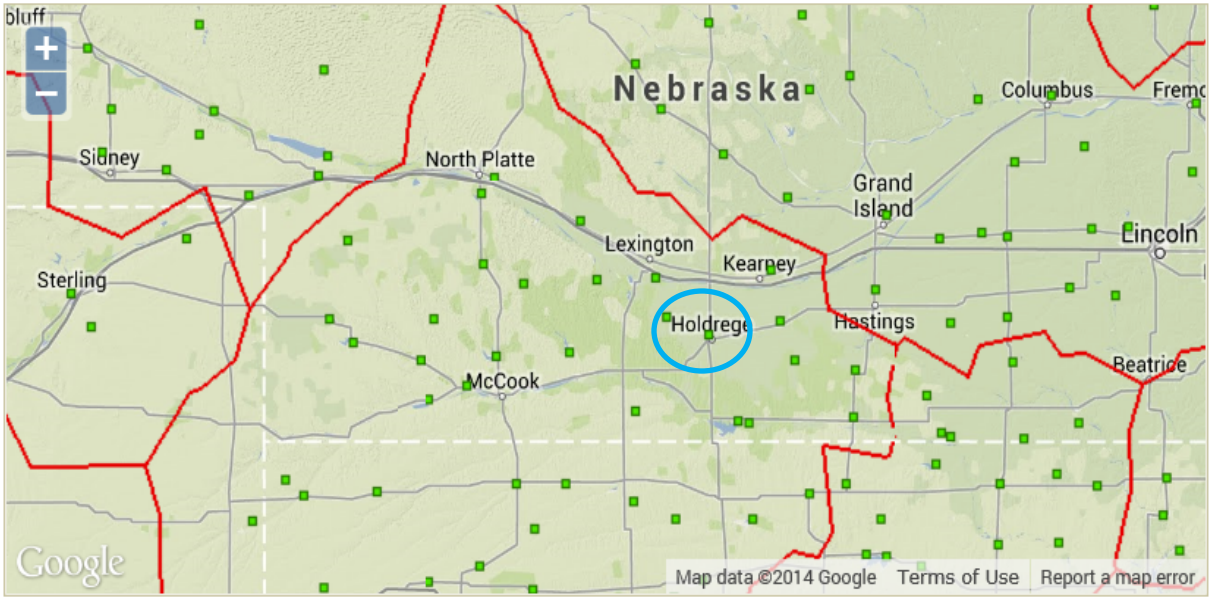
Precipitation Only
No

Download Metadata

The Atlas period of record can and will vary from the ACIS period of record. Stations may have had data periods that did not meet the criteria used in the Atlas. Those data periods

Similar Stations

Atlas Region



Related Stations:

(Click to select)

050834: BONNY DAM 2NE

051121: BURLINGTON

141699: COLBY 1SW

Climate Time Series

Climate Data

Selected Atlas Station: **253910 (HOLDREGE)**

Select New Station

Station | Climate | Deciles | SPI | SPEI | PDSI | SC-PDSI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

Date

1/1/1908 to 12/31/2012

Period of Record

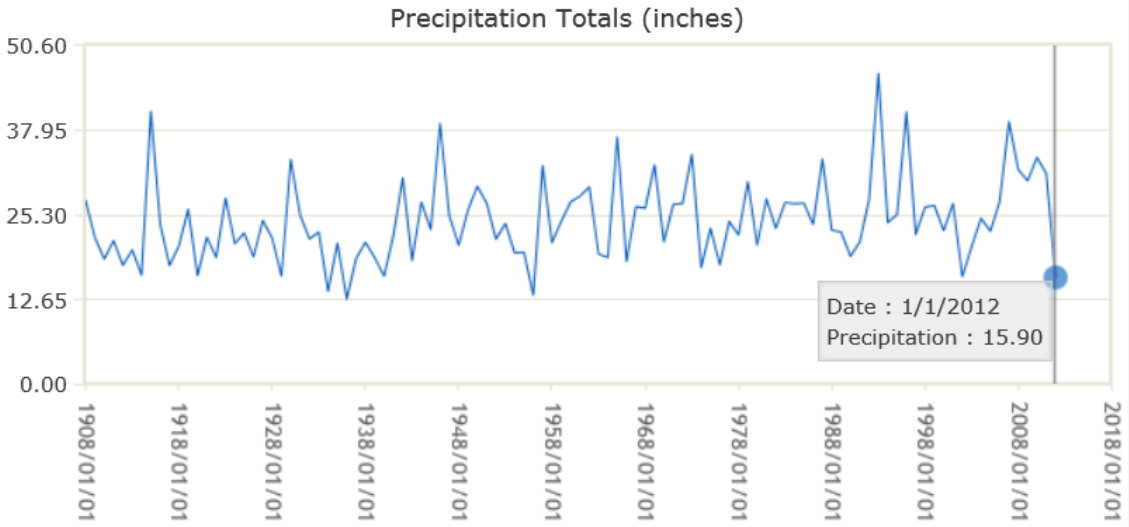
Station start date: 1/1/1908

Aggregate

Annual

Results for **HOLDREGE (253910)** between 1/1/1908 and 12/31/2012, aggregated by year.

Note: these precipitation totals may include days with no data values and these temperature averages may include days with no data values. Please see the tabular datasets for more information.



Climate Tabular Data

Home | Map Viewer | Data | Methodology | About | Help

0 Current Location » Data

Climate Data

Selected Atlas Station: **253910 (HOLDREGE)**

Select New Station

Station | Climate | Deciles | SPI | SPEI | PDSI | SC-PDSI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

Date

1/1/1908 to 12/31/2012

Period of Record

Station start date: 1/1/1908

Aggregate

Annual

Results for **HOLDREGE (253910)** between 1/1/1908 and 12/31/2012, aggregated by year.

Show 25 entries Search:

Date	Precipitation (in.)	Contains NoData	TMax (°F)	Contains NoData	TMin (°F)	Contains NoData
1936	12.67	No	66.37	No	38.91	No
1956	13.25	No	65.95	No	40.31	No
1934	13.82	No	70.54	No	41.99	No
2012	15.90	No	66.32	No	37.86	No
2002	16.03	No	63.61	No	38.56	No
1940	16.07	No	63.55	No	40.50	No
1929	16.10	No	64.22	No	39.24	No
1920	16.18	No	64.85	No	39.11	No
1914	16.26	No	66.14	No	38.56	No
1974	17.37	No	65.75	No	37.85	No
1917	17.68	No	63.86	No	35.65	No
1912	17.70	No	62.02	No	36.26	No
1976	17.78	No	65.06	No	37.29	No

Drought Time Series

0 Current Location » Data

Climate Data

Selected Atlas Station: **253910 (HOLDREGE)**

Select New Station

Station | Climate | Deciles | SPI | SPEI | PDSI | SC-PDSI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

Date

1/1/1908 to 12/31/2012

Period of Record

Station start date: 1/1/1908

Aggregate

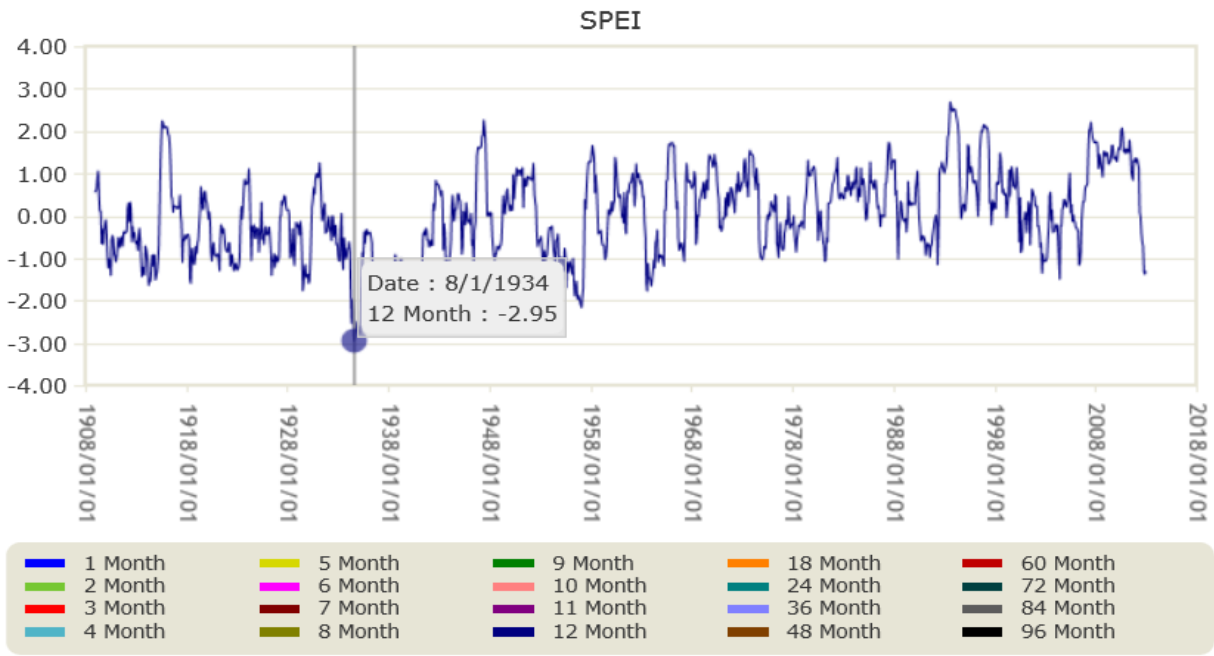
Month

Timestep

Select one or more timesteps to compare.

- 1 month
- 2 month
- 3 month
- 4 month
- 5 month
- 6 month
- 7 month
- 8 month
- 9 month
- 10 month
- 11 month
- 12 month
- 18 month
- 24 month

Results for **HOLDREGE (253910)** for the 12 Month timestep(s) between 1/1/1908 and 12/31/2012 and aggregated by month.



To zoom in on the chart, click and drag across the chart area. To return to the complete chart, double-click in the chart area.

Drought Time Series

Climate Data

Selected Atlas Station: **253910 (HOLDREGE)**

Select New Station

Station | Climate | Deciles | SPI | SPEI | PDSI | SC-PDSI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

Date

1/1/1908 to 12/31/2012

Period of Record

Station start date: 1/1/1908

Aggregate

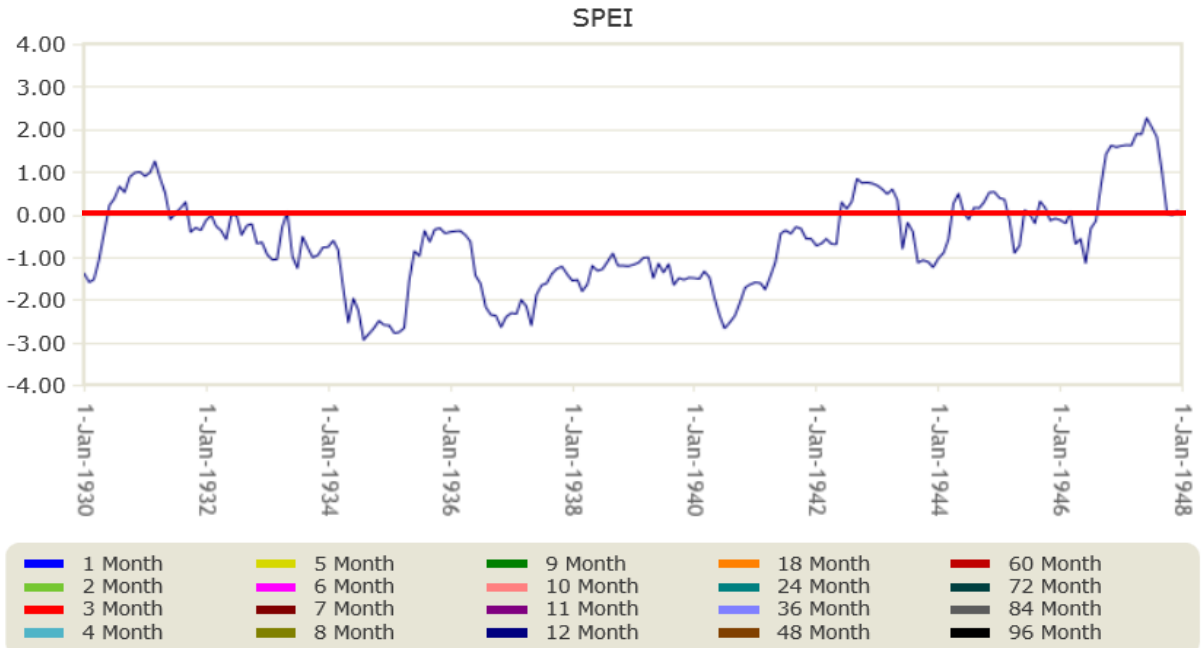
Month

Timestep

Select one or more timesteps to compare.

- 1 month
- 2 month
- 3 month
- 4 month
- 5 month
- 6 month
- 7 month
- 8 month
- 9 month
- 10 month
- 11 month
- 12 month
- 18 month
- 24 month

Results for **HOLDREGE (253910)** for the 12 Month timestep(s) between 1/1/1908 and 12/31/2012 and aggregated by month.



To zoom in on the chart, click and drag across the chart area. To return to the complete chart, double-click in the chart area.

Drought Time Series

Climate | Deciles | SPI | SPEI | PDSI | SC-PDSI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

te

1/1/1908 to 12/31/2012

Period of Record

Station start date: 1/1/1908

gregate

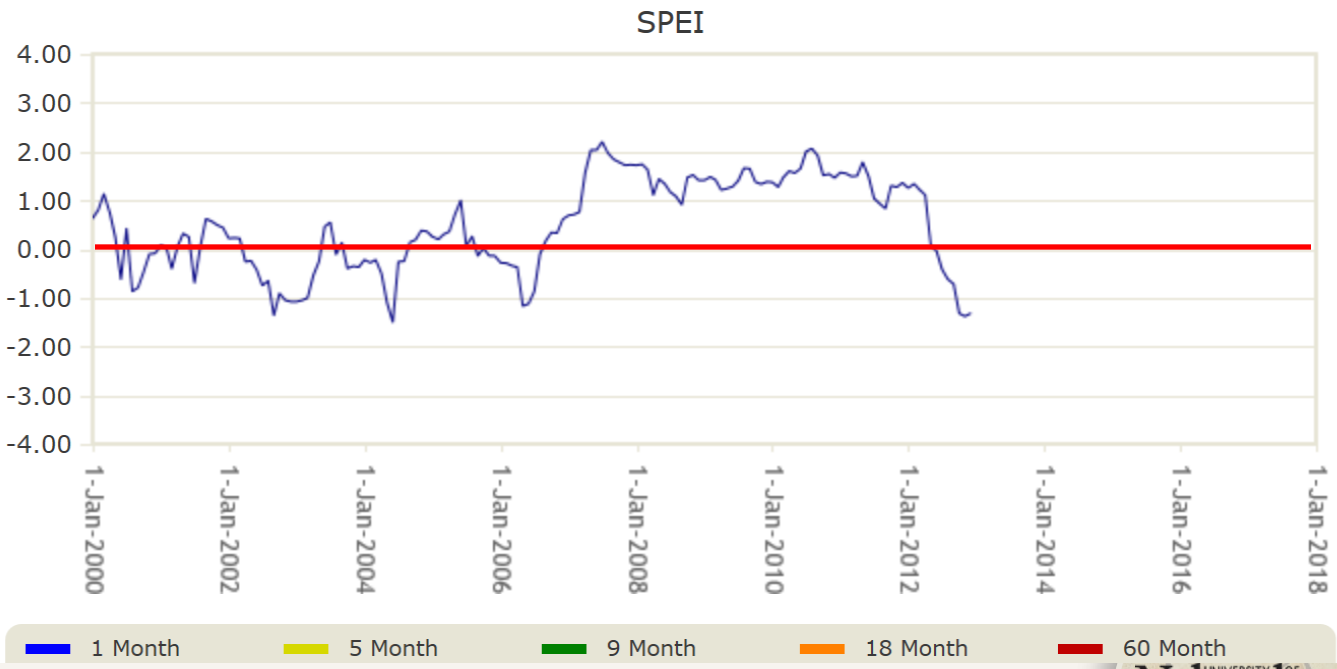
Month

mestep

Select one or more timesteps to compare.

1 month
2 month
3 month
4 month
5 month
6 month
7 month

Results for **HOLDREGE (253910)** for the 12 Month timestep(s) between 1/1/1908 and 12/31/2012 and aggregated by month.



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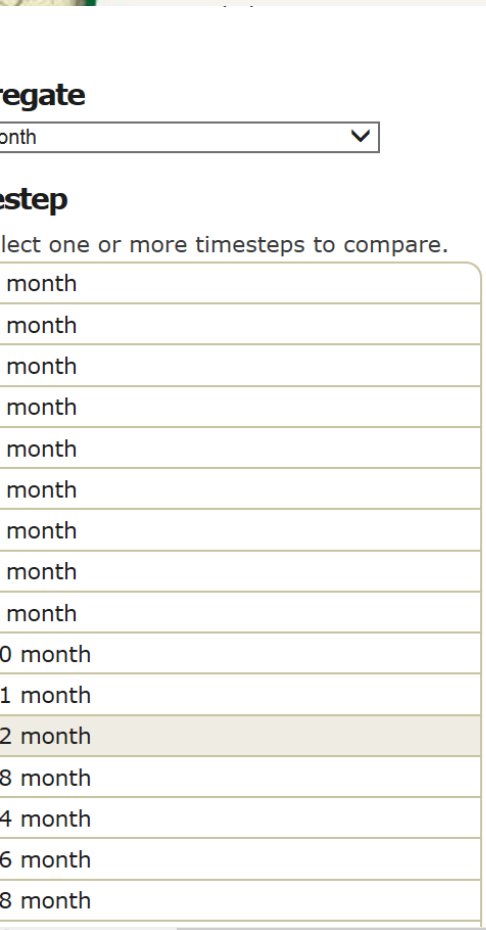
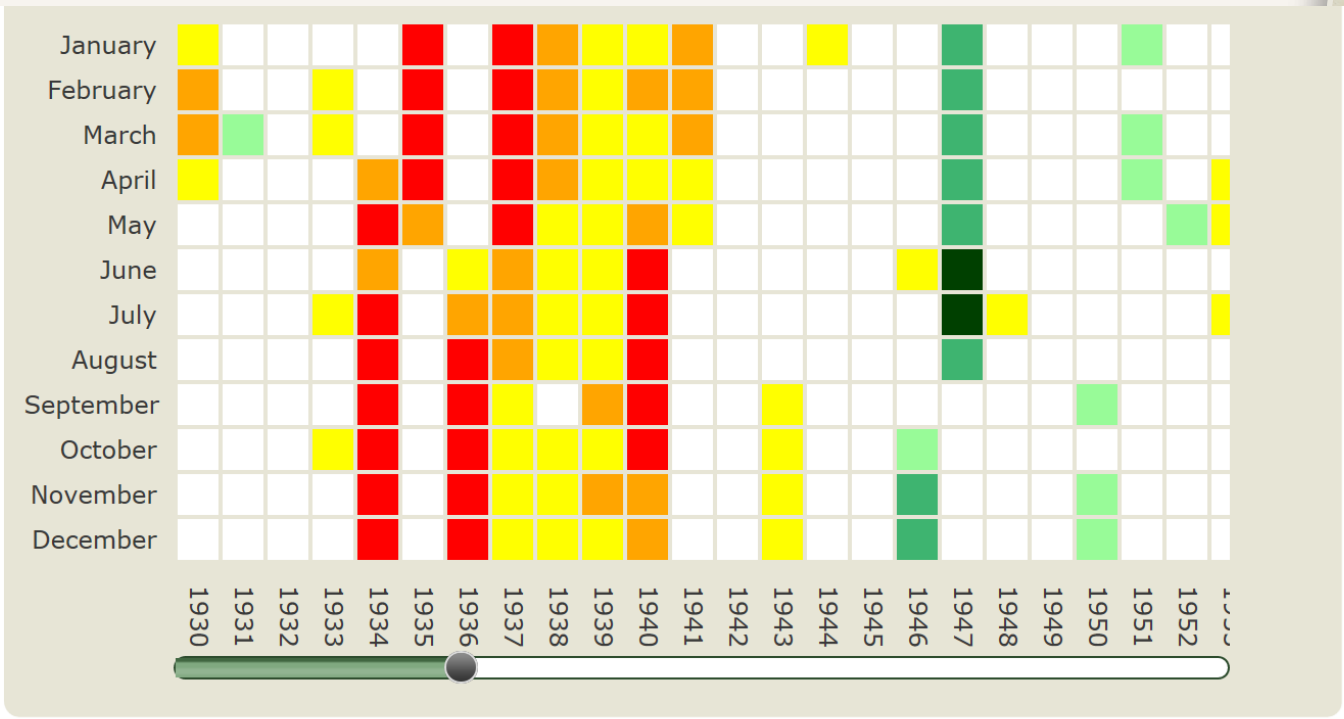
Heat Map Visualization

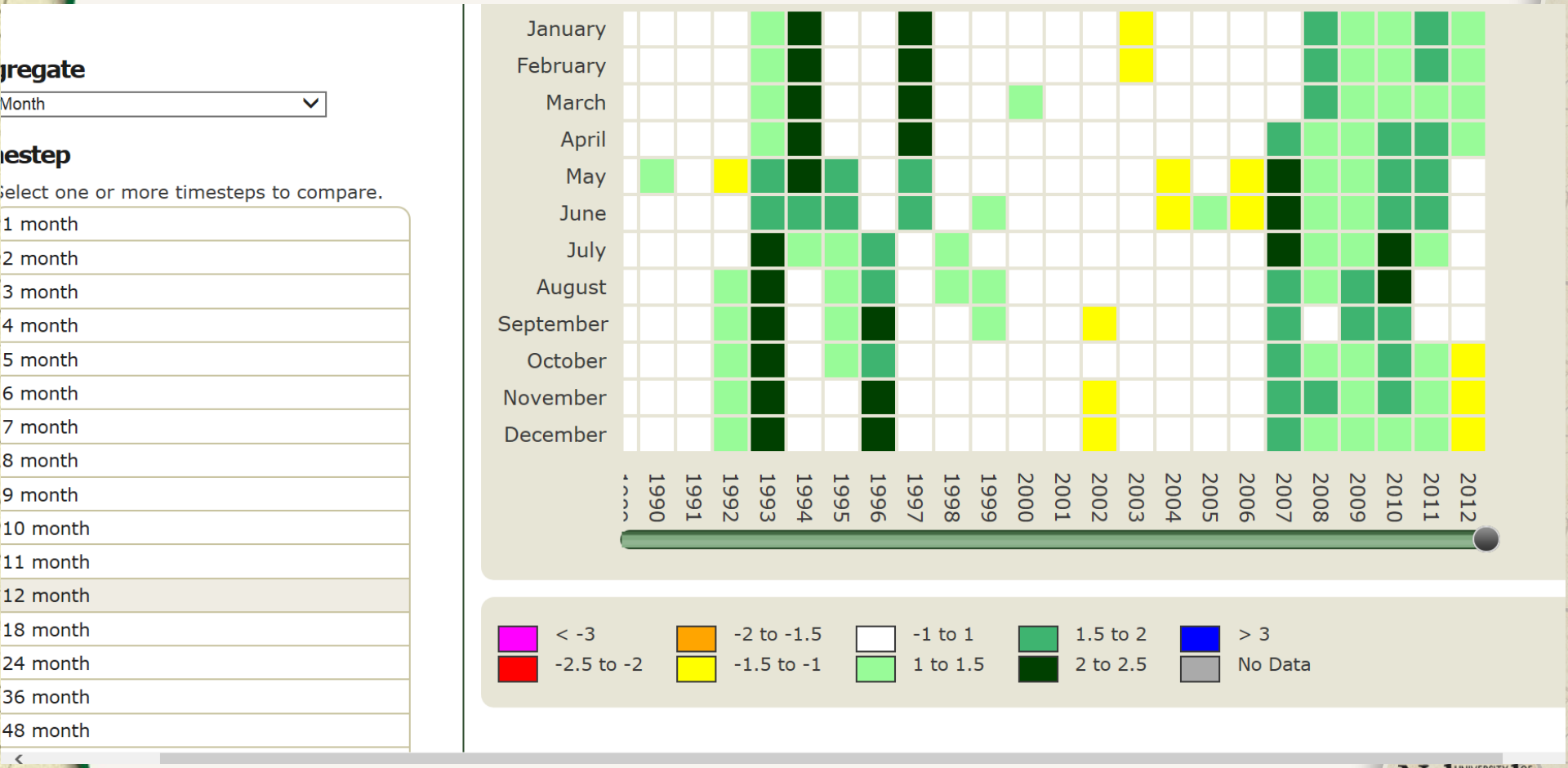




University of Nebraska Lincoln

National Drought Mitigation Center

Heat Map Visualization



University of Nebraska Lincoln

National Drought Mitigation Center

Drought Periods

Home | Map Viewer | Data | Methodology | About | Help

0 Current Location » Data

Climate Data

Selected Atlas Station: **253910 (HOLDREGE)**

Select New Station

Station | Climate | Deciles | SPI | SPEI | PDSI | SC-PDSI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

Date

1/1/1908 to 12/31/2012

Period of Record

Station start date: 1/1/1908

Index

Select an index

- SPI
- SPEI
- PDSI
- Self-calibrated PDSI

Drought Classification

-2

Timestep

12 Month

Results for **HOLDREGE (253910)** at the 12 Month timestep with a minimum drought class of -2 between 1/1/1908 and 12/31/2012.

Number of Droughts: 3

Longest Drought: 358 weeks

Average Duration: 139 weeks

Time in Drought: 7.67%

Show 25 entries Search:

Drought Start	Drought End	Duration (weeks)
6/24/1988	8/12/1988	7
6/10/1956	6/25/1957	54
7/30/1934	6/18/1941	358

Showing 1 to 3 of 3 entries

Frequencies

Home | Map Viewer | Data | Methodology | About | Help

0 Current Location » Data

Climate Data

Selected Atlas Station: **253910 (HOLDREGE)**

Select New Station

Station | Climate | Deciles | SPI | SPEI | PDSI | SC-PDSI | Drought Monitor | Drought Periods | Compare Indices | Frequencies

Index
SPI

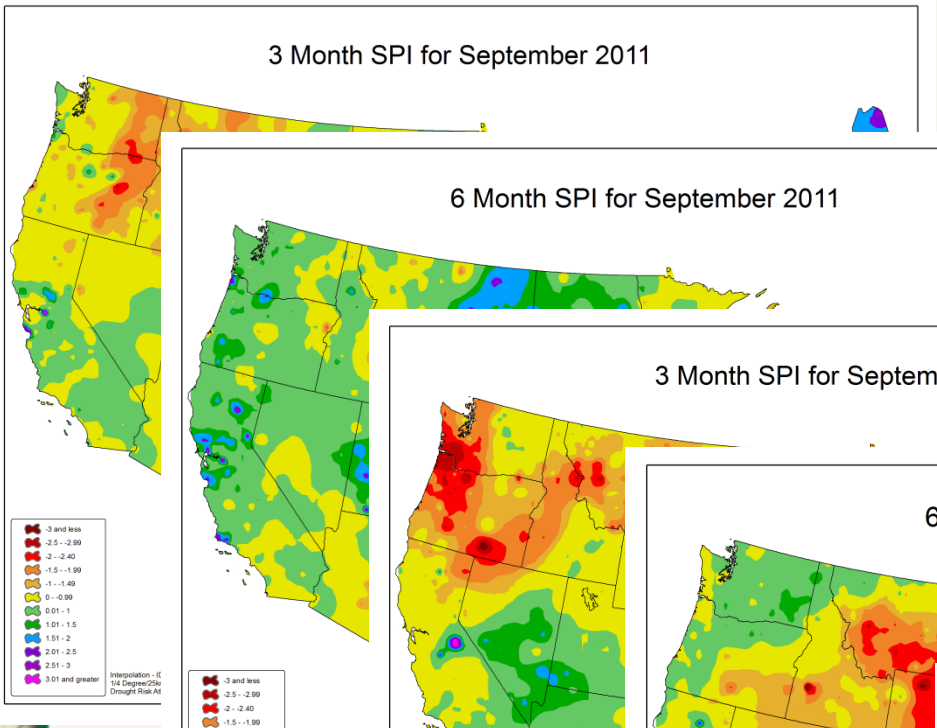
Aggregate
Month

Timestep
12 Month

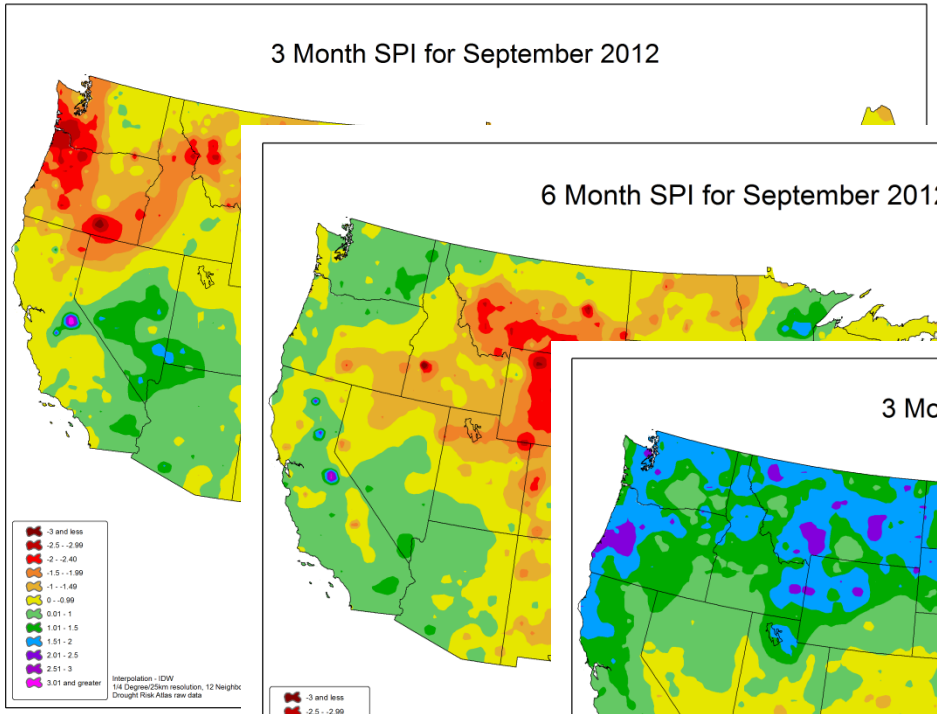
Results for **HOLDREGE (253910)** for the 12 Month timestep and aggregated by month.

Show 25 entries Search:

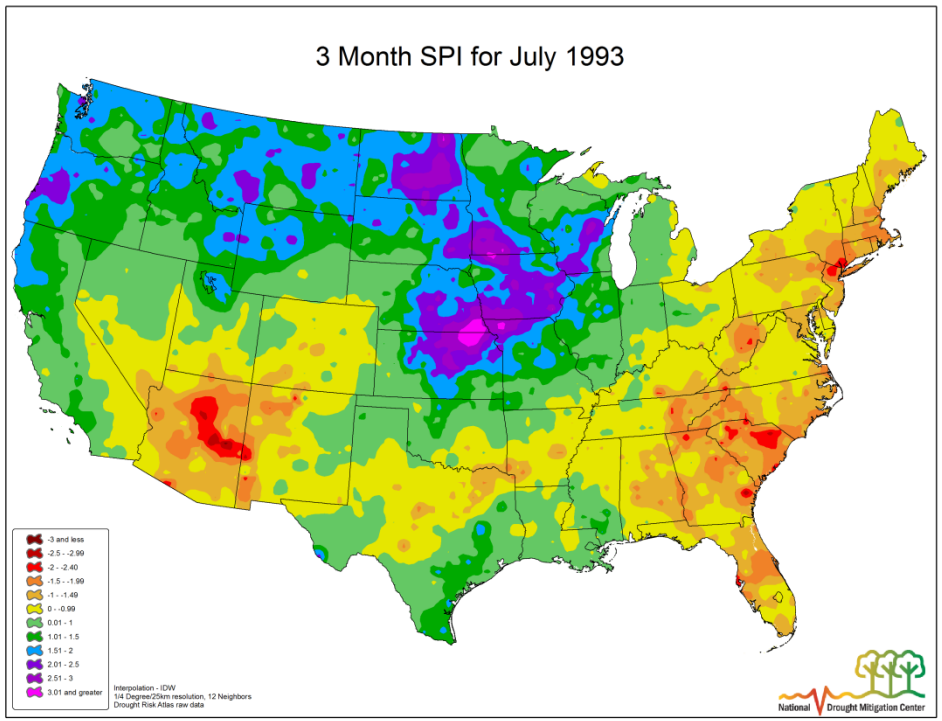
Threshold	Frequency	Return Period (Years)
-2.8	2	52
-2.6	2	52
-2.5	1	104.08
-2.4	2	52
-2.3	4	26
-2.2	7	14.83
-2.1	8	13
-2	5	20.75
-1.9	4	26
-1.8	5	20.75
-1.7	5	20.75
-1.6	8	13
-1.5	16	6.5
-1.4	20	5.17
-1.3	22	4.67


3 Month SPI for September 2011
-3 and less
-2.5 - -2.99
-2 - -2.40
-1.5 - -1.99
-1 - -1.49
0 - -0.99
0.01 - 1
1.01 - 1.5
1.51 - 2
2.01 - 2.5
2.51 - 3
3.01 and greater

6 Month SPI for September 2011
-3 and less
-2.5 - -2.99
-2 - -2.40
-1.5 - -1.99
-1 - -1.49
0 - -0.99
0.01 - 1
1.01 - 1.5
1.51 - 2
2.01 - 2.5
2.51 - 3
3.01 and greater


3 Month SPI for September 2012
-3 and less
-2.5 - -2.99
-2 - -2.40
-1.5 - -1.99
-1 - -1.49
0 - -0.99
0.01 - 1
1.01 - 1.5
1.51 - 2
2.01 - 2.5
2.51 - 3
3.01 and greater

6 Month SPI for September 2012
-3 and less
-2.5 - -2.99
-2 - -2.40
-1.5 - -1.99
-1 - -1.49
0 - -0.99
0.01 - 1
1.01 - 1.5
1.51 - 2
2.01 - 2.5
2.51 - 3
3.01 and greater
Interpolation - IDW
1/4 Degree/25km resolution, 12 Neighbors
Drought Risk Atlas raw data


3 Month SPI for July 1993
-3 and less
-2.5 - -2.99
-2 - -2.40
-1.5 - -1.99
-1 - -1.49
0 - -0.99
0.01 - 1
1.01 - 1.5
1.51 - 2
2.01 - 2.5
2.51 - 3
3.01 and greater
Interpolation - IDW
1/4 Degree/25km resolution, 12 Neighbors
Drought Risk Atlas raw data
National Drought Mitigation Center

Final Thoughts

- Developing ***usable*** information and services is critical (trust factor too)
- ***Tools help bridge*** the gap between monitoring/early warning, prediction and preparedness (***information and triggers*** for decision support)
- Goal is to ***link scientific knowledge w/ the actions*** needed to reduce impacts and future risk via planning

NIDIS

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Great Plains Drought Symposium, Lincoln, NE, April 2-4, 2014

Artwork: Jess Benjamin, Omaha, NE

National Drought Mitigation Center