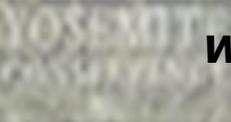


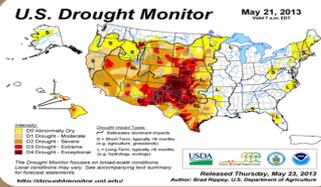
Some Thoughts on Drought Indicators and Triggers

**Mark Svoboda, Climatologist/Monitoring Program Area Leader
National Drought Mitigation Center
Drought Risk Management Research Center
University of Nebraska-Lincoln**

*Western States Drought Coordinators and Emergency Managers Meeting
Seattle, WA, July 21-22, 2015*



NDMC Program Objectives



Improve the science of drought monitoring, planning, and mitigation

Impacts | New Mexico
04-22-2013 - 05-22-2013

Total Impacts	27
Statewide Impacts	8
Category	
● Agriculture	12
● Business & Industry	1
● Fire	10
● Plants & Wildlife	8
● Relief, Response & Restrictions	13
● Society & Public Health	3
● Water Supply & Quality	9

Build awareness of drought & its impacts on society and the environment, and how human actions affect our vulnerability to drought



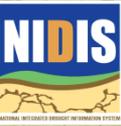
Focus the attention of policy makers on the importance of drought policy and planning in the wise stewardship of natural resources

NEW MEXICO DROUGHT WORKSHOP
Drought Outlook and Management Considerations for Rangeland/ Livestock Production

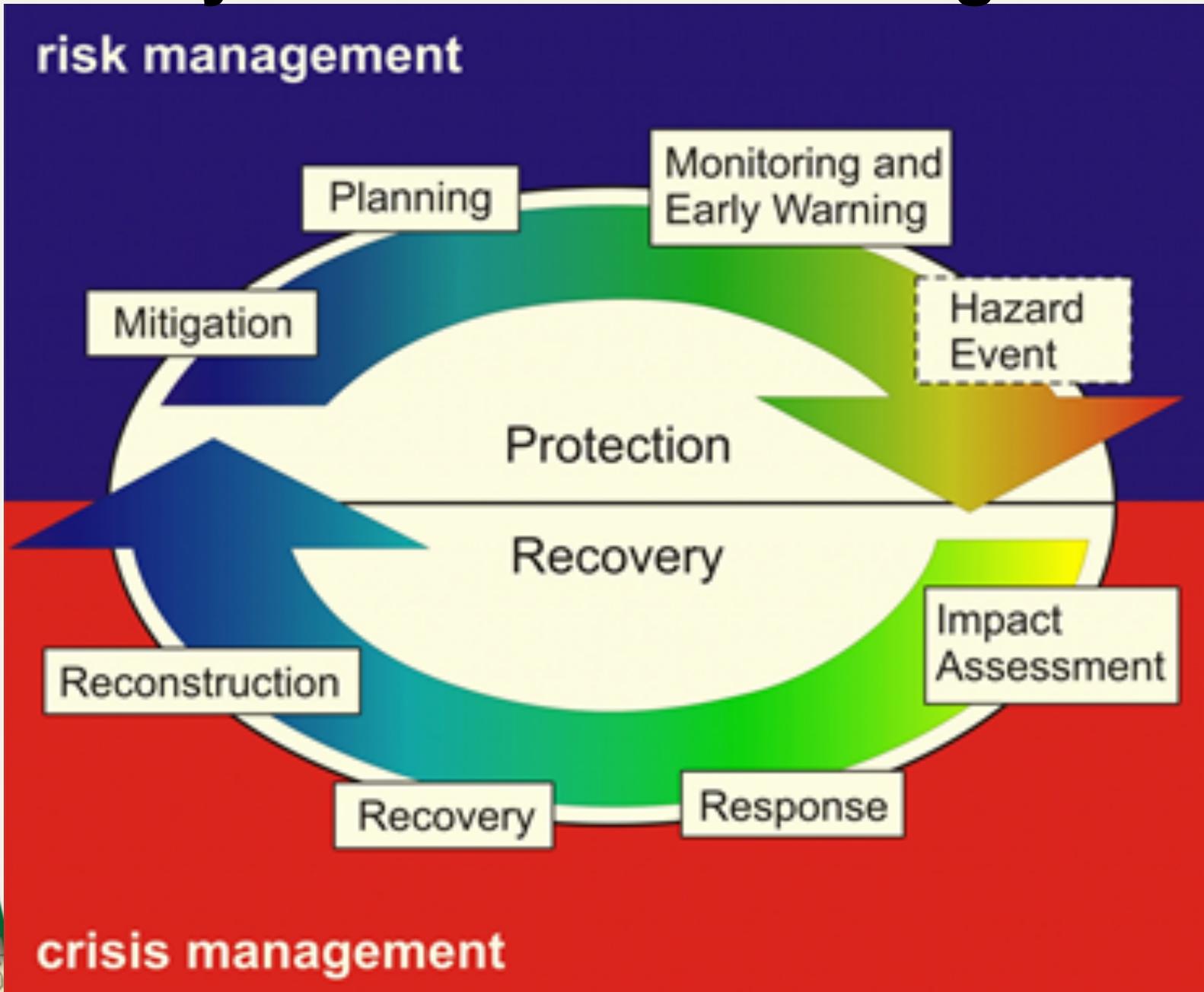
WHEN: May 29, 2013
WHERE: University of Nebraska-Lincoln

Capacity is limited to 300 participants, so please register online at the following location as soon as possible:
<http://rsvp.rmsu.edu/rsvp/drought>

Conduct and maintain operational tools, research, outreach and training



The Cycle of Disaster Management



What is Drought?



Droughts differ in terms of:

- **INTENSITY**
- **Duration**
- **Spatial Extent**

Types of Drought:

- ▶ **Meteorological**
 - ▶ **Agricultural**
 - ▶ **Hydrological**
 - ▶ **Socioeconomic**
-
- ▶ There are ***indicators and indices for all*** of these types of drought
 - ▶ There is ***no one definition*** of drought
 - ▶ Thus, there is typically ***no one-size-fits-all*** drought index or indicator



Monitoring the Drought Hazard: Many Parameters and Indices to Choose from:

Parameters (Indicators) to measure: temperature, precipitation, soil moisture, reservoir/lake levels, streamflow, ground water, snow pack, ET, vegetation health/stress, short and long-term/seasonal forecasts, *impacts!*

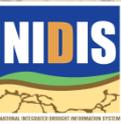
Assessing Drought:

Meteorological/Agricultural Indices

- Percent of normal precipitation
- Standardized Precipitation (Evapotranspiration) Index (SPI/SPEI)
- Palmer Drought Severity Index (PDSI, scPDSI)
- Remotely sensed vegetation stress indices (VCI, VegDRI, ESI, EDDI...)

Hydrologic Drought Indices

- Palmer Hydrological Drought Index (PHDI)
- Surface Water Supply Index (SWSI)

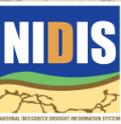


Definitions: Indicators, Indices and Triggers

- ▶ **Indicators:** Variables or parameters used to describe drought conditions.
(NOTE: Indices are Indicators as well)

Examples: precipitation, temperature, streamflow, groundwater, reservoir levels, snowpack, soil moisture, drought indices, etc.

- ▶ **Indices:** Typically a computed numerical representation of a drought's severity/intensity using climatic or hydrologic inputs.



Definitions: Indicators, Indices and Triggers

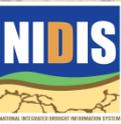
▶ **Triggers:** Specific values of an indicator/indice that initiate and/or terminate each level of a drought plan, and associated management responses.

- **Who is accountable to do what and when?**
- **Ties back to the plan!**

Examples: 6-mo SPI below the 5th percentile for two consecutive months → Level 4 Drought

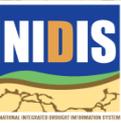
OR...

3-mo SPI above the 30th percentile for three consecutive months → No Drought



Importance of Drought Indices

- ▶ ***Simplify*** complex relationships and provide a good communication tool for diverse audiences/users
- ▶ ***Quantitative*** assessment of anomalous climatic conditions
 - Intensity
 - Duration
 - Spatial extent
- ▶ ***Historical*** reference (probability of recurrence)
 - Planning and design applications



Considerations for Choosing Indicators / Triggers

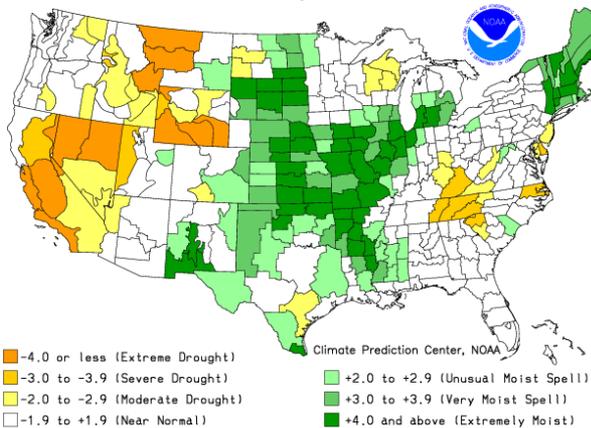
- ▶ Proper and Timely Detection of Drought
- ▶ Spatial and Temporal Sensitivity
- ▶ Supplies and Demands
- ▶ ***Drought In / Drought Out***
- ▶ Composite and/or Multiple Indicators
- ▶ Data availability/stability, period of record, and validity
- ▶ Ease of Implementation
- ▶ ***Validation....do they match the impacts/reality of the situation on the ground?***



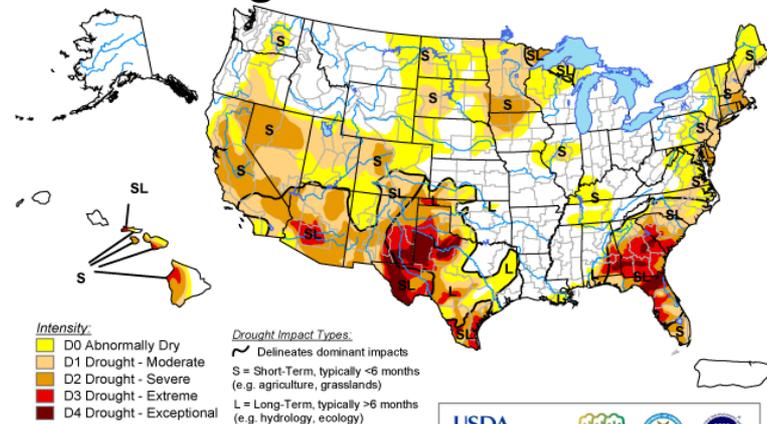
Approaches to Drought Assessment

- **Single index or indicator (parameter)**
- **Multiple indices or indicators**
 - Assessed stand-alone
- **Composite (or "hybrid") Indicator**
 - **Blended approach**

Drought Severity Index by Division
Weekly Value for Period Ending OCT 18, 2008
Long Term Palmer



U.S. Drought Monitor April 10, 2012
Valid 7 a.m. EDT

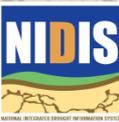


The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

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



Released Thursday, April 12, 2012
Author: David Miskus, NOAA/NWS/NCEP/CPC



UNIVERSITY OF
Nebraska
Lincoln



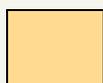
National Drought Mitigation Center

Percentiles and the U.S. Drought Monitor

➤ Advantages of percentiles:

- Can be applied to any parameter
- Can be used for any length of data record
- Puts drought in historical perspective

➤ USDM Drought Intensity Categories:

- D4, Exceptional Drought: (2)  once per 50+ years
- D3, Extreme Drought: (5)  once per 20 to 50 years
- D2, Severe Drought: (10)  once per 10 to 20 years
- D1, Moderate Drought: (20)  once per 5 to 10 years
- D0, Abnormally Dry: (30)  once per 3 to 5 years

U.S. Drought Monitor Approach



▶ “Convergence of Evidence”

- Many types of drought “information” can be collectively analyzed to **determine if the majority of information is ‘converging’ (telling the same story)** about the accuracy, or inaccuracy, of the drought as depicted by the USDM
- Need to **look at 100% of the data, BUT don’t believe in any one piece of data input 100%** in making a decision...
- *Multiple indicators and types of information* that describe different environmental parameters are needed to get a complete picture of a drought indicators performance
- *Impacts are the “ground truth”*, yet aren’t monitored....you can’t measure what you don’t monitor!

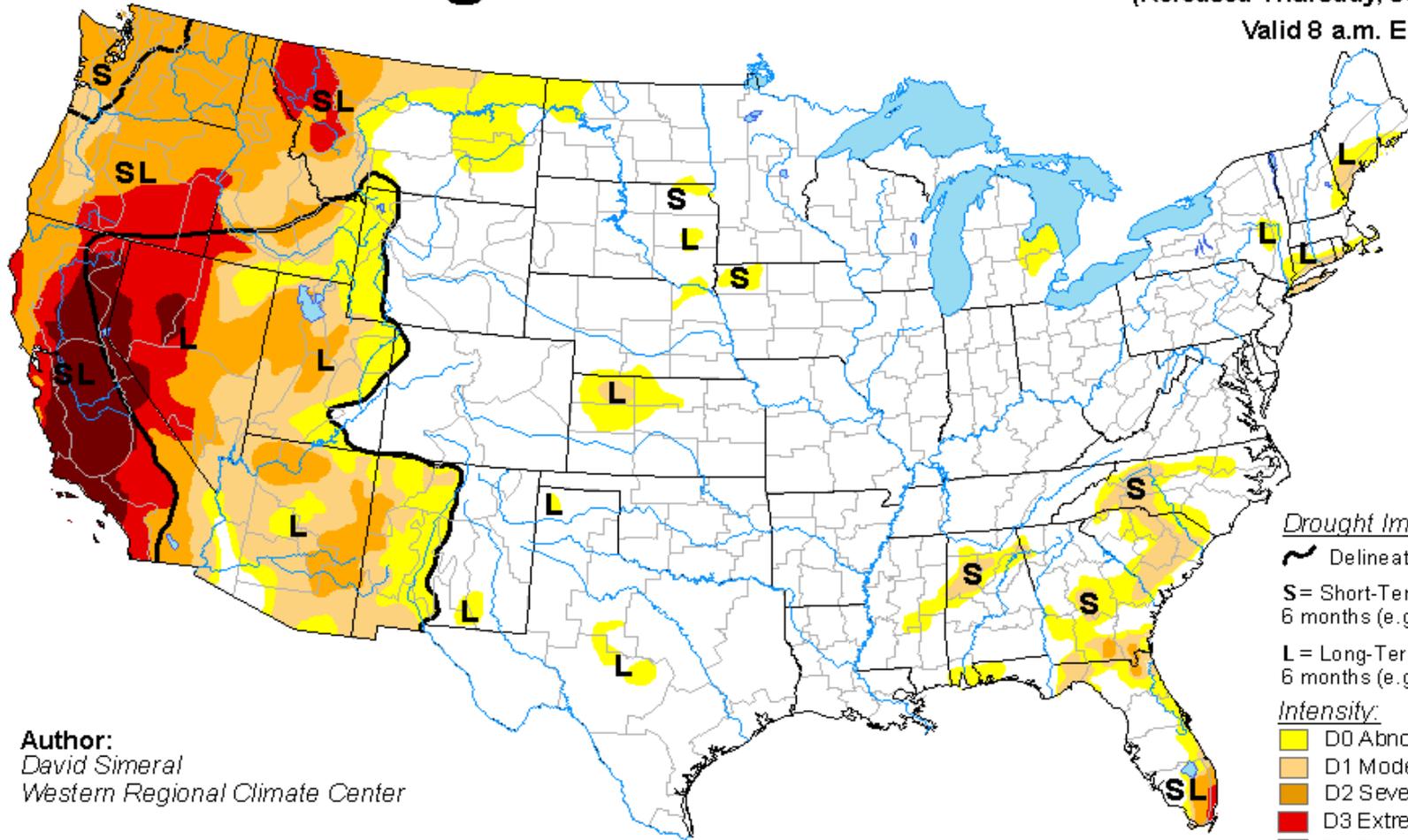


U.S. Drought Monitor

July 14, 2015

(Released Thursday, Jul. 16, 2015)

Valid 8 a.m. EDT



Author:
David Simeral
Western Regional Climate Center

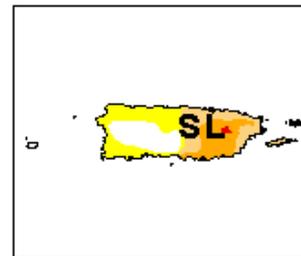
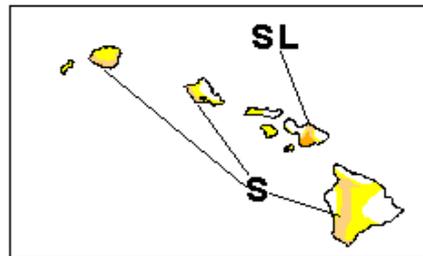
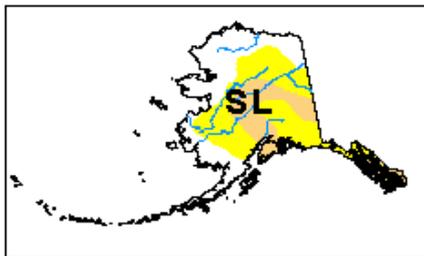
Drought Impact Types:

- ~ 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:

- 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/>

U.S. Drought Monitor West

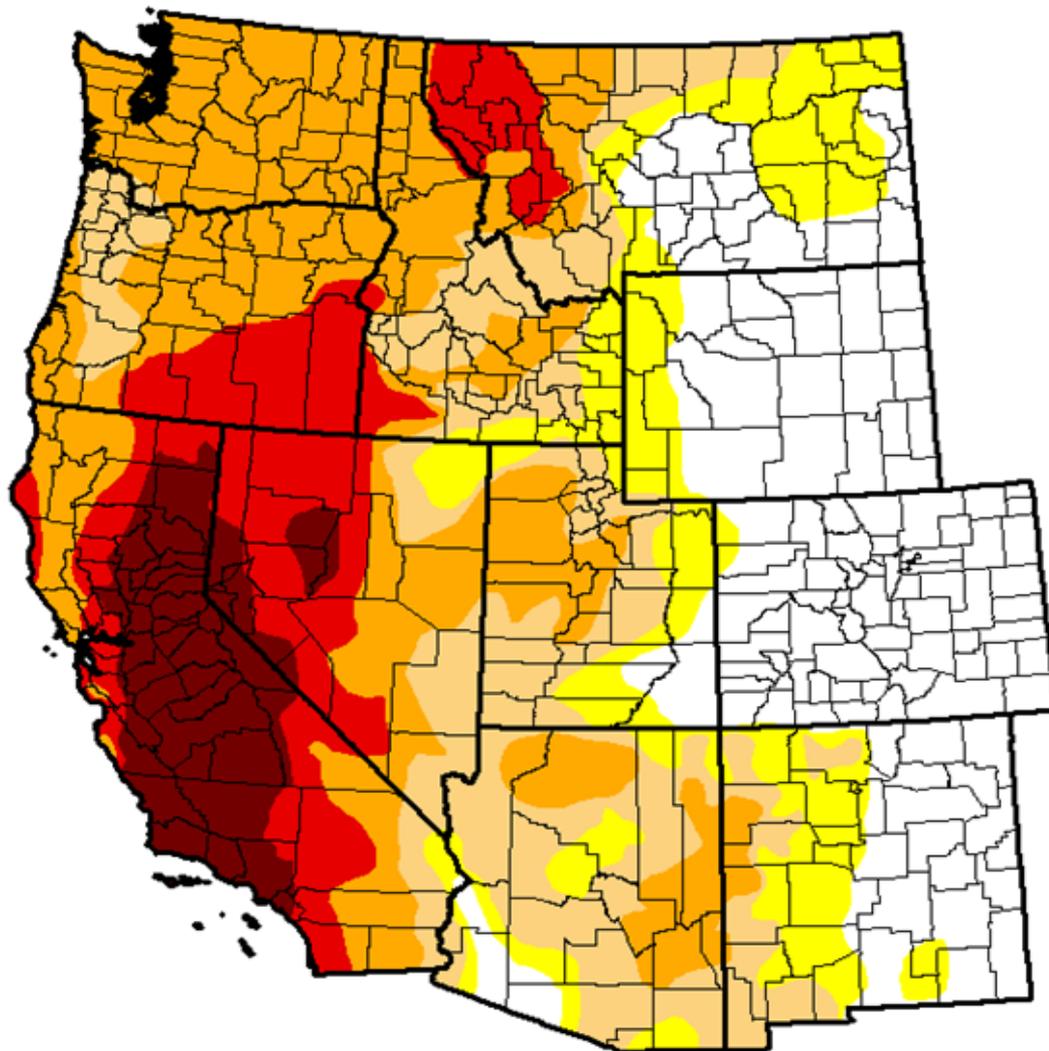
July 14, 2015

(Released Thursday, Jul. 16, 2015)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	25.49	74.51	61.37	43.76	18.87	7.17
Last Week <i>7/7/2015</i>	22.40	77.60	61.14	43.04	18.87	7.26
3 Months Ago <i>4/14/2015</i>	26.55	73.45	61.00	37.91	17.04	7.63
Start of Calendar Year <i>12/30/2014</i>	34.76	65.24	54.48	33.50	18.68	5.40
Start of Water Year <i>9/30/2014</i>	31.48	68.52	55.57	35.65	19.95	8.90
One Year Ago <i>7/15/2014</i>	31.51	68.49	60.35	46.65	23.56	6.02



Intensity:



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

Author:

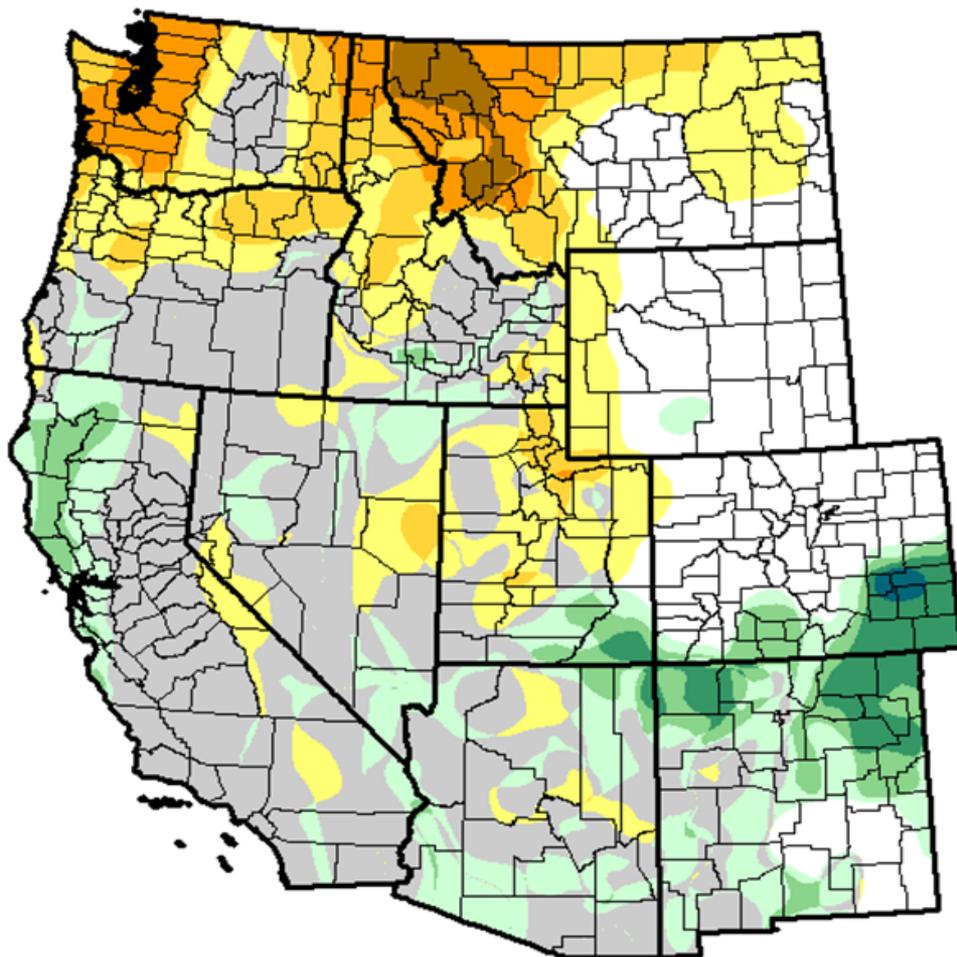
David Simeral

Western Regional Climate Center

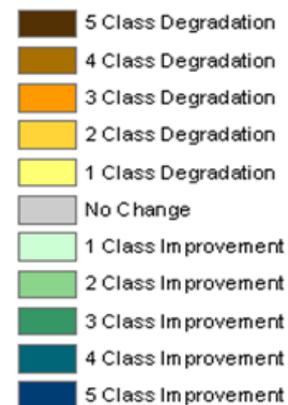


<http://droughtmonitor.unl.edu/>

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



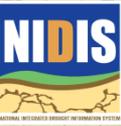
July 14, 2015
compared to
September 30, 2014



The Importance of Drought Early Warning and Information Systems (DEWIS)

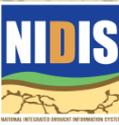


- ▶ Allows for **early** drought detection
- ▶ Improves response (**proactive**)
- ▶ Data and tools for **decision support**
- ▶ **"Triggers"** actions within a drought plan
- ▶ A critical **mitigation** action
- ▶ **Foundation** of a drought plan



Components of a Drought Early Warning and Information System (DEWIS)

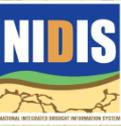
- 
- ▶ Monitoring **AND** Forecasting
 - ▶ Access to **timely** data (including **impacts**) and “value added” **information**
 - ▶ **Synthesis/analysis** of data used to “trigger” set actions within a drought plan
 - ▶ **Tools** for decision makers
 - ▶ Efficient **dissemination/communication** (WWW,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



Drought Plan Components

- ▶ **Monitoring and early warning**
 - Integrate and distill information
 - Assess, communicate, and **trigger** action
 - **Foundation** of a drought mitigation plan
- ▶ **Vulnerability assessment**
 - Who and what is at **risk** and why?
- ▶ **Mitigation and response actions**
 - Actions/programs that **reduce risk and impacts** and enhance recovery

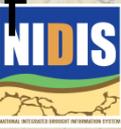
Most processes and plans in the past have primarily focused on monitoring and response...



Lessons Learned

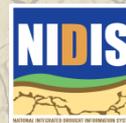


- ▶ Monitoring is the **foundation** of risk management planning
 - **Trigger to who does what and when!**
 - **One can not manage what is not monitored!**
- ▶ **Impact collection must be an integral part** of any drought early warning information system
- ▶ Tool development should be an **iterative process** in partnership with the users
- ▶ **Dissemination** is needed through a variety of media and educational materials in order to reach a variety of audiences



Critical Observations:

- 1) ***No single*** indicator/index is used solely in determining appropriate actions
- 2) Instead, ***different*** thresholds from ***different*** combinations of inputs is the best way to approach monitoring and triggers using a variety of indices and indicators
- 3) Decision making (or ***“triggers”***) based on ***quantitative values*** are supported favorably and are better understood



Final Thoughts

- ▶ Seeing a ***shift toward more development of remotely sensed, modeled, gridded and/or combined/composite indices (e.g. NLDAS, MDSI, VegDRI, ESI, SMAP...)*** being integrated into USDM + DEWIS/ GDEWIS...
- ▶ ***Decision Support*** Tools/Applications/ Services help bridge the gap between monitoring/early warning, prediction and preparedness ("***triggers***" for decision support)



Thank You!

CONTACT INFO:

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msovoda2@unl.edu