Drought ??

Jim Broderick

Monday, January 24, 2005

Questions?

- Does your community have a drought plan?
- When was it developed? Is it current?
- What indicators/indices are used to monitor water supply/drought conditions?
- Do you have voluntary and mandatory water restrictions?
- What triggers are used to initiate these restrictions?

Questions?

- When did the current drought begin?
- How does it compare to historical droughts?
- Did you experience water supply shortages in 2002, 2001, or 2000?
- What steps has your community taken to improve drought management in 2003?

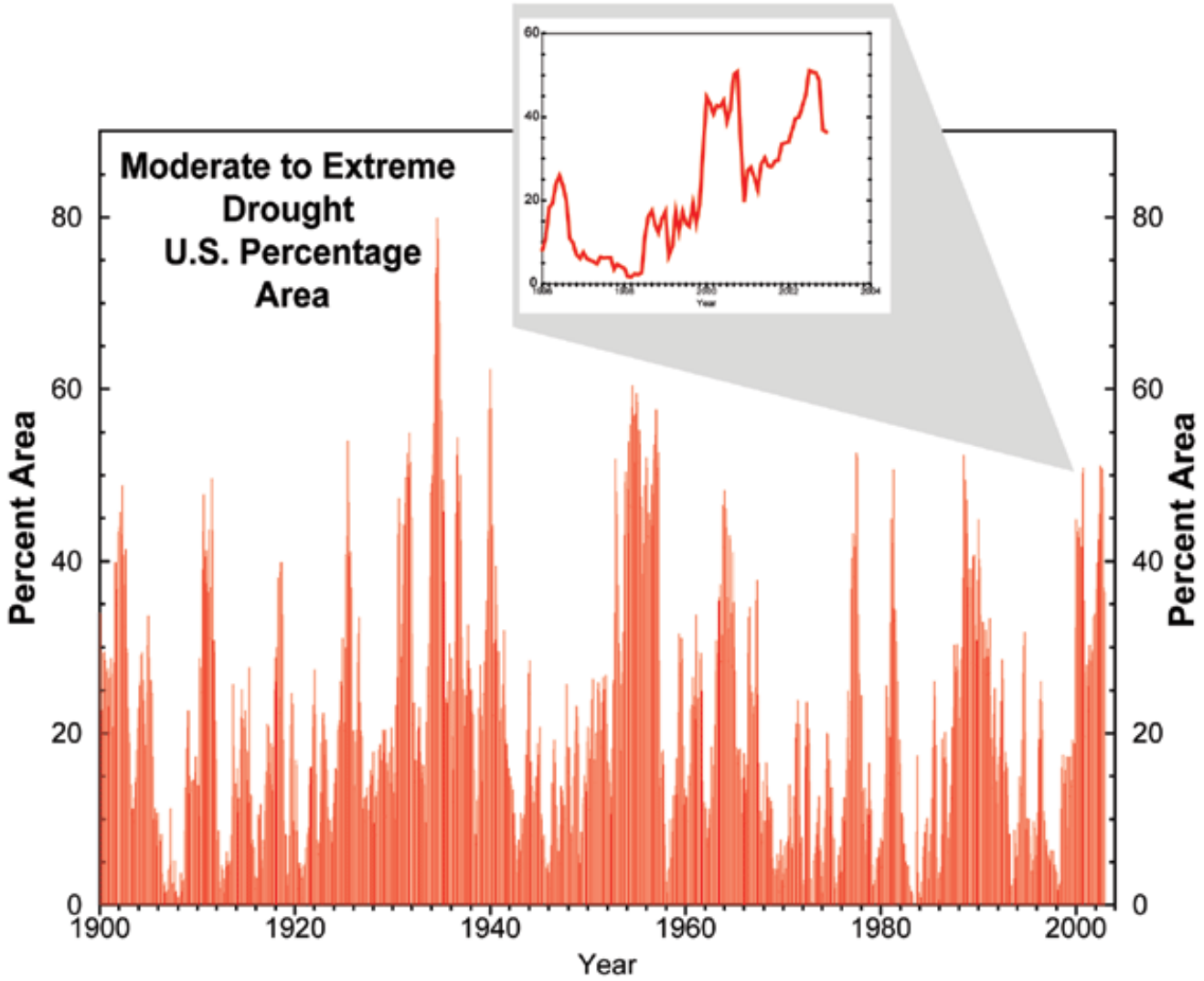
Drought : **a deficiency of precipitation from expected or "normal" that, when extended over a season or longer period of time, is insufficient to meet the demands of human activities and the environment.**

Drought is:

- *a temporary aberration*
- *a relative condition*
- *aggravated by temperature, high winds, and low RH*

Droughts differ in terms of:

- INTENSITY
- Duration
- Spatial Extent



Percent of contiguous US affected by moderate to extreme drought during each month of the year from January 1900 through November 2002 (the period of instrumental record). The greatest expanse of drought occurred in July 1934 when moderate to extreme drought affected 80% of the US. During the summer of 2002, moderate to extreme drought affected slightly more than 50% of the contiguous US.

NOAA National Climatic Data Center

Types of Drought

- Meteorological
  - Precipitation
- Agricultural
  - Soil moisture
- Hydrological
  - Surface/subsurface water supplies

Components of Drought Risk Management

Risk = Hazard x Vulnerability

(natural event) (social factors)

Components of Drought Plans

- Monitoring, early warning and prediction
  - Foundation of a drought mitigation plan
  - Indices linked to impacts and triggers
- Risk and impact assessment
  - Who and what is at risk and why
- Mitigation and response
  - Actions/programs that reduce risk and impacts and enhance recovery

The Importance of Drought Monitoring Systems

- Allows for early drought detection
- Allows for proactive (mitigation) and reactive (emergency) responses
- “Triggers” actions within a drought plan
- *Bottom line*—provides information for decision support

Key Indicators for Monitoring Drought

- ✓ Climate data (precip, temp)
- ✓ Stream flow
- ✓ Ground water
- ✓ Reservoir and lake levels
- ✓ Soil moisture
- ✓ Snow pack
- ✓ Short, medium, and long range forecasts
- ✓ Vegetation health/stress and fire danger

Drought Assessment Tools

- Percent of Normal
- Deciles
- Palmer Drought Severity Index (PDSI)
- Crop Moisture Index (CMI)
- Surface Water Supply Index (SWSI)
- Standardized Precipitation Index (SPI)
- U.S. Drought Monitor

Importance of Drought Indices

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

Approaches to Drought Assessment

- Single index or indicator
- Multiple indices or indicators
- Composite index

Triggers

Triggers: thresholds determining specific, timely actions by decision makers. Link impacts to index or indicator values.

- Appropriate
- Consistent with impacts
- Adaptable

What is the PDSI?

- A commonly used indicator of the status of the environmental demand for precipitation with respect to what has actually been received (supply).
- Includes
  - Average temperature
  - Total precipitation
  - Parameterization of soil type and water holding capacity of the top layers of the soil.

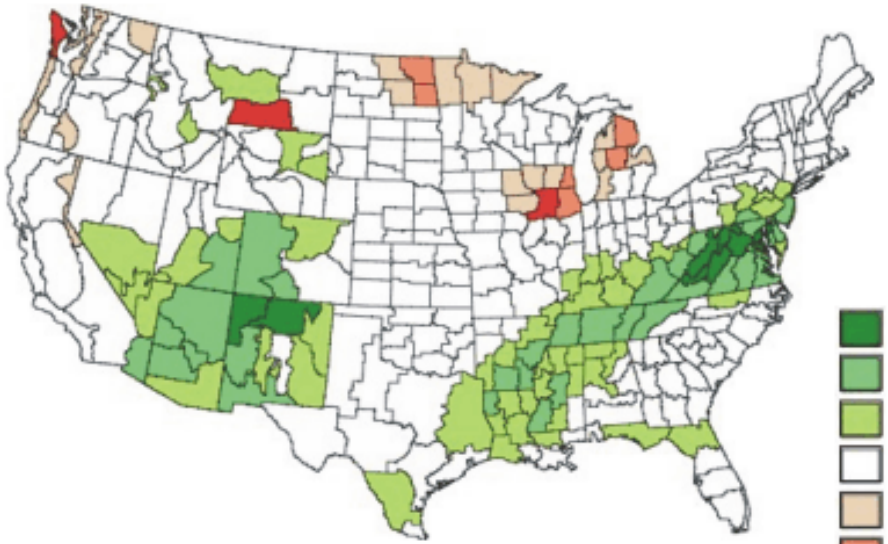
Surface Water Supply Index (SWSI)

- River basin, watershed approach
- Hydro/climate index for mountainous regions relying on snowpack
- Indicators: precipitation, reservoir levels, snowpack, and streamflow
- Computed seasonally
- Data normalized, probability of non-exceedance computed for each component
- Index unique for each basin, limits comparison

Characteristics of the SPI

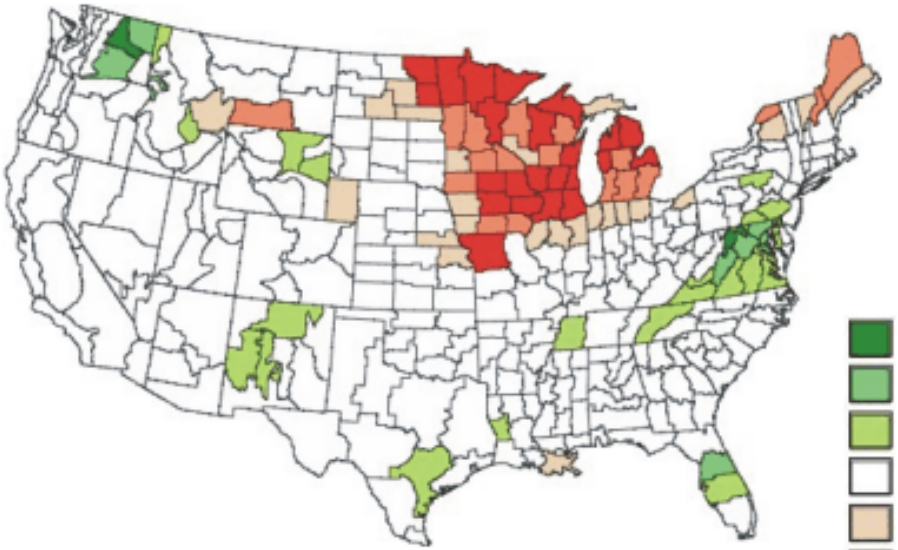
- Developed by McKee et al. in 1993
- Simple index—precipitation is the only parameter (probability of observed precipitation transformed into an index)
- Being used in research or operational mode in over 40 countries
- Multiple time scales allow for temporal flexibility in evaluation of precipitation conditions and water supply

1-month SPI through the end of February 2003



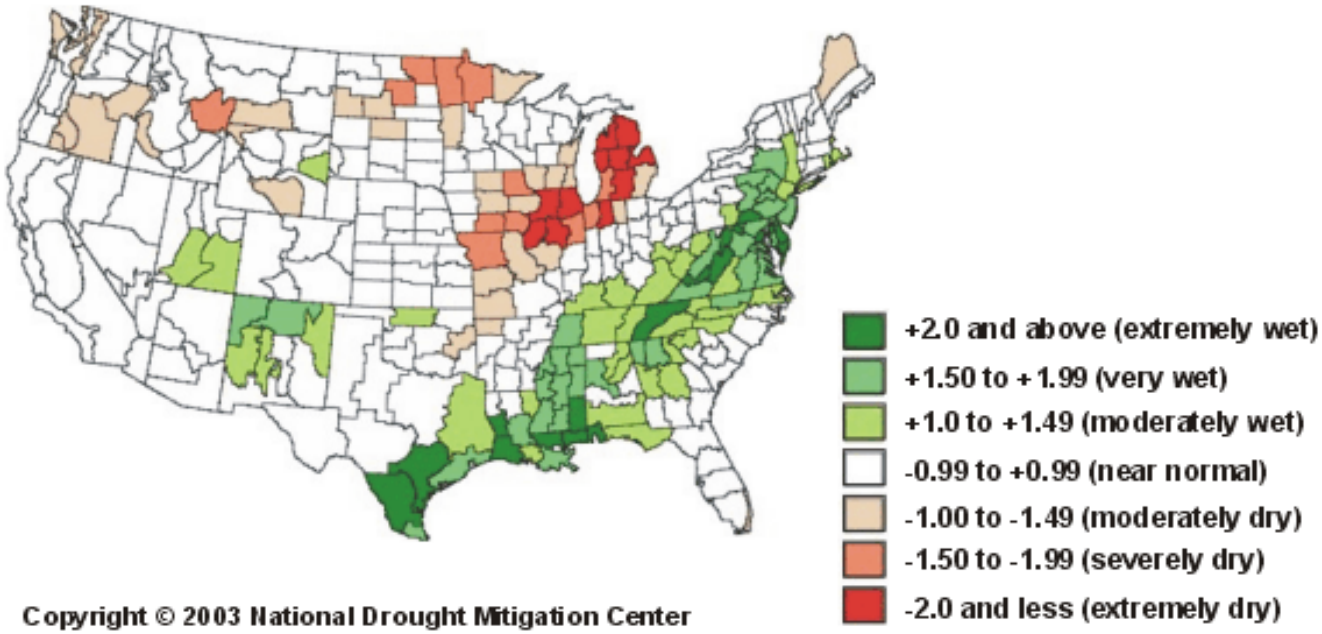
- +2.0 and above (extremely wet)
- +1.50 to +1.99 (very wet)
- +1.0 to +1.49 (moderately wet)
- -0.99 to +0.99 (near normal)
- -1.00 to -1.49 (moderately dry)
- -1.50 to -1.99 (severely dry)
- -2.0 and less (extremely dry)

3-month SPI through the end of February 2003

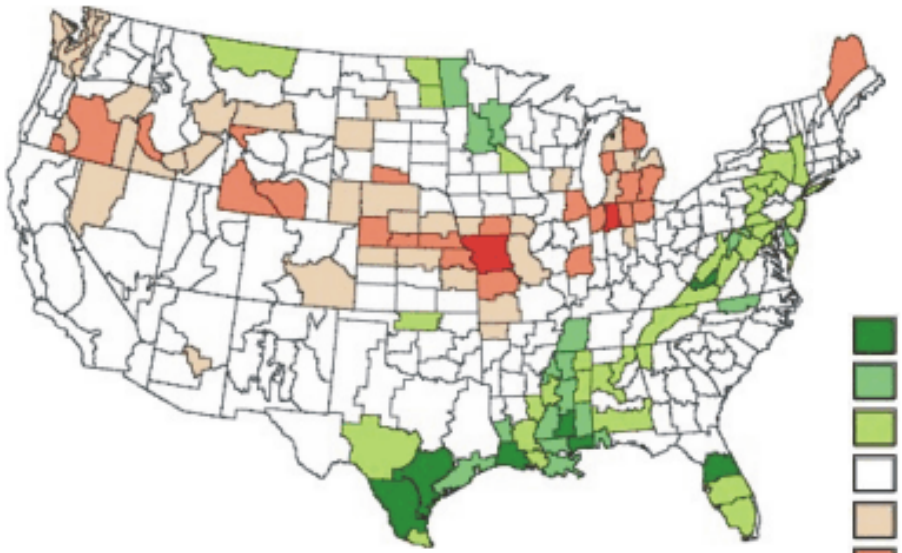


+2.0 and above (extremely wet)
+1.50 to +1.99 (very wet)
+1.0 to +1.49 (moderately wet)
-0.99 to +0.99 (near normal)
-1.00 to -1.49 (moderately dry)
-1.50 to -1.99 (severely dry)
-2.0 and less (extremely dry)

6-month SPI through the end of February 2003



9-month SPI through the end of February 2003



+2.0 and above (extremely wet)
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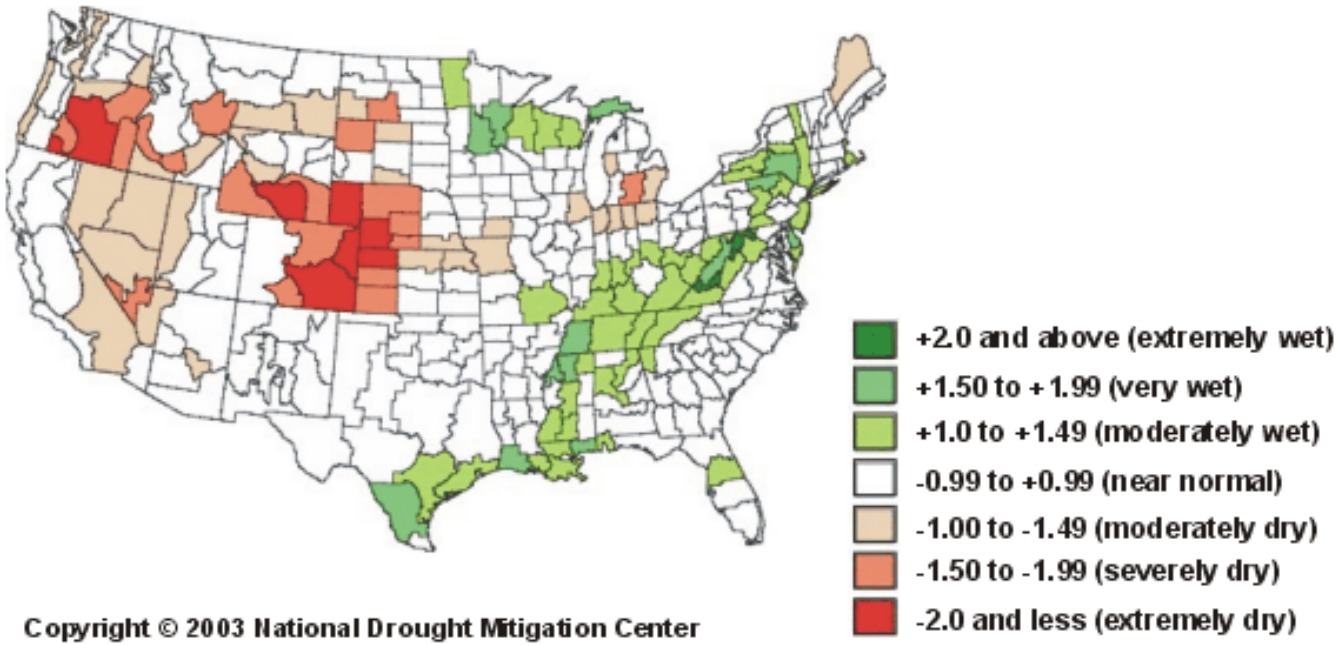
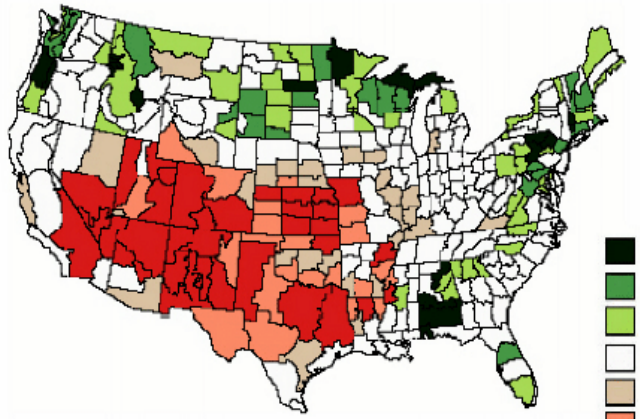
-1.50 to -1.99 (severely dry)
-2.0 and less (extremely dry)

12-month SPI through the end of February 2003



6-month SPI through the end of March 1996



+2.0 and above (extremely wet)
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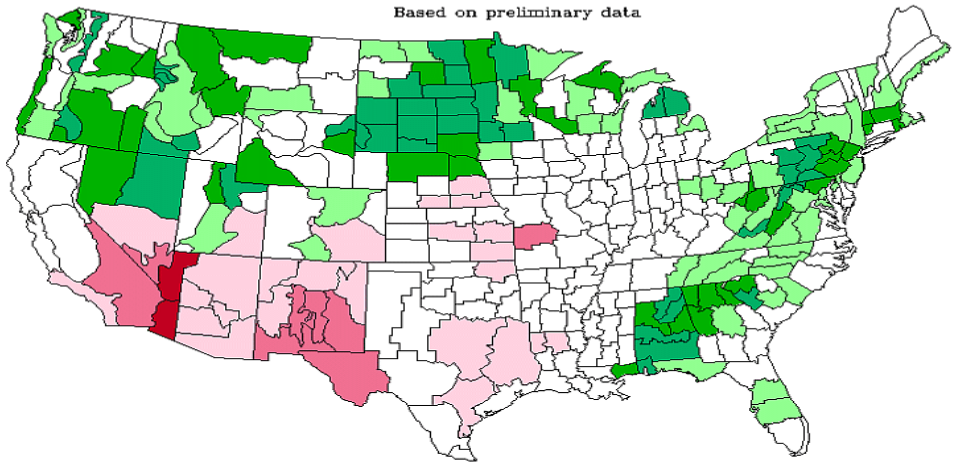
+1.0 to +1.49 (moderately wet)
-0.99 to +0.99 (near normal)
-1.00 to -1.49 (moderately dry)
-1.50 to -1.99 (severely dry)
-2.0 and less (extremely dry)

DROUGHT SEVERITY INDEX BY DIVISION
(LONG TERM PALMER)

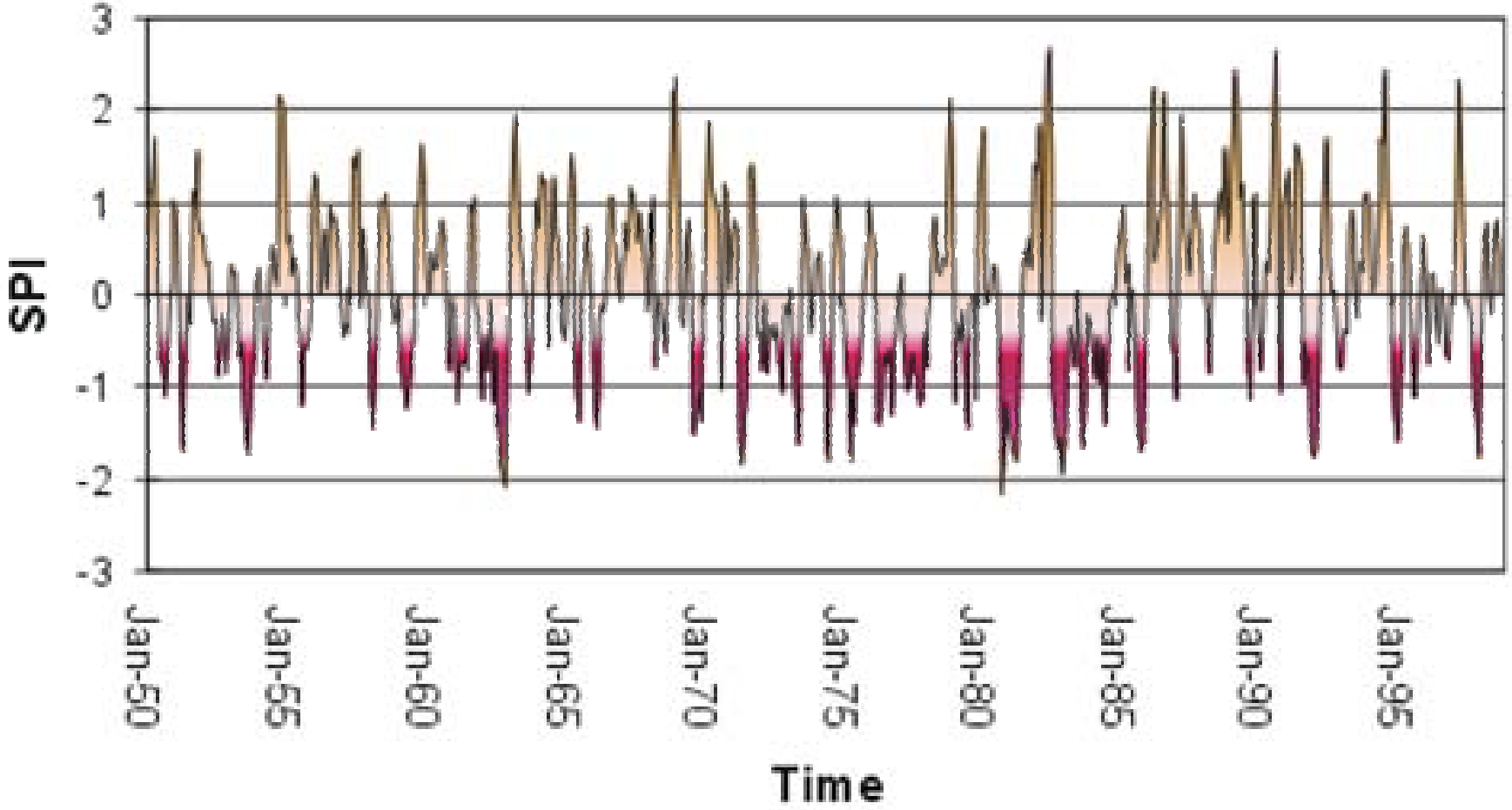
MAR 30, 1996
Based on preliminary data



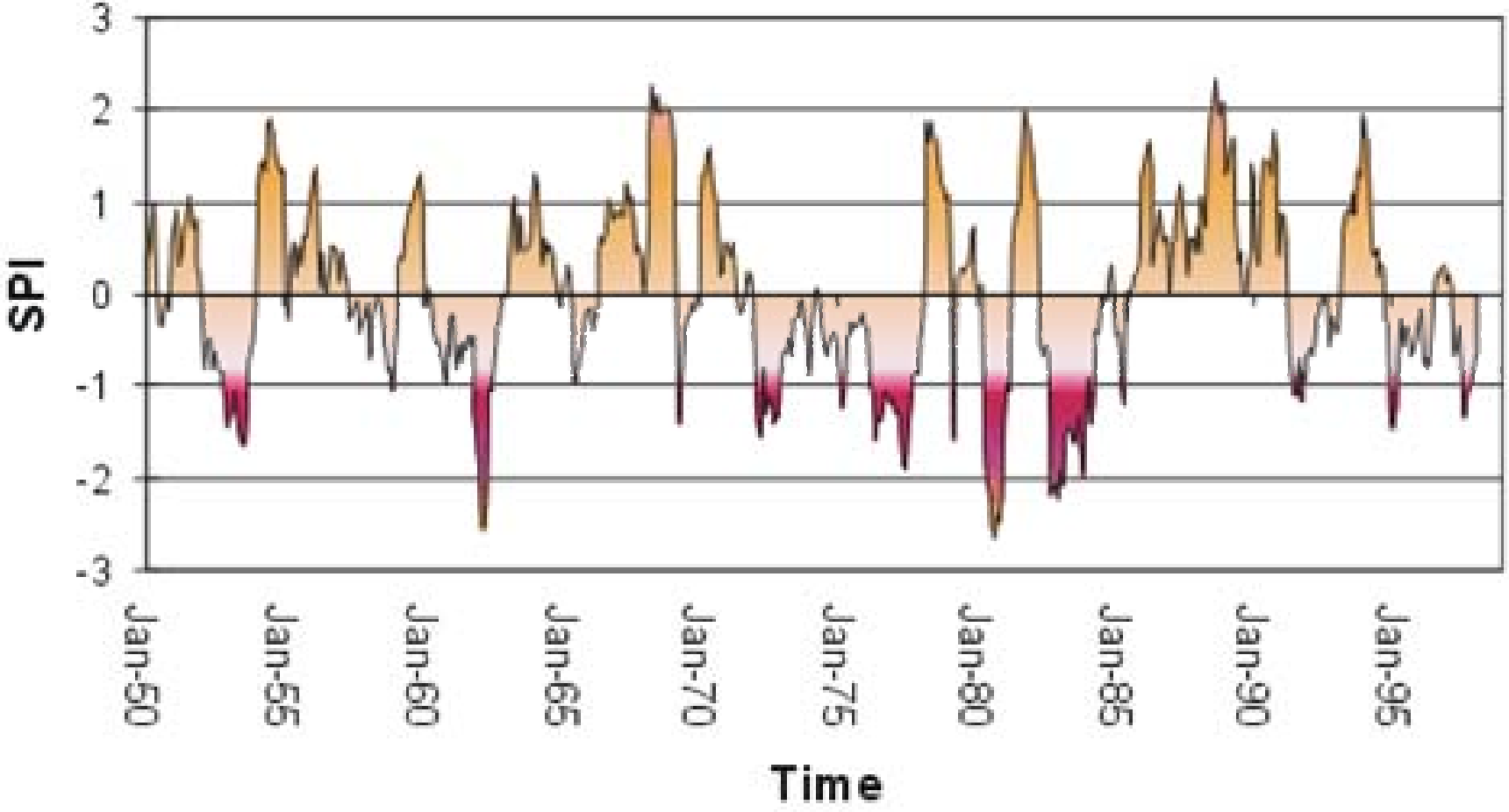
−4.0 or less (extreme drought)
−3.0 to −3.9 (severe drought)
−2.0 to −2.9 (moderate drought)
−1.9 to +1.9 (near normal)
+2.0 to +2.9 (unusual moist spell)
+3.0 to +3.9 (very moist spell)
+4.0 and above (extremely moist)

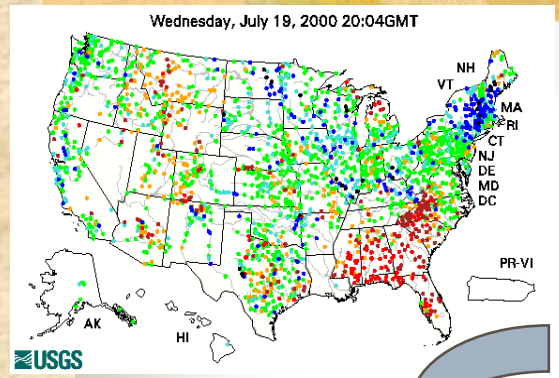
CLIMATE PREDICTION CENTER, NOAA

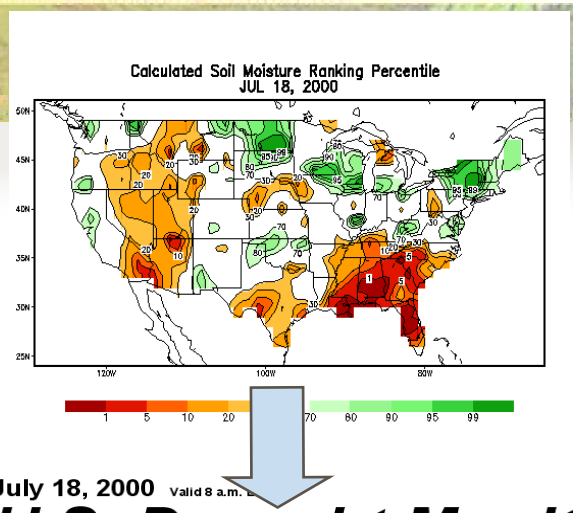
Hilo 3-Month SPI (1950-1998)

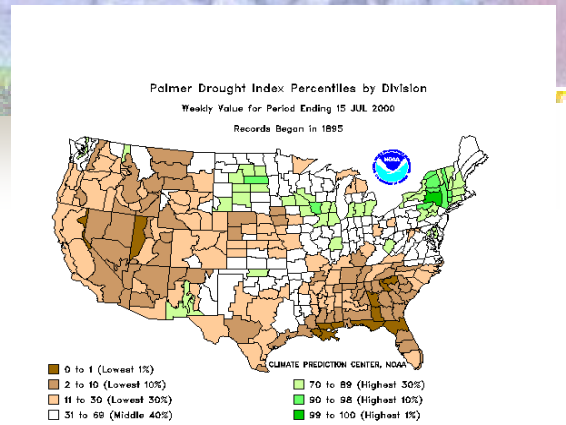


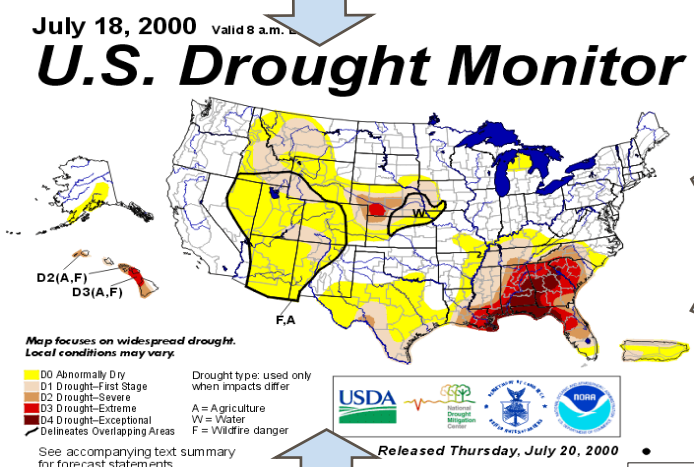
Hilo 12-Month SPI (1950-1998)

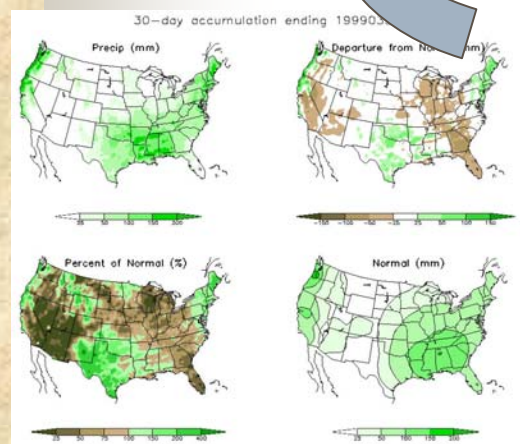


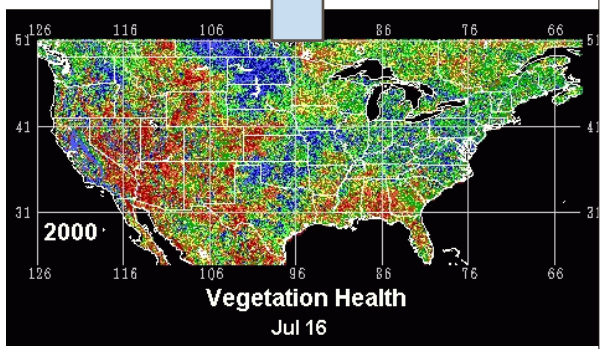

Wednesday, July 19, 2000 20:04GMT
NH
VT
MA
RI
CT
NJ
DE
MD
DC
PR-VI
AK
HI
USGS

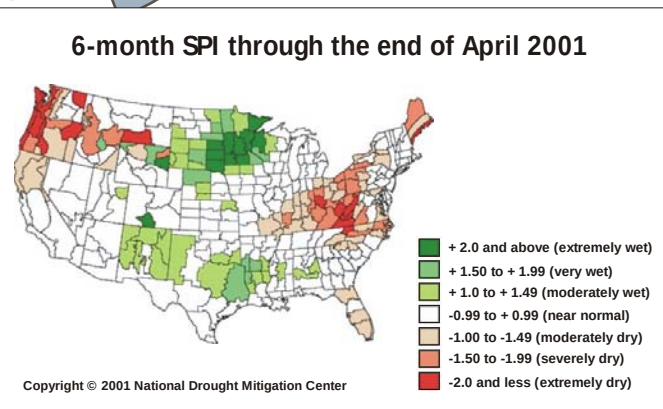

Calculated Soil Moisture Ranking Percentile
JUL 18, 2000
1
5
10
20
70
80
90
95
99


Palmer Drought Index Percentiles by Division
Weekly Value for Period Ending 15 JUL 2000
Records Began in 1895
CLIMATE PREDICTION CENTER, NOAA
0 to 1 (Lowest 1%)
2 to 10 (Lowest 10%)
11 to 30 (Lowest 30%)
31 to 69 (Middle 40%)
70 to 89 (Highest 30%)
90 to 98 (Highest 10%)
99 to 100 (Highest 1%)


July 18, 2000
U.S. Drought Monitor
D2(A,F)
D3(A,F)
W
F,A
Map focuses on widespread drought.
Local conditions may vary.
D0 Abnormally Dry
D1 Drought–First Stage
D2 Drought–Severe
D3 Drought–Extreme
D4 Drought–Exceptional
Delineates Overlapping Areas
Drought type: used only when impacts differ
A = Agriculture
W = Water
F = Wildfire danger
See accompanying text summary for forecast statements
USDA
Released Thursday, July 20, 2000


30-day accumulation ending 19990
Precip (mm)
Departure from Normal (mm)
Percent of Normal (%)
Normal (mm)


2000
Vegetation Health
Jul 16


6-month SPI through the end of April 2001
+ 2.0 and above (extremely wet)
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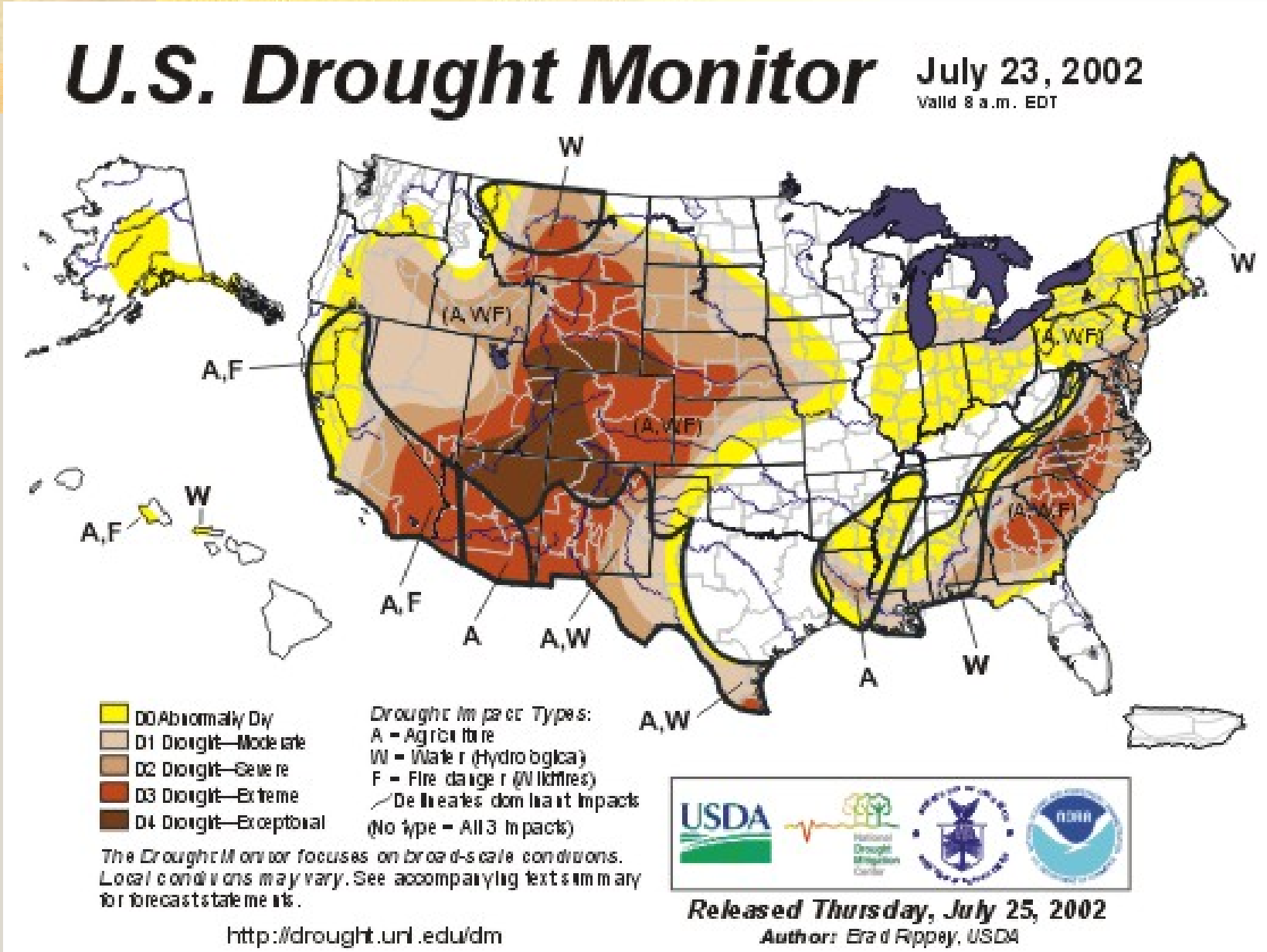
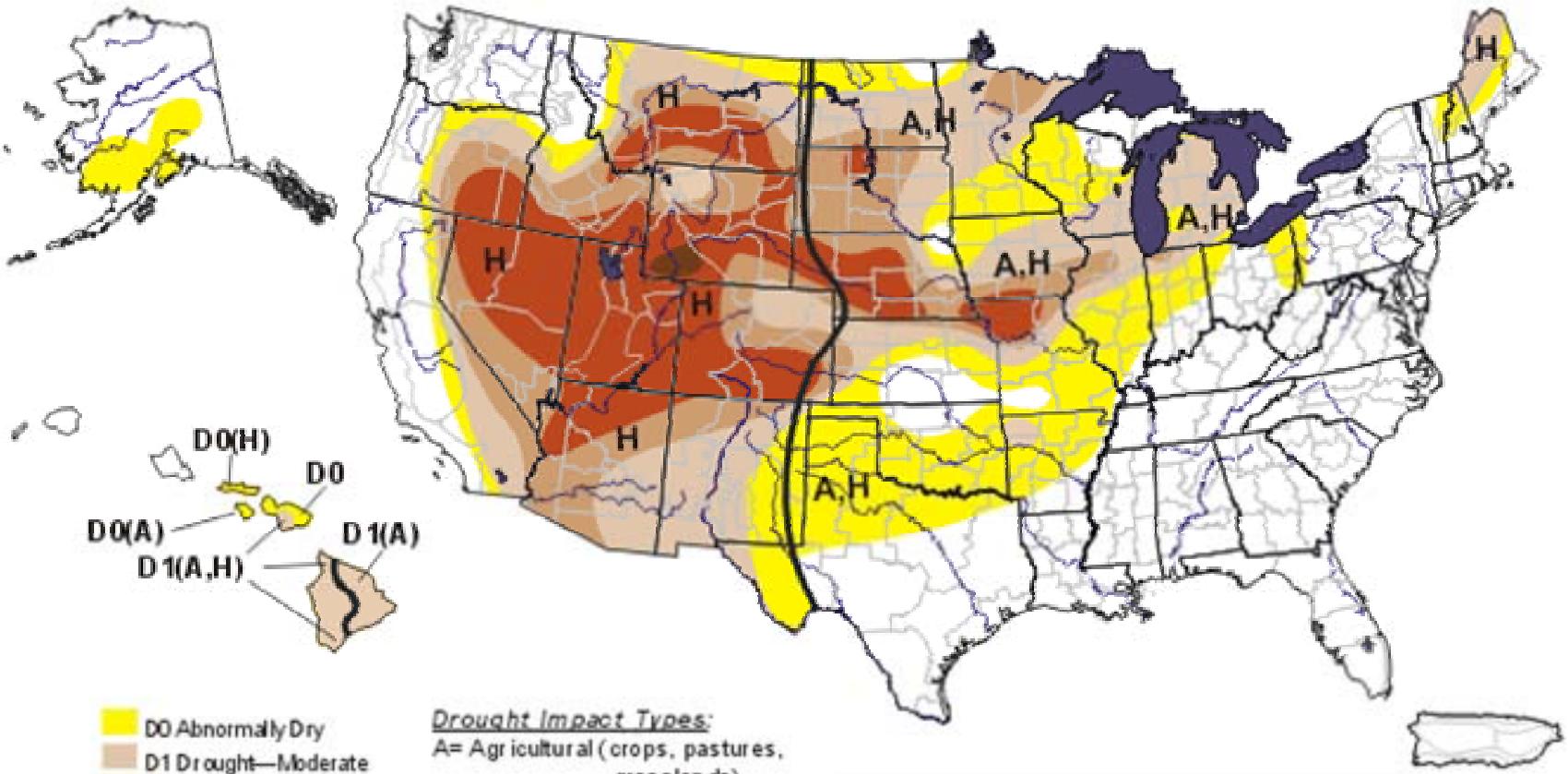


http://drought.unl.edu/dm

U.S. Drought Monitor

April 15, 2003
Valid 8 a.m. EDT



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

Drought Impact Types:
A= Agricultural (crops, pastures, grasslands)
H= Hydrological (water)
Delineates dominant impacts
(No type = both impacts)

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

http://drought.unl.edu/dm

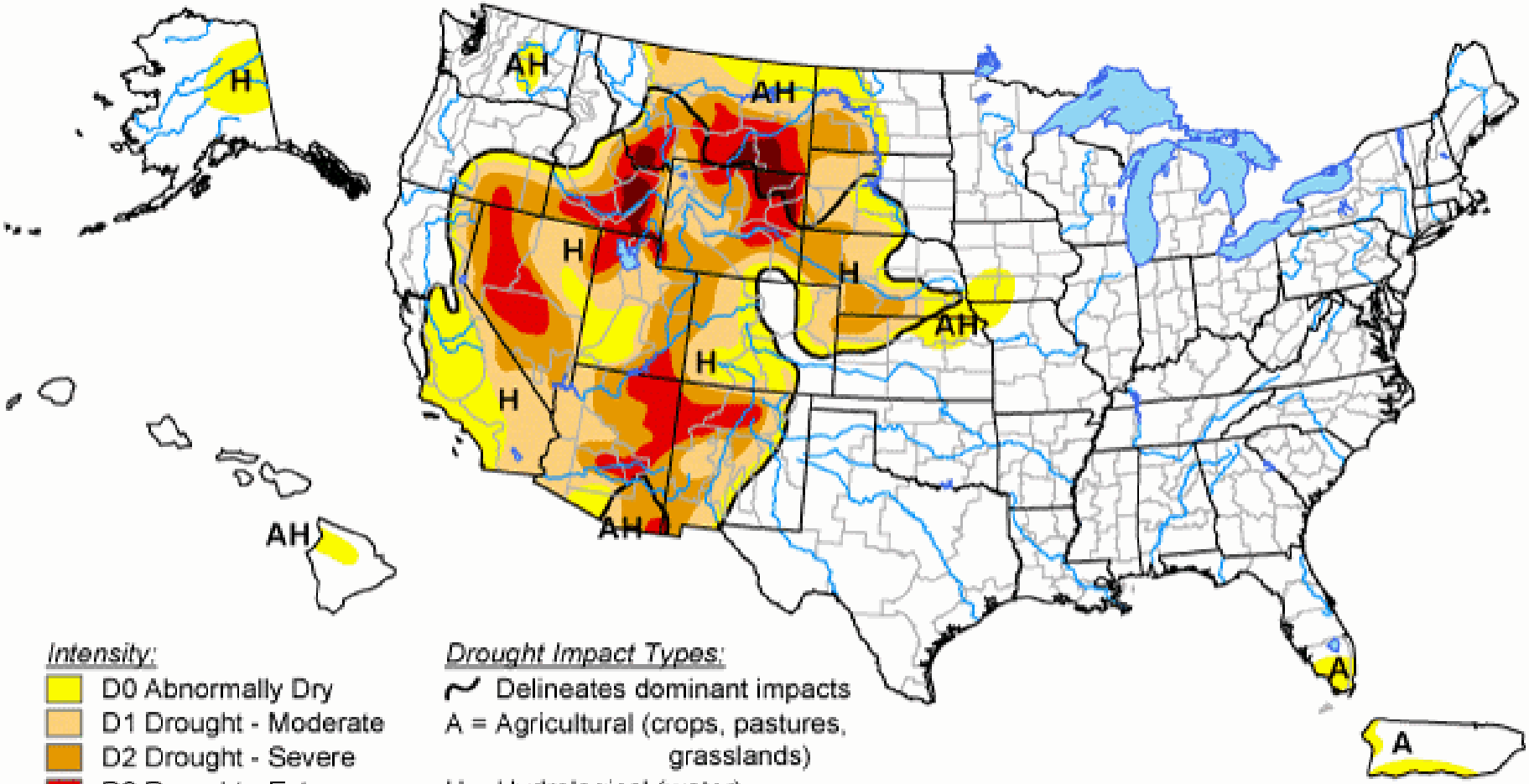
USDA | National Drought Mitigation Center | NOAA

Released Thursday, April 17, 2003

Author: *Brad Rippey, USDA*

U.S. Drought Monitor

December 14, 2004
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)
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http://drought.unl.edu/dm

USDA | National Drought Mitigation Center

Released Thursday, December 16, 2004

Author: David Miskus, JAWF/CPC/NOAA

Summary

- Monitoring drought effectively requires multiple indicators or indices
- Experiences from other states and water utilities can be helpful and will avoid “reinventing the wheel”
- U.S. Drought Monitor is an important tool to provide a national and regional perspective
- Local, more site specific information is essential to evaluate local conditions and trends

Summary

- Historical climate information is readily available to help determine the “drought of record” for your location
- Communicating timely and reliable information on drought severity to the public is critical
- Developing appropriate triggers for the start-up and shut-down of phased voluntary and mandatory response actions for water users is a critical element of a drought plan