Western Regional Climate Center

The West Wide Drought Tracker

Drought Monitoring at Fine Scales

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37th Annual Climate Diagnostics and Prediction Workshop

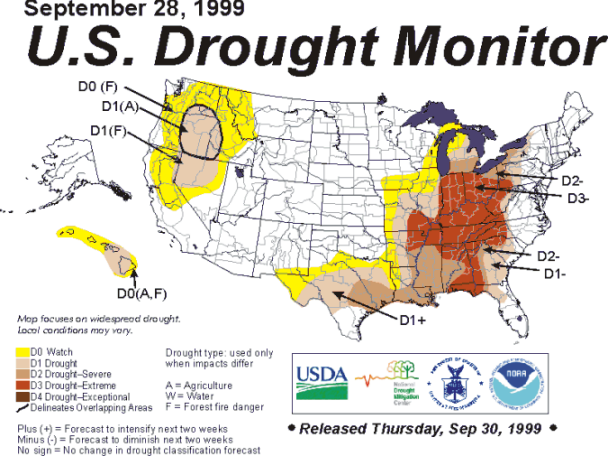
Fort Collins CO

22-26 October 2012

University of Idaho

DRI Desert Research Institute

South Dakota State University SDSU



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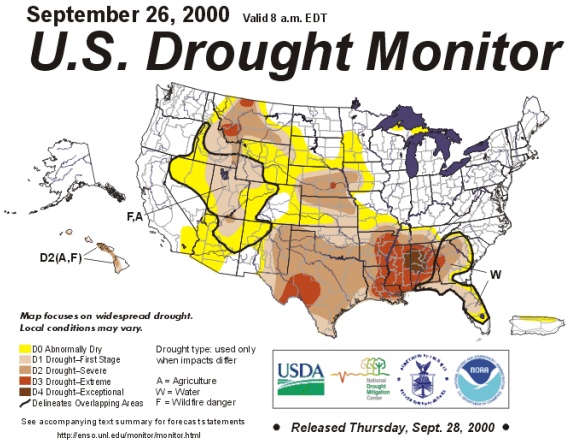

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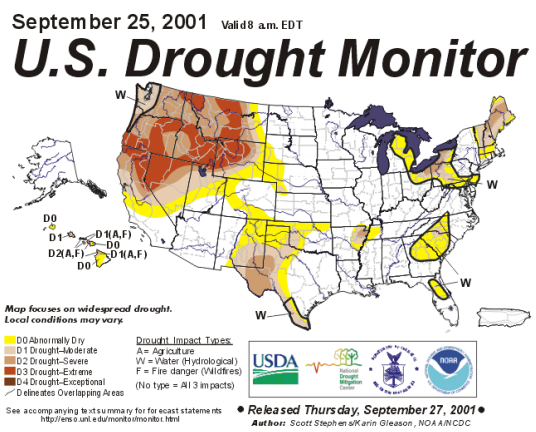

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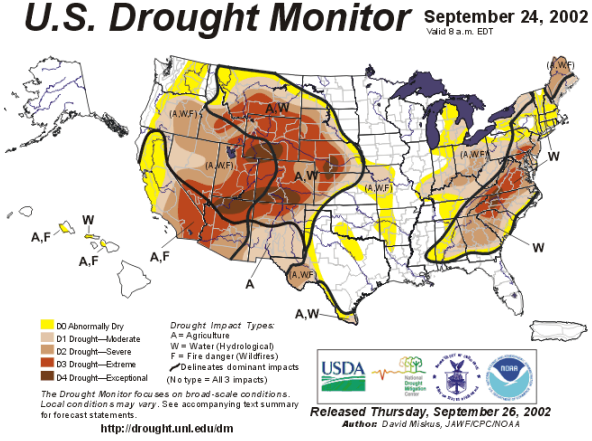

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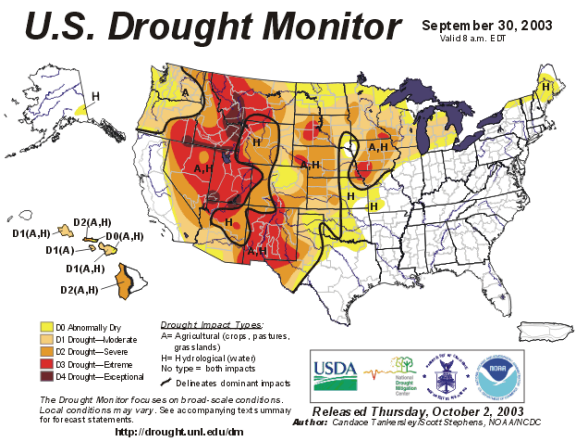

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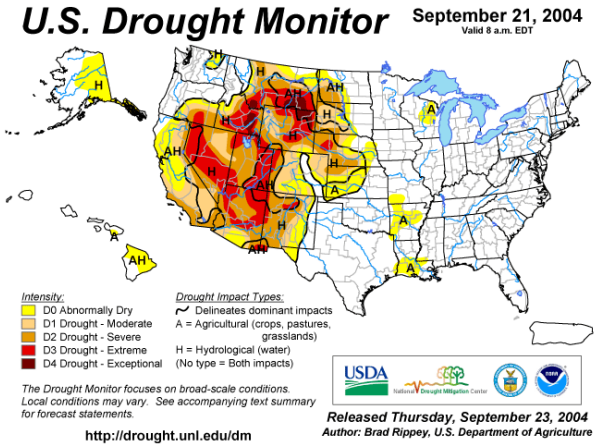

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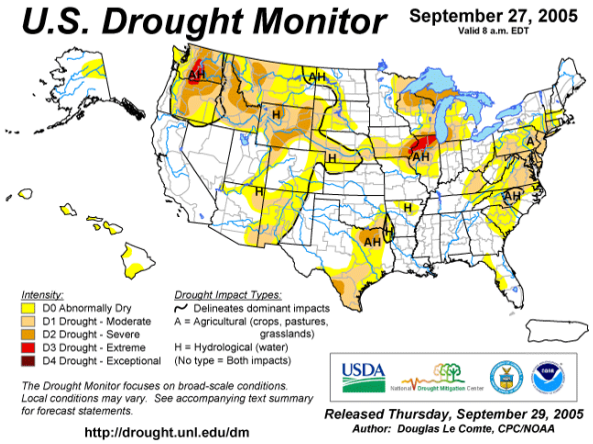

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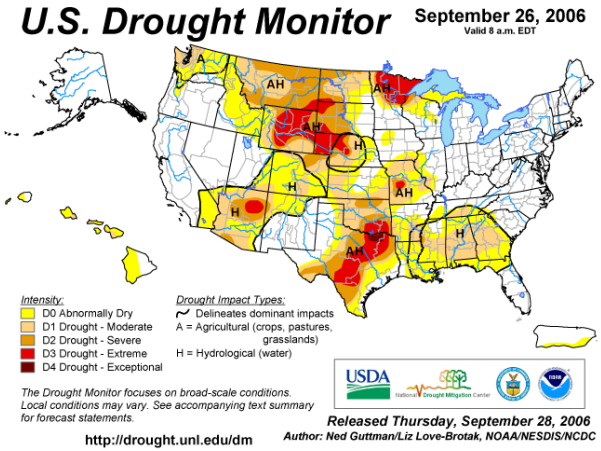

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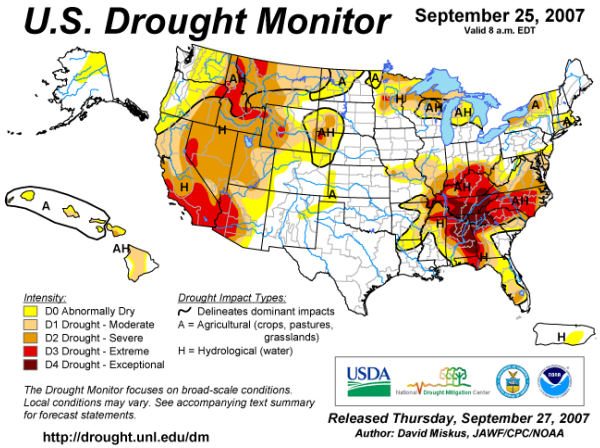

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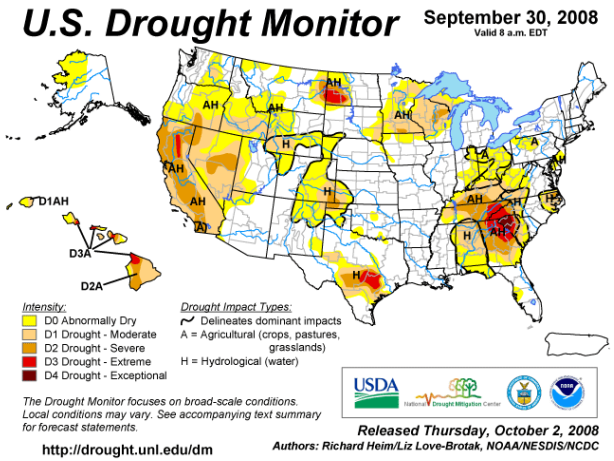

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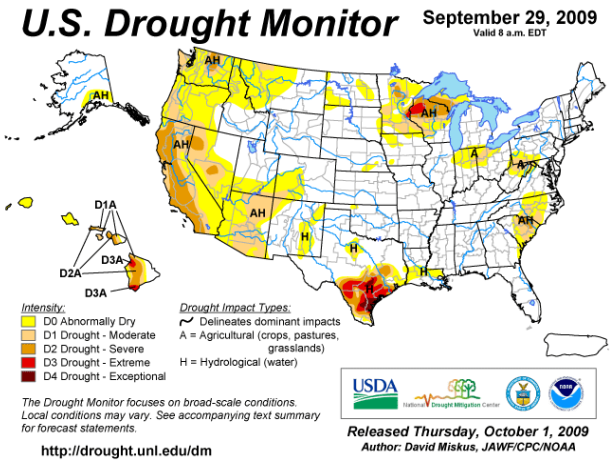

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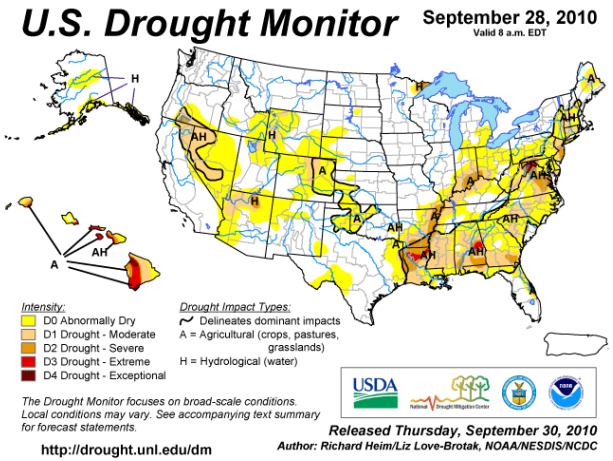

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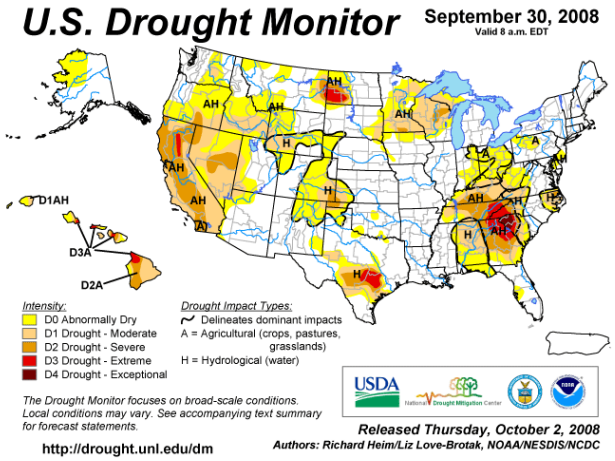

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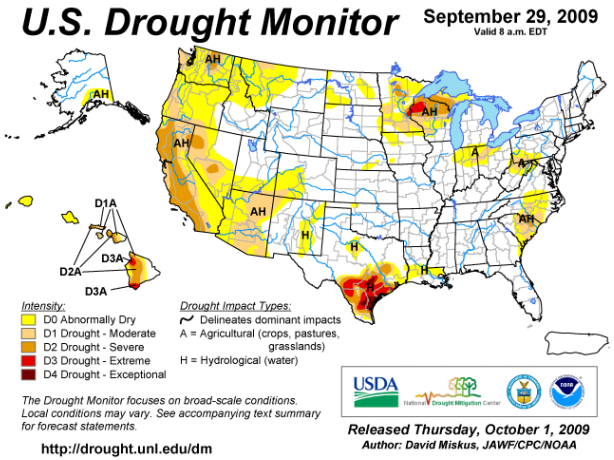

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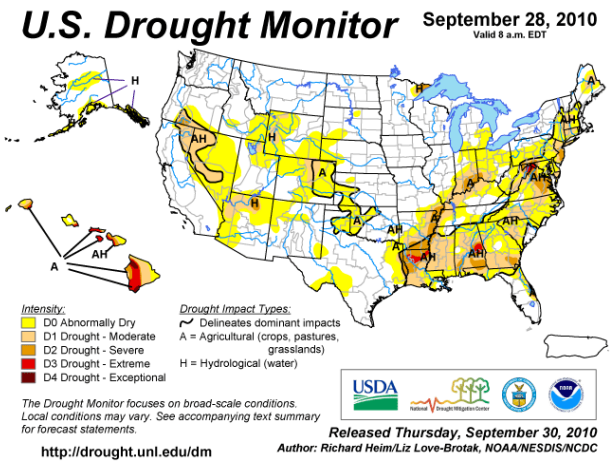

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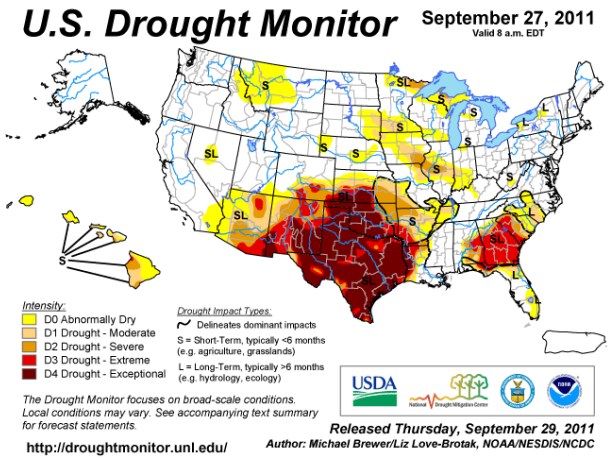

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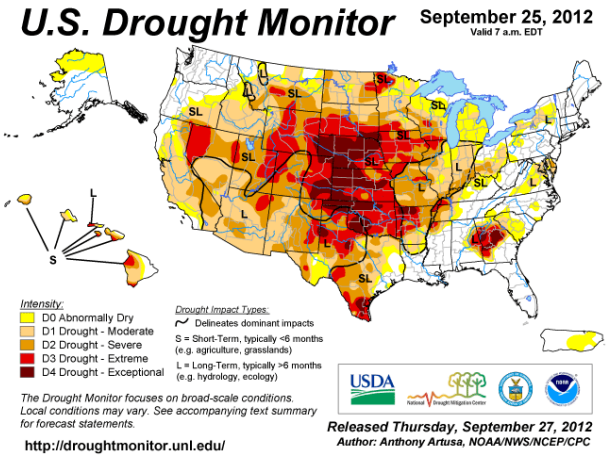

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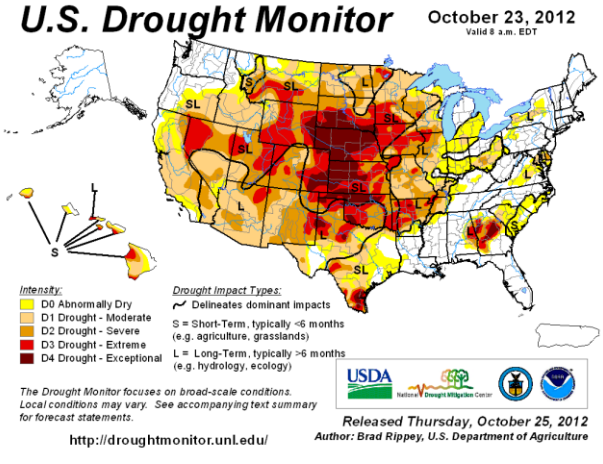
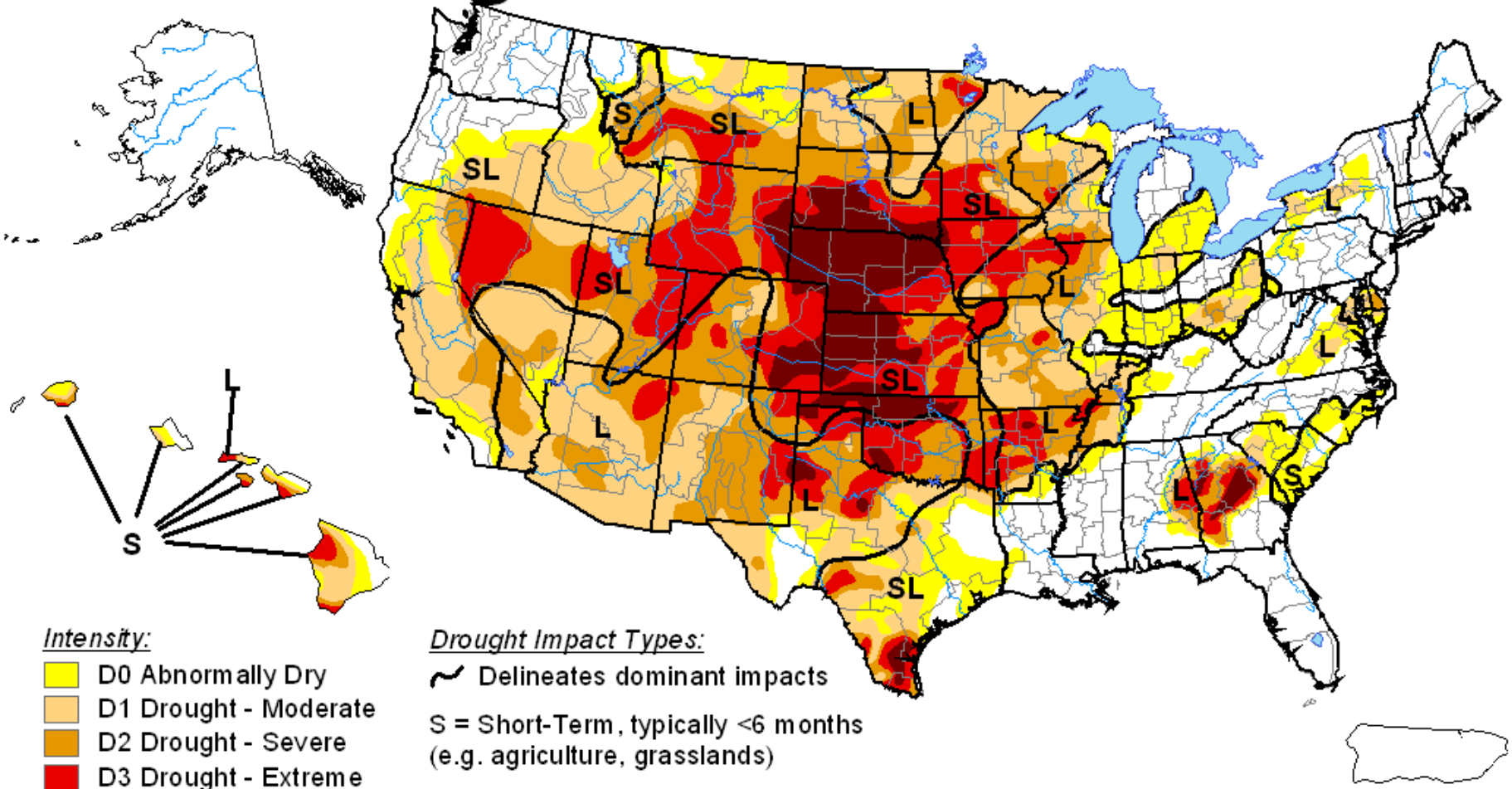


Oct 23, 2012

U.S. Drought Monitor

October 23, 2012
Valid 8 a.m. EDT



Intensity:

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

Drought Impact Types:

Delineates dominant impacts

S = Short-Term, typically <6 months
(e.g. agriculture, grasslands)

L = Long-Term, typically >6 months
(e.g. hydrology, ecology)

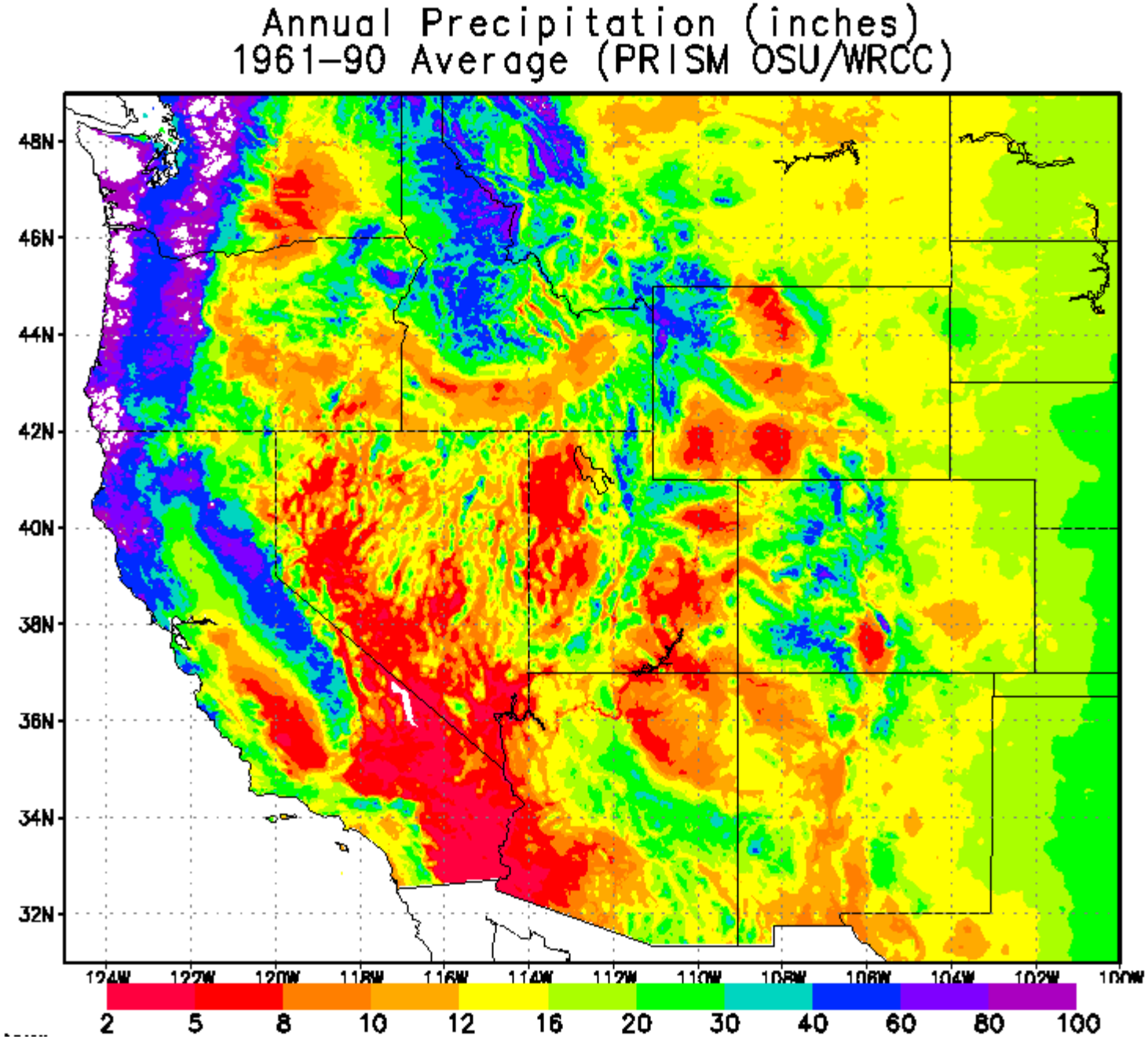
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

USDA National Drought Mitigation Center

Released Thursday, October 25, 2012

Author: Brad Rippey, U.S. Department of Agriculture


Annual Precipitation (inches)
1961–90 Average (PRISM OSU/WRCC)
48N
46N
44N
42N
40N
38N
36N
34N
32N
124W
122W
120W
118W
116W
114W
112W
110W
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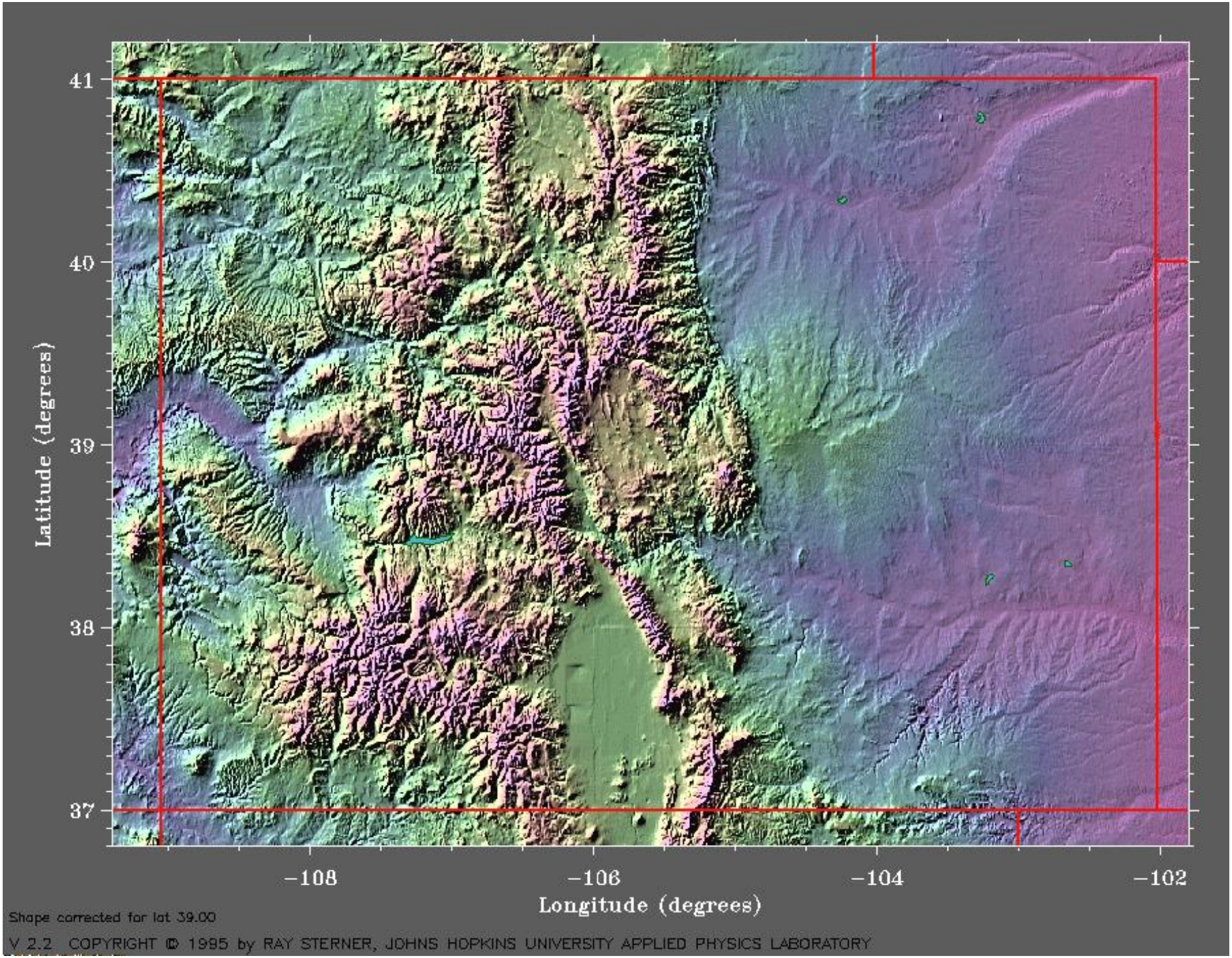
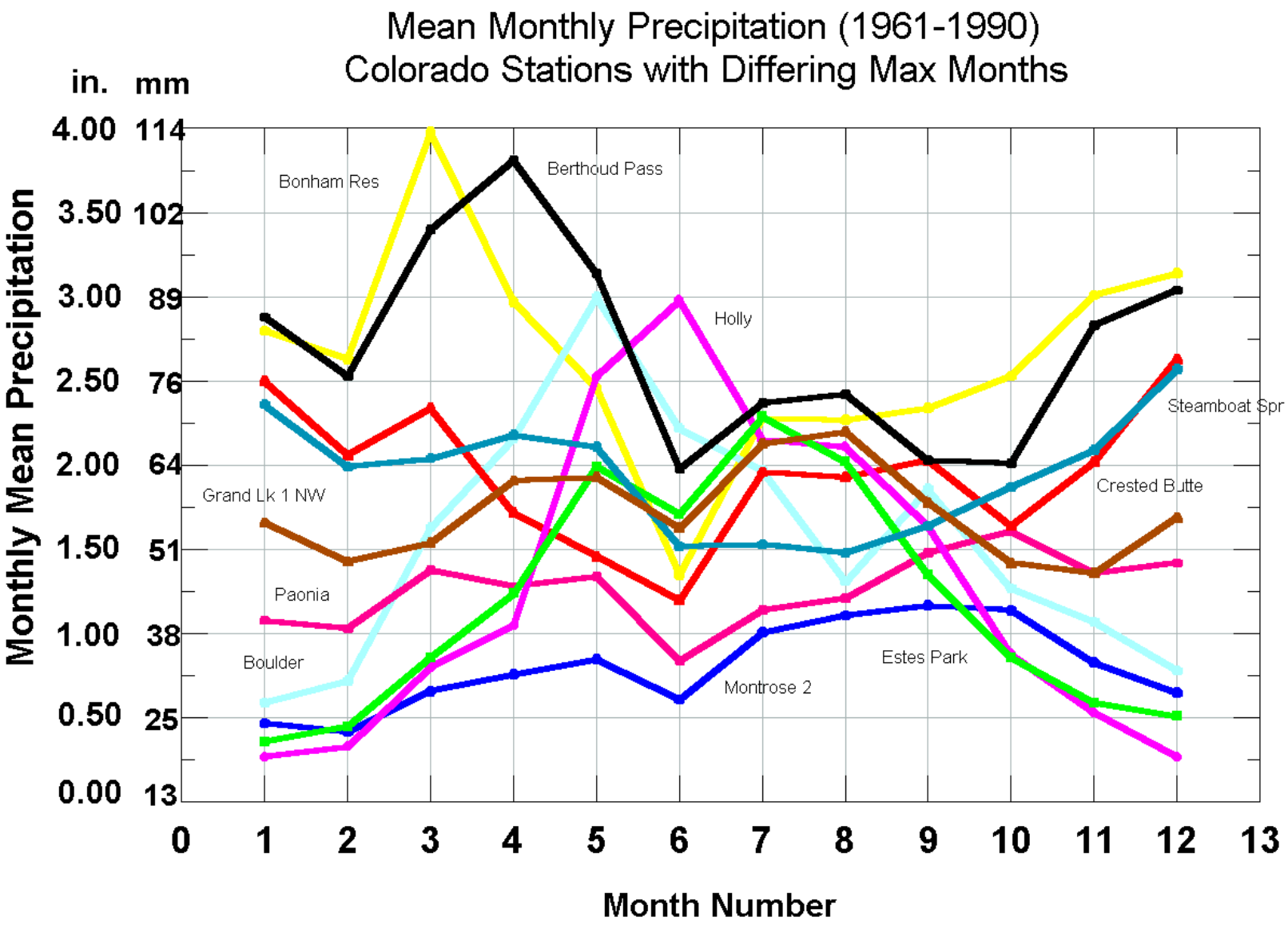
20
30
40
60
80
100

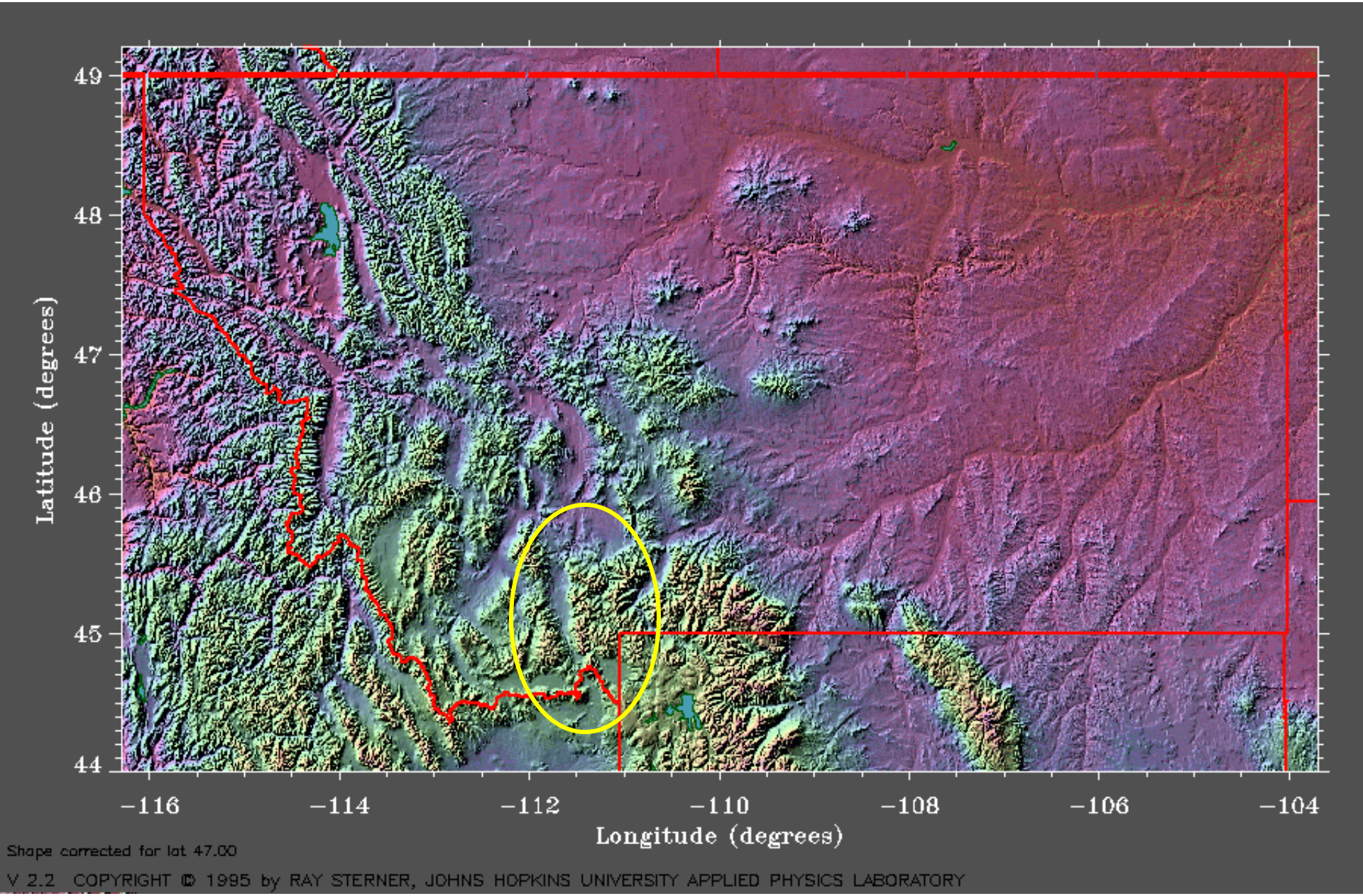

41
40
39
38
37
Latitude (degrees)
−108
−106
−104
−102
Longitude (degrees)
Shape corrected for lat 39.00
V 2.2 COPYRIGHT © 1995 by RAY STERNER, JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY

Adjacent locations with differing annual precipitation cycles



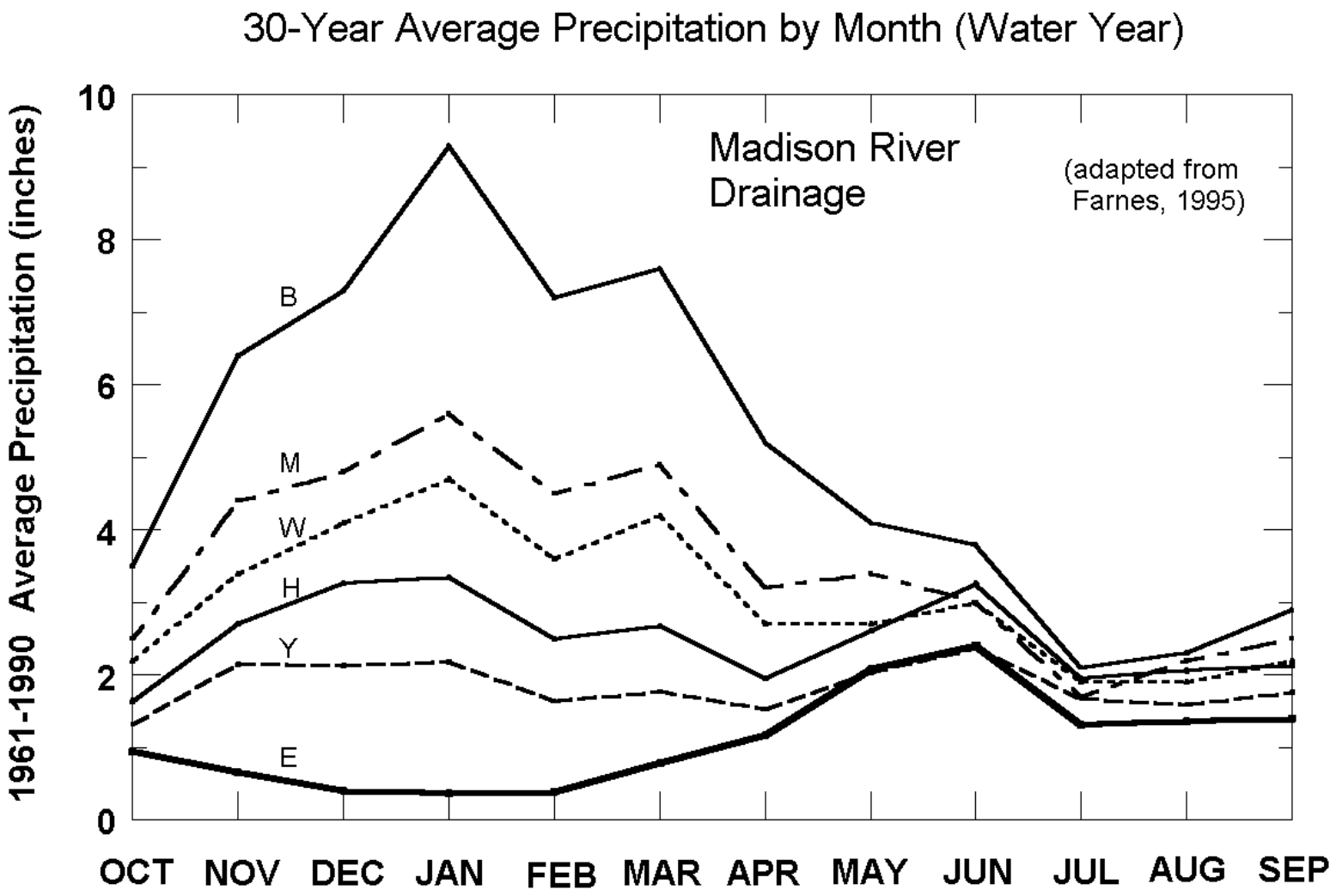
K. Redmond, 2003. p 29-48, Water and Climate in the Western United States. U Colorado Press.

Madison Valley Seasonality Comparison Area.



Adjacent locations with differing annual precipitation cycles

Adapted from Phil Farnes, Western Snow Conference, 1995.



B - Black Bear	7950'/2423 m	M - Madison Plateau	7149'/2179 m
W - Whiskey Creek	6802'/2073 m	H - Hebgen Dam	6490'/1978 m
Y - West Yellowston	6660'/2030 m	E - Ennis	4954'/1510 m

March 10, 2004
70” / 1800 mm
55” / 1400 mm
12” / 300 mm
7.5” / 170 mm

Motivations

Complexity of western drought

- Topography a dominant influence
- Climate varies greatly in short distances
- Dominant influence of snow
- Climate seasonality a function of elevation
- Hydrologic lags introduced by snowpack
- Hydrologic lags introduced by mountain block recharge
- Climate effects experienced at different place and time from climate drivers
- High elevation supply, low elevation demand
- Winter supply, summer demand

Drought every year in the West since middle 1990s

General aridity a pre-existing condition in most of the West

Desire to use gridded information

Ability to build on existing infrastructure

Data

PRISM 4-km gridded monthly time series, 1895-present, contiguous USA

- **Tmax**
- **Tmin**
- **Tave**
- **Precip**

Updated monthly, about mid-month, by OSU PRISM Group

Interim updates at beginning of month use NLDAS-2 before PRISM update

- **Bi-linearly interpolated to PRISM grid**
- **Bias corrected for climatology differences between PRISM and NLDAS-2**
  - **Overlapping period 1979-2011 (following Abatzoglou, 2011)**

Historical Climatology Network infilled data from ~1200 locations for time series

Products

Palmer family

- Palmer Drought Severity Index (PDSI)
- Self-calibrated Palmer Drought Severity Index (scPDSI)
- Palmer Z Index (Z)

Standardized Precipitation Index (SPI)

- 1-72 months

Standardized Precipitation Evapotranspiration Index (SPEI) (Vicente-Serrano, 2010)

- 1-72 months

Climate (past 1-12 months)

- Temperature
  - Anomaly (in degrees)
  - Percentile
- Precipitation
  - Anomaly (percentage)
  - Percentile

Archive access to all above products, all years 1895-present

- Several million maps

Outputs available in GIS-compatible formats

Regions

States

- Individual western states (zoom)
- USA lower 48 as a group, for now
  - Originally, only intended for the West

Counties

Climate divisions

Hydrologic basins

Predictive Services areas (fire community)

Points (4x4 km resolution)

Stations (HCN)

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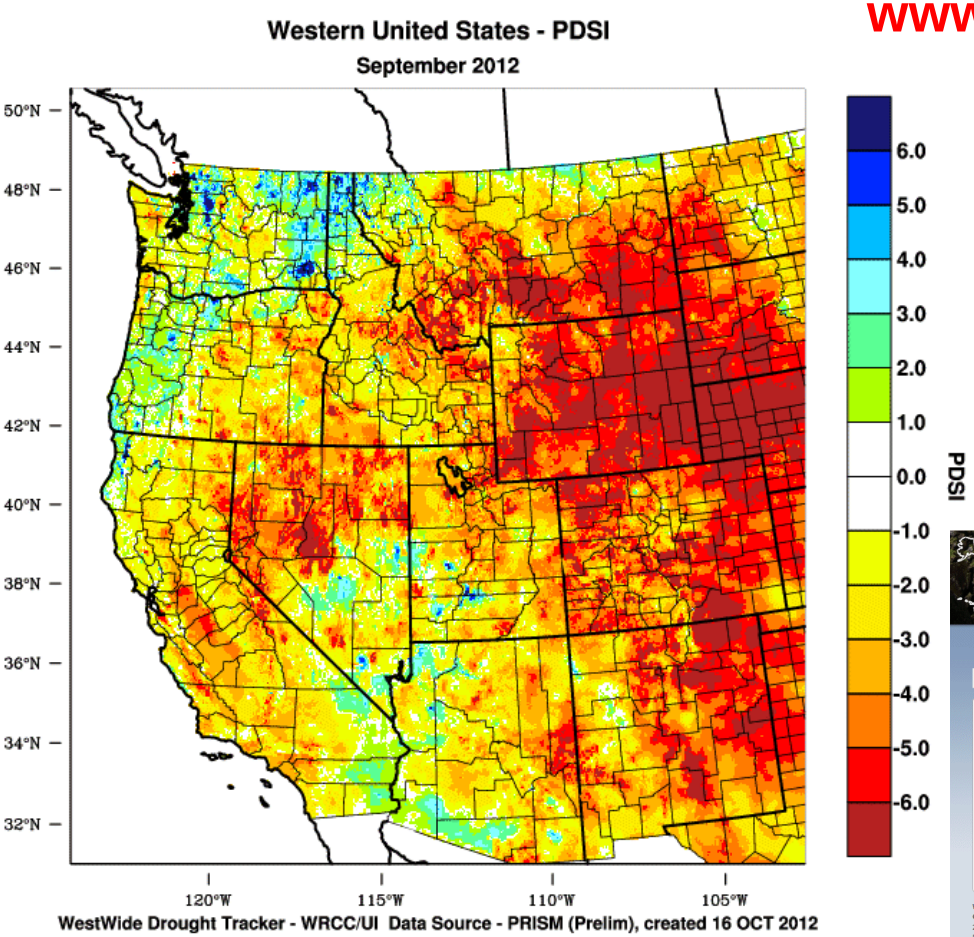
Climate Product Options

Expand All | Contract All

- Variable
  - Drought Index
  - Climate
    - Temperature
      - Anomaly
      - Percentile
    - Precipitation
      - Anomaly
      - Percentile
- Region
  - Western US
  - Arizona
  - California
  - Colorado
  - Idaho
  - Montana
  - Nevada
  - New Mexico
  - Oregon
  - Utah
  - Washington
  - Wyoming
  - United States

Current Product:
PRISM > Palmer Drought Severity Index > Western US



Download PRISM Palmer Drought Severity Index NETCDF Data for United States

Download PRISM Palmer Drought Severity Index GeoTIFF Data for United States

Home page:
www.wrcc.dri.edu/wwdt

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Monitoring
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Drought Monitoring

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- Variable
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      - Percentile
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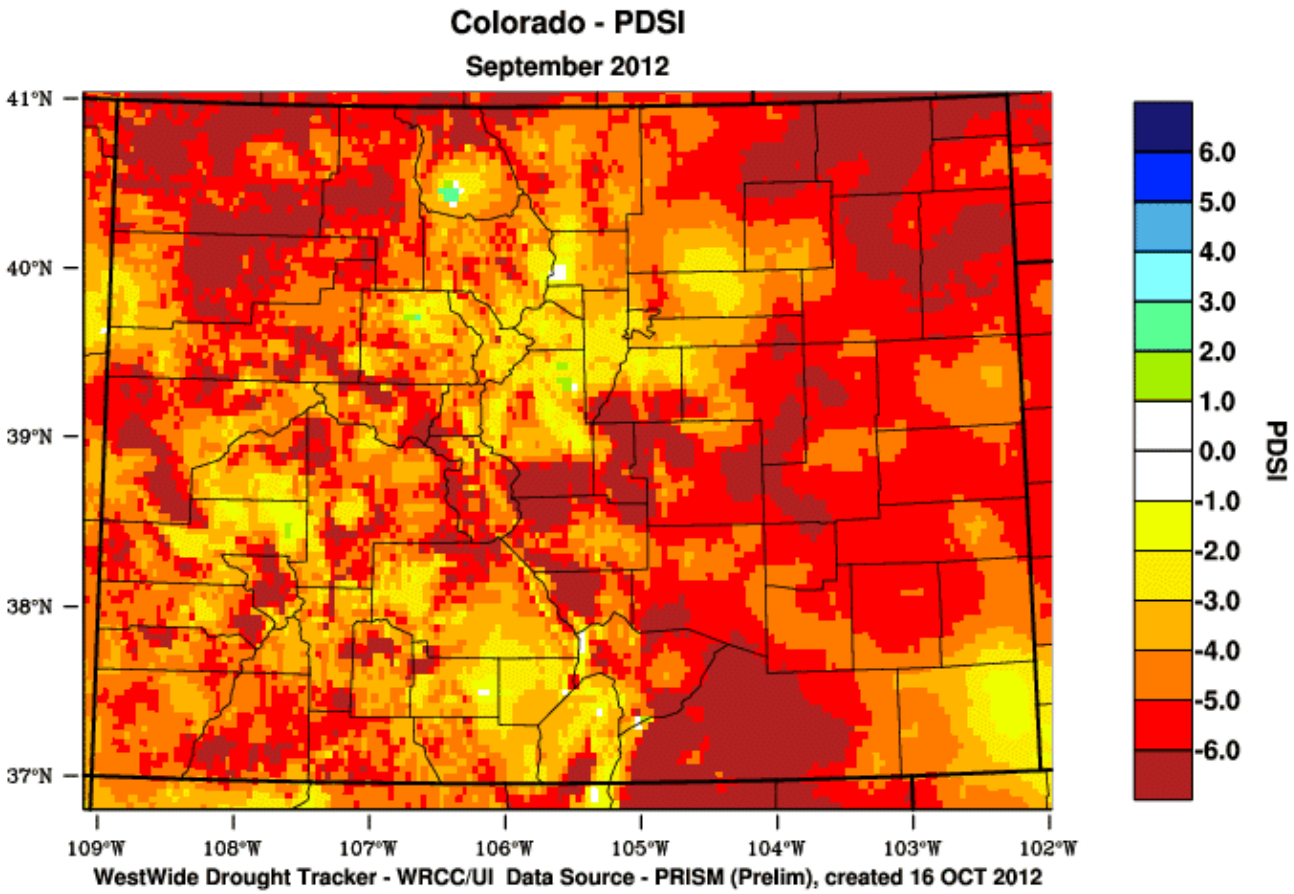
  - Arizona
  - California
  - Colorado
  - Idaho
  - Montana
  - Nevada
  - New Mexico
  - Oregon
  - Utah
  - Washington
  - Wyoming
  - United States

State Maps only for Western States

Current Product:
PRISM > Palmer Drought Severity Index > Colorado



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  - United States

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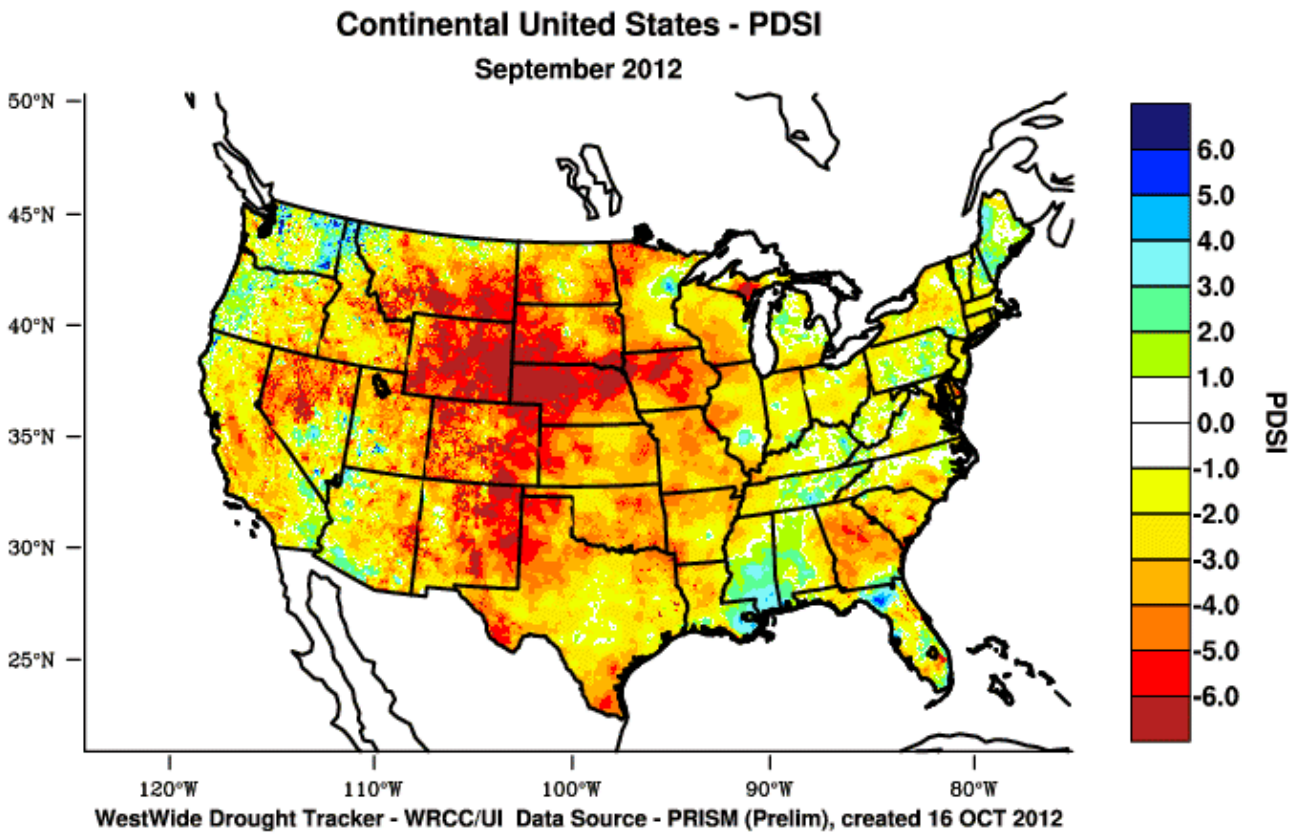
PRISM > Palmer Drought Severity Index > United States



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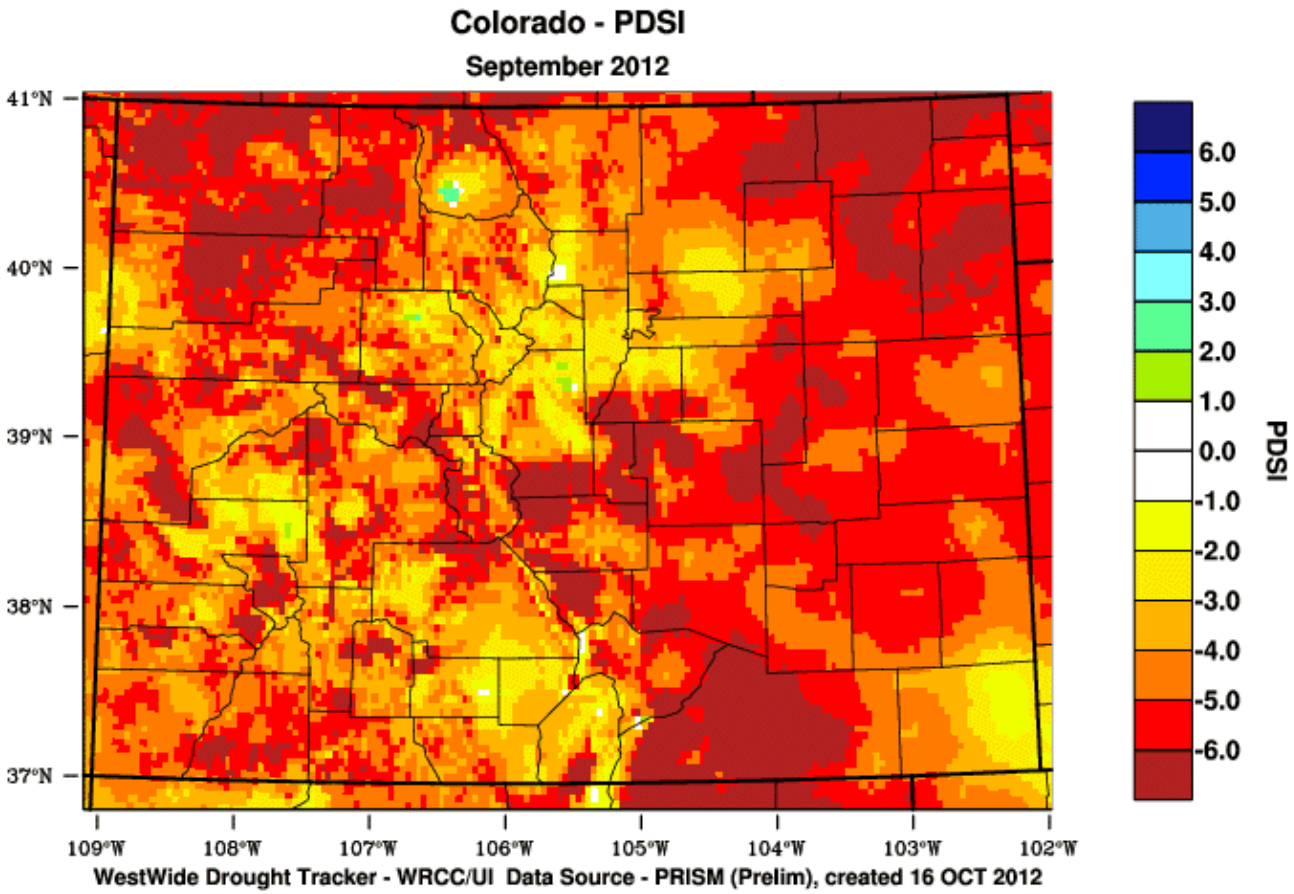

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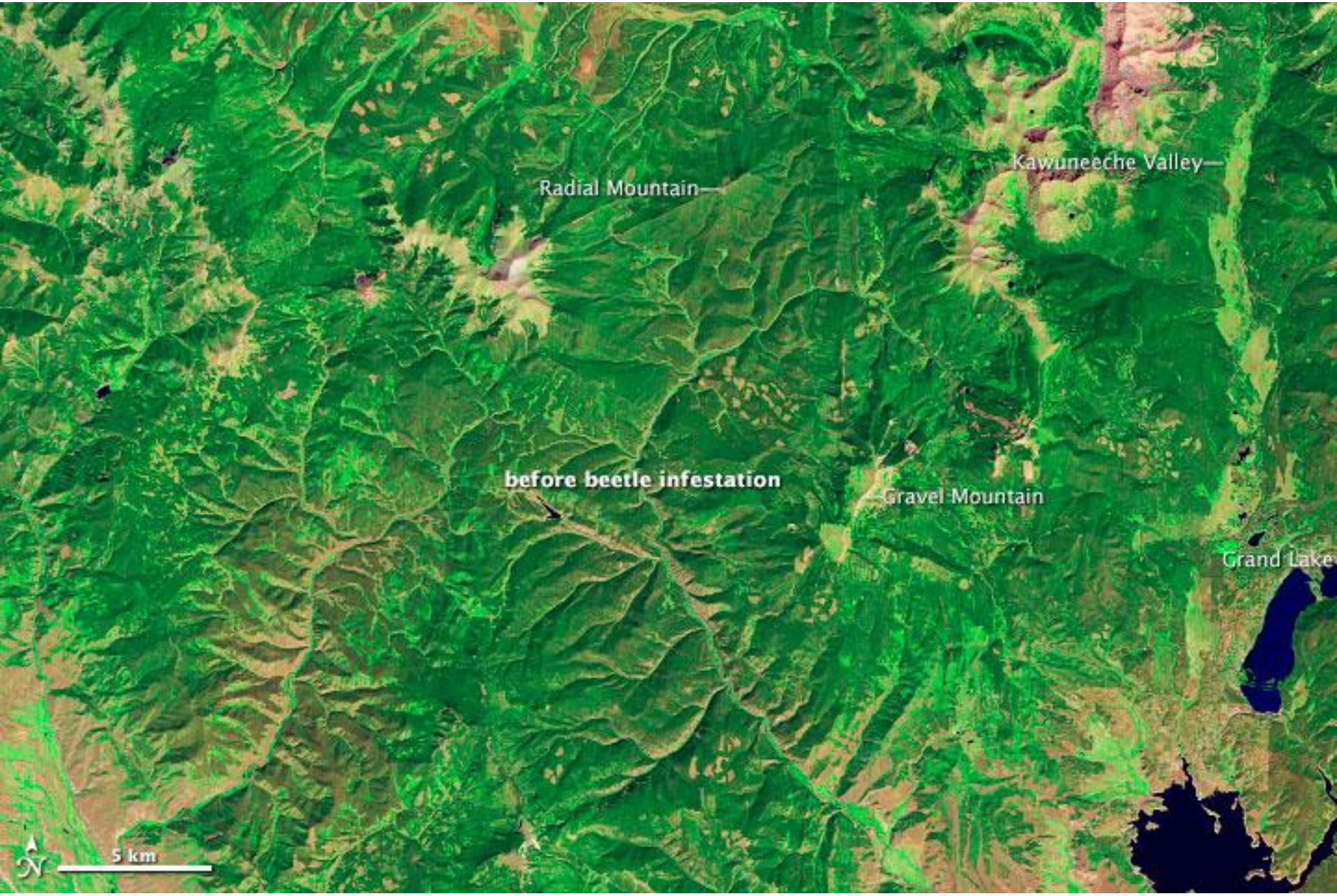
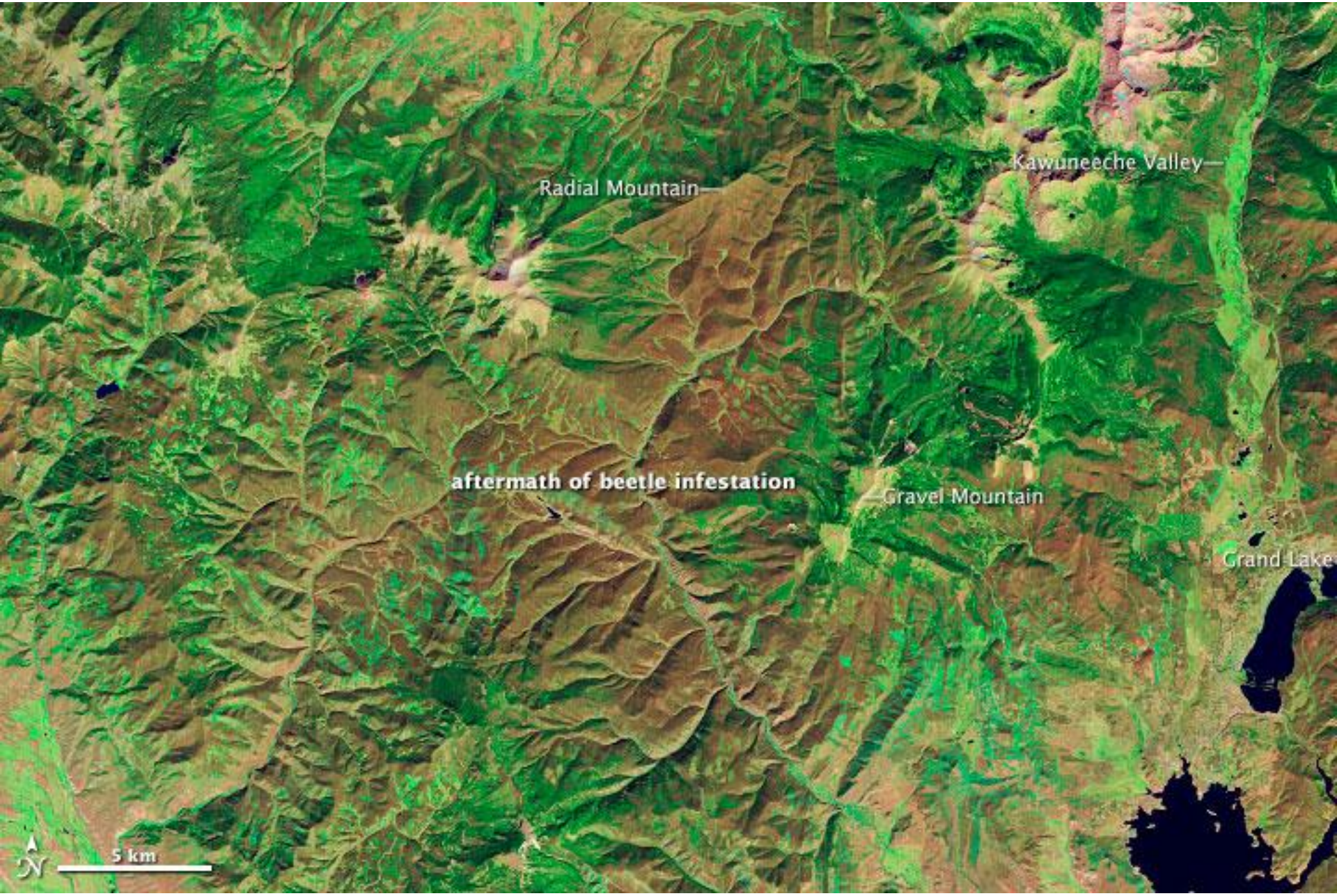
KTR 20120930

Central Colorado Mountain Pine Beetle 2005 09 05



Central Colorado Mountain Pine Beetle 2011 09 28



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Select Year: 2012 Select Month: 9

Submit

Choose Year/Month, press Submit and then choose product below

Climate Product Options

Expand All | Contract All

- Variable
  - Drought Index
  - Climate
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      - Anomaly
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    - Precipitation
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        - Last 2-Months
        - Last 3-Months
        - Last 4-Months
        - Last 5-Months
        - Last 6-Months
        - Last 7-Months
        - Last 8-Months
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        - Last 10-Months
        - Last 11-Months
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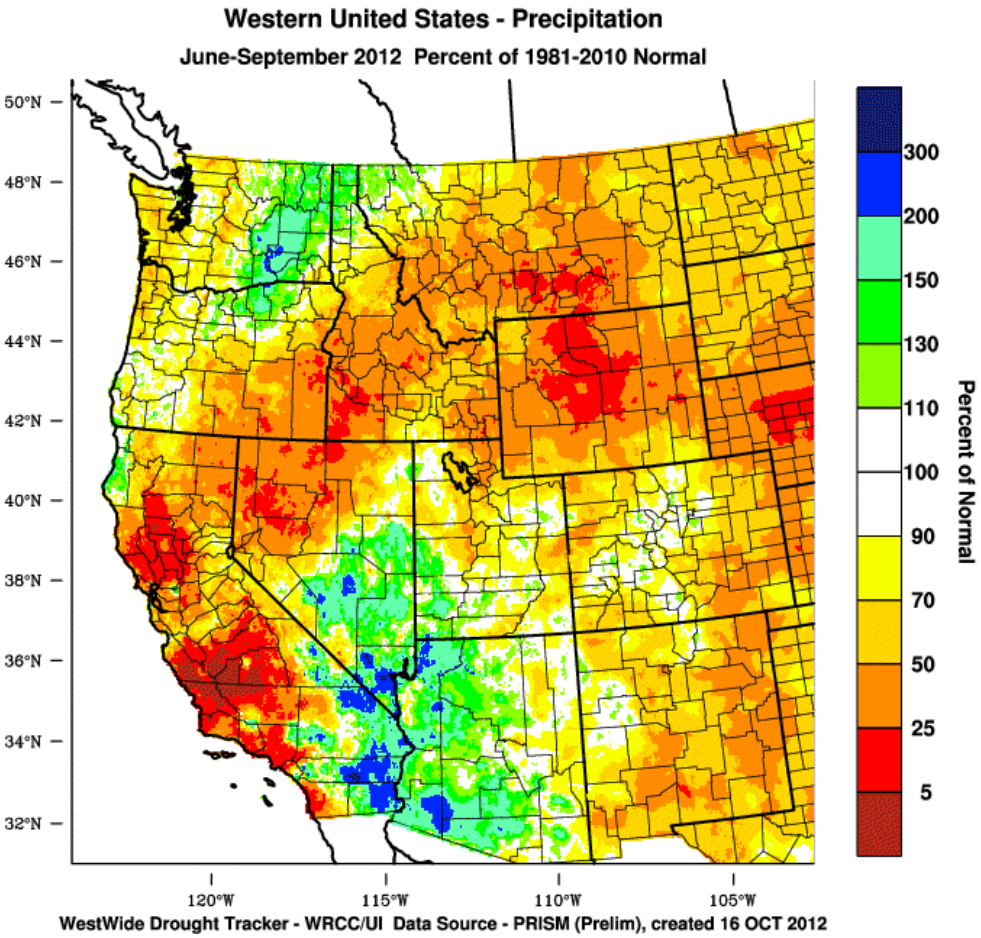
Archived Image:
PRISM > 09/2012 > Precipitation Anomaly 4 Month > United States



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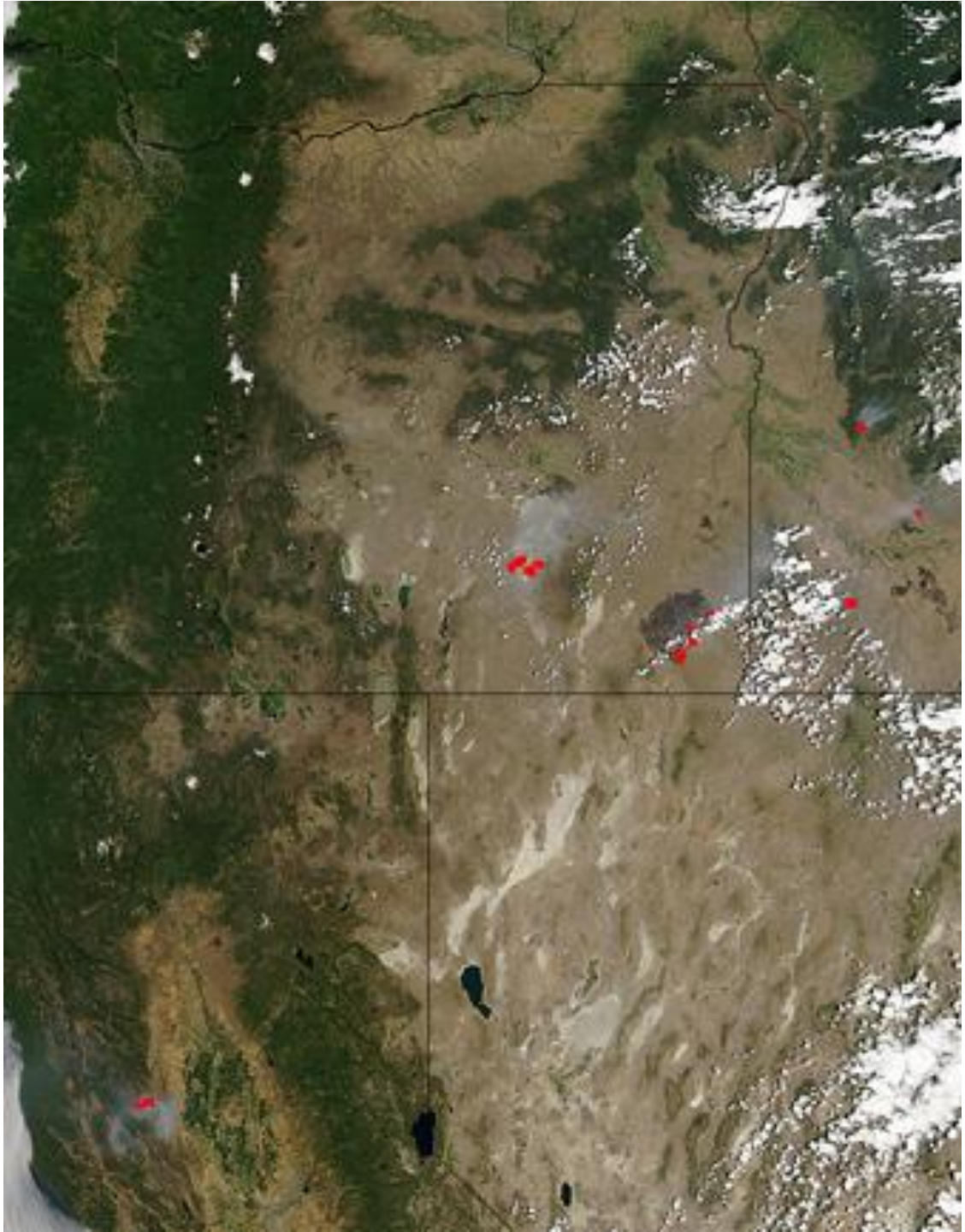
Download PRISM Precipitation Anomaly 4 Month GeoTIFF Data for United States

Recent Summer and Southwest Monsoon

Precipitation Percentage

4-mo ending Sept 2012



Long Draw Fire
557,648 acres as of July 17
Oregon's largest fire ever
MODIS 1 km
2012 July 11

Long Draw Fire SE Oregon 2012 July 24

Jamie Francis, Oregonian

Next to Long Draw Fire SE Oregon 2012 July 24

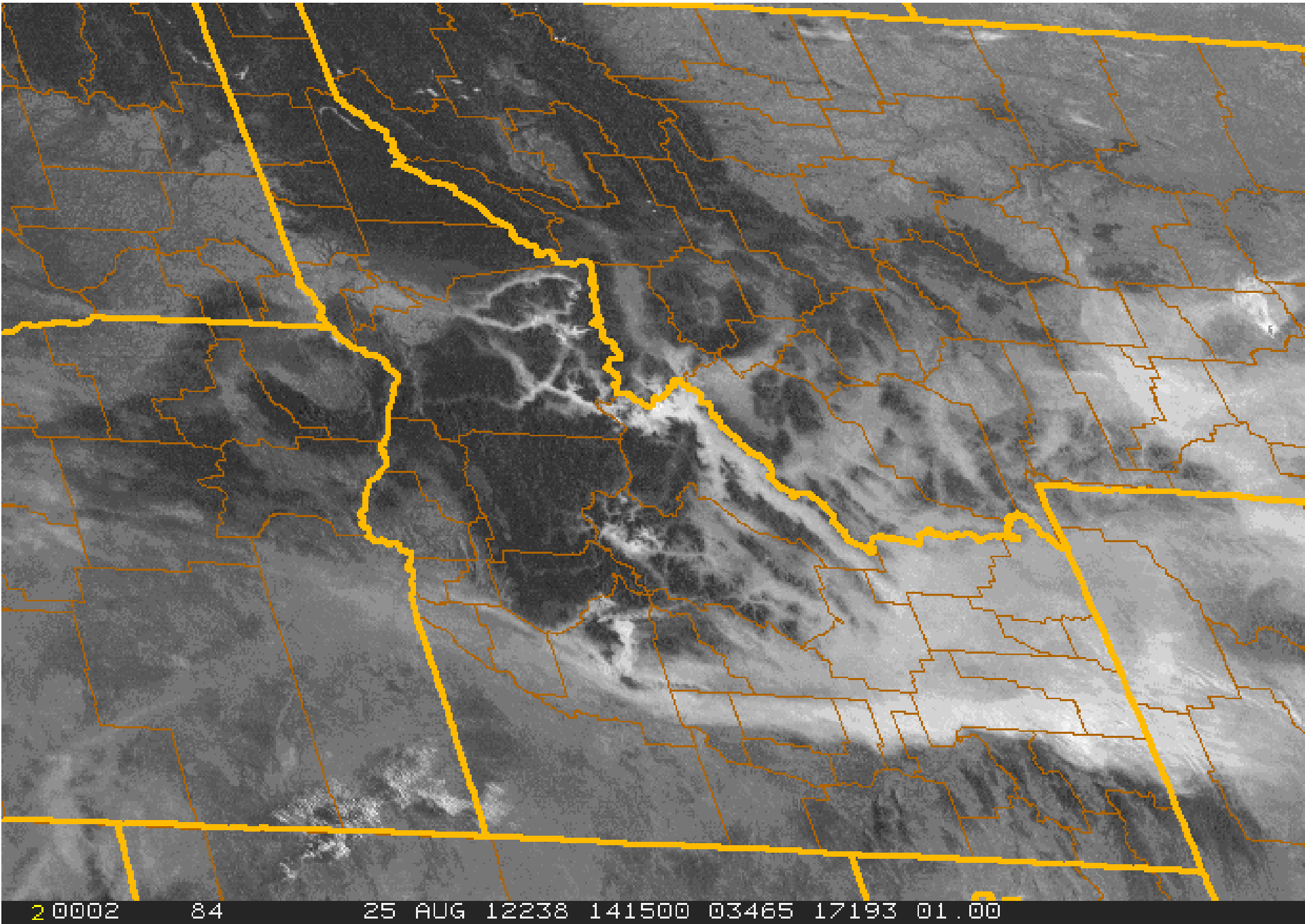
Jamie Francis, Oregonian

Long Draw Fire SE Oregon 2012 July 24

Jamie Francis, Oregonian

20120806 Karen Dong Boise

Smoking Section 2012 August 25 1415 GMT



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Select Year: 2012 Select Month: 4

Submit

Choose Year/Month, press Submit and then choose product below

Climate Product Options

Expand All | Contract All

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  - Climate
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      - Percentile
    - Precipitation
      - Anomaly
      - Percentile
        - Last Full Month
        - Last 2-Months
        - Last 3-Months
        - Last 4-Months
        - Last 5-Months
        - **Last 6-Months**
        - Last 7-Months
        - Last 8-Months
        - Last 9-Months
        - Last 10-Months
        - Last 11-Months
        - Last 12-Months
- Region
  - Western US
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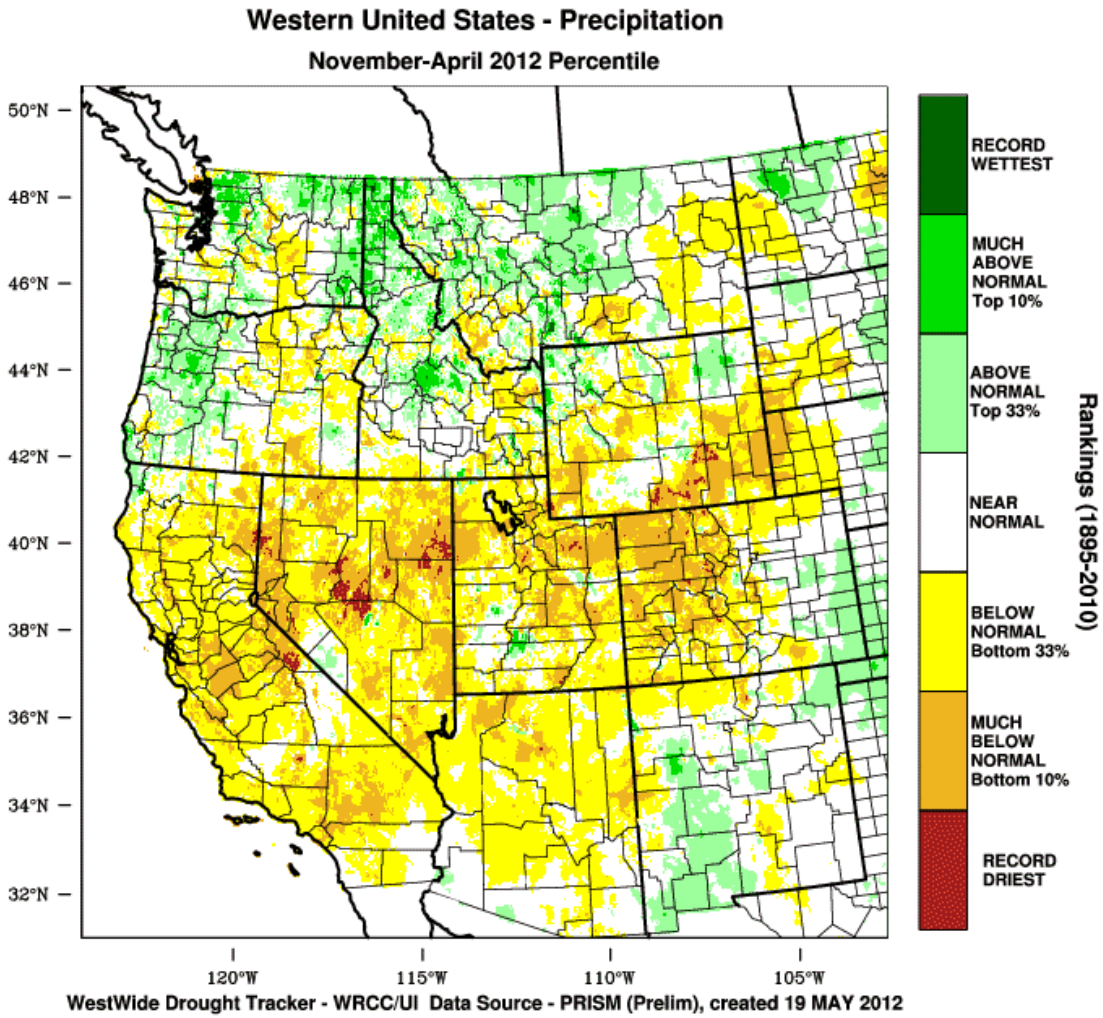
  - New Mexico

Archived Image:
PRISM > 04/2012 > Precipitation Percentile 6 Month > United States



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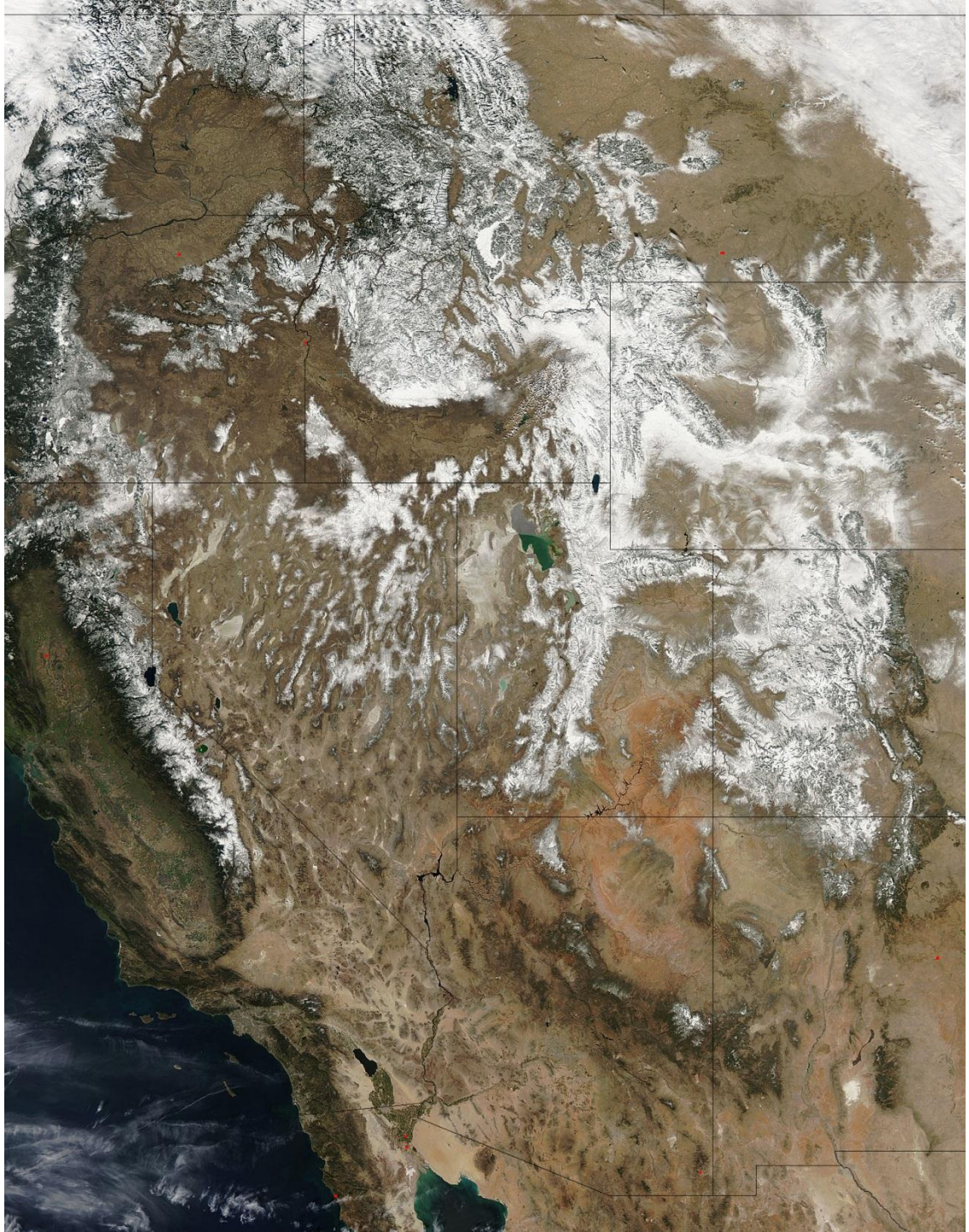
Archive

6-mo Ending Apr 2012

i.e. Winter 2011-12



MODIS
2012 Mar 4

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Select Year: 2011 Select Month: 12

Submit

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Climate Product Options

Expand All | Contract All

- Variable
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    - Precipitation
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      - Percentile
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        - Last 11-Months
        - Last 12-Months
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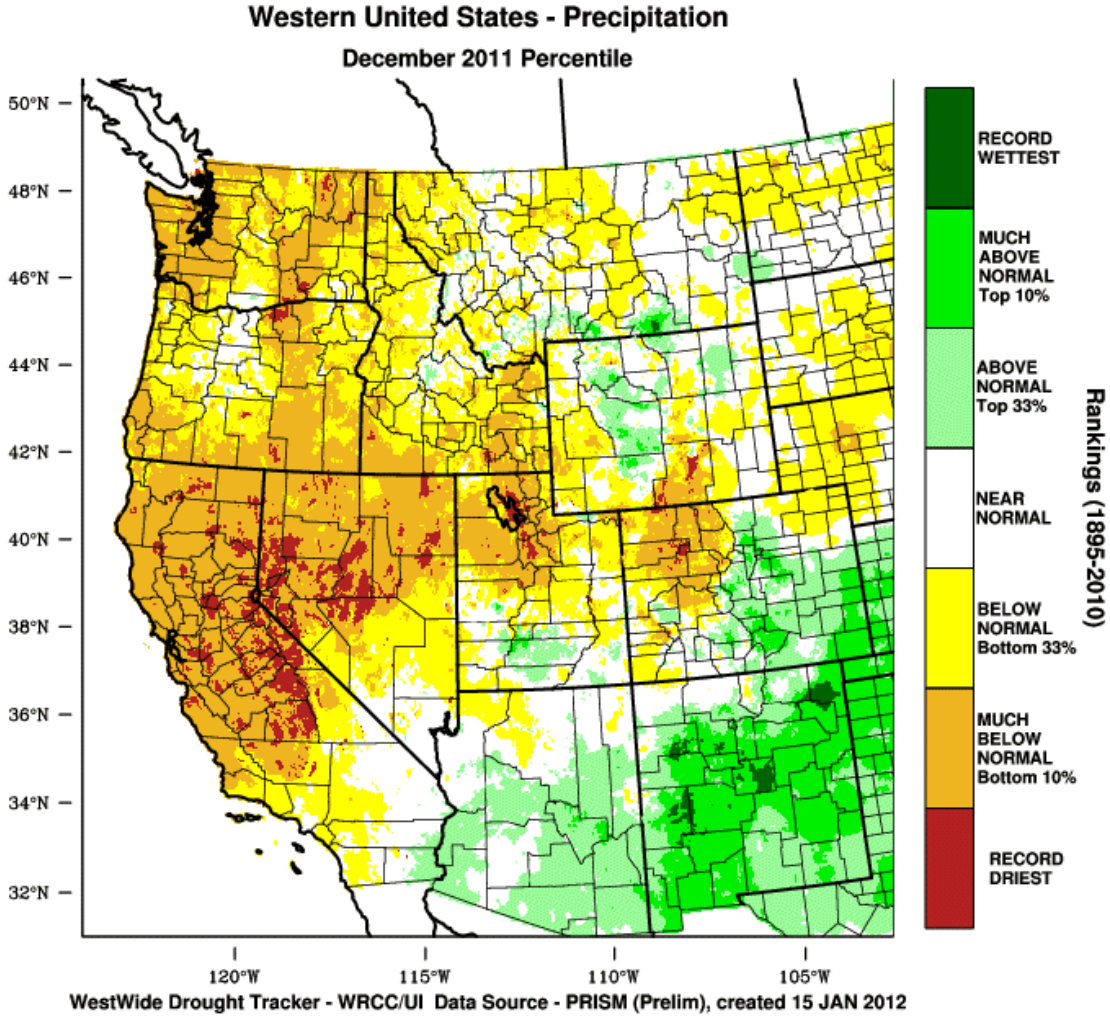
Archived Image:
PRISM > 012/2011 > Precipitation Percentile 1 Month > United States



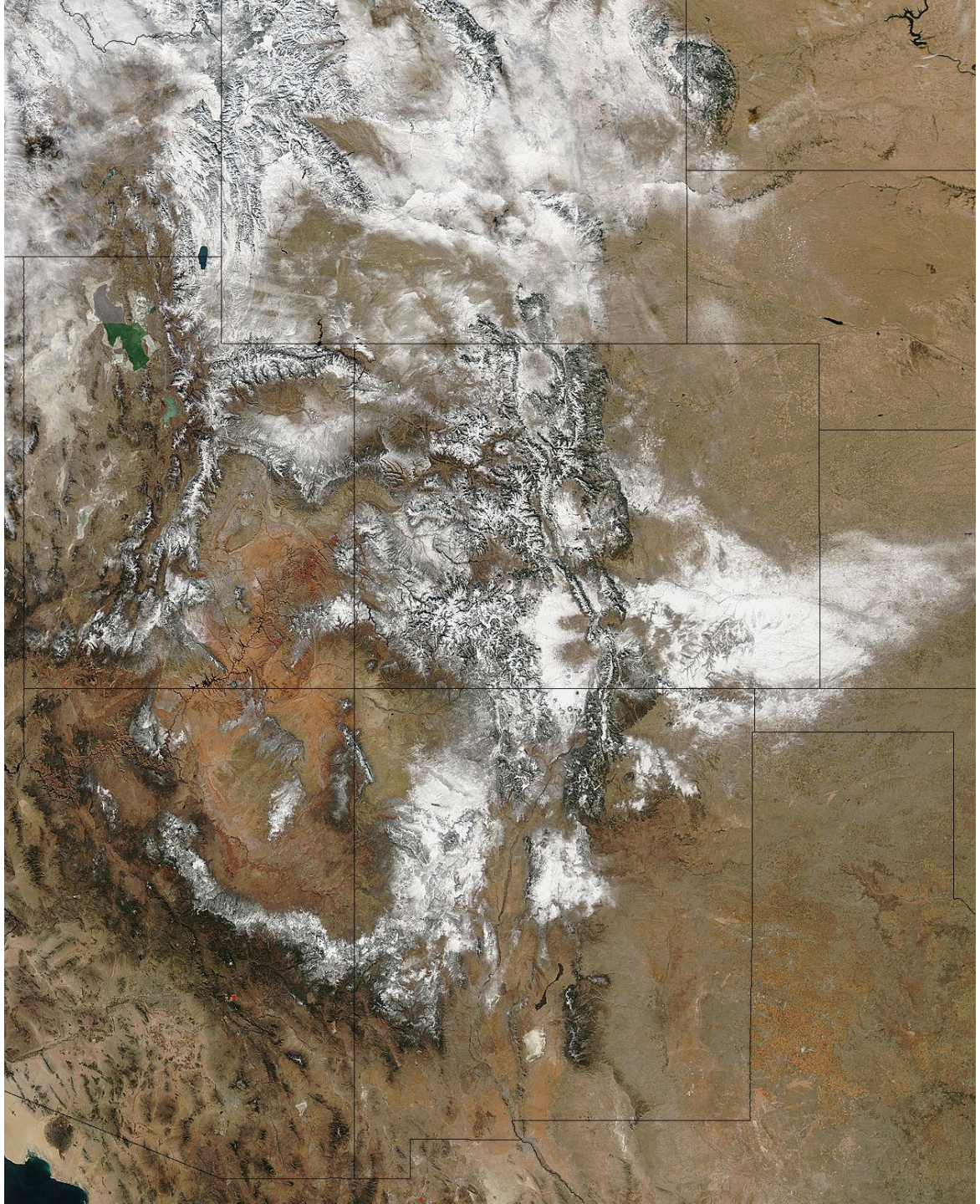
Download PRISM Precipitation Percentile 1 Month NETCDF Data for United States

Download PRISM Precipitation Percentile 1 Month GeoTIFF Data for United States

Archive

1-mo Ending Dec 2011

i.e. Dec 2011



MODIS
Where's the snow ?
2012 Jan 2

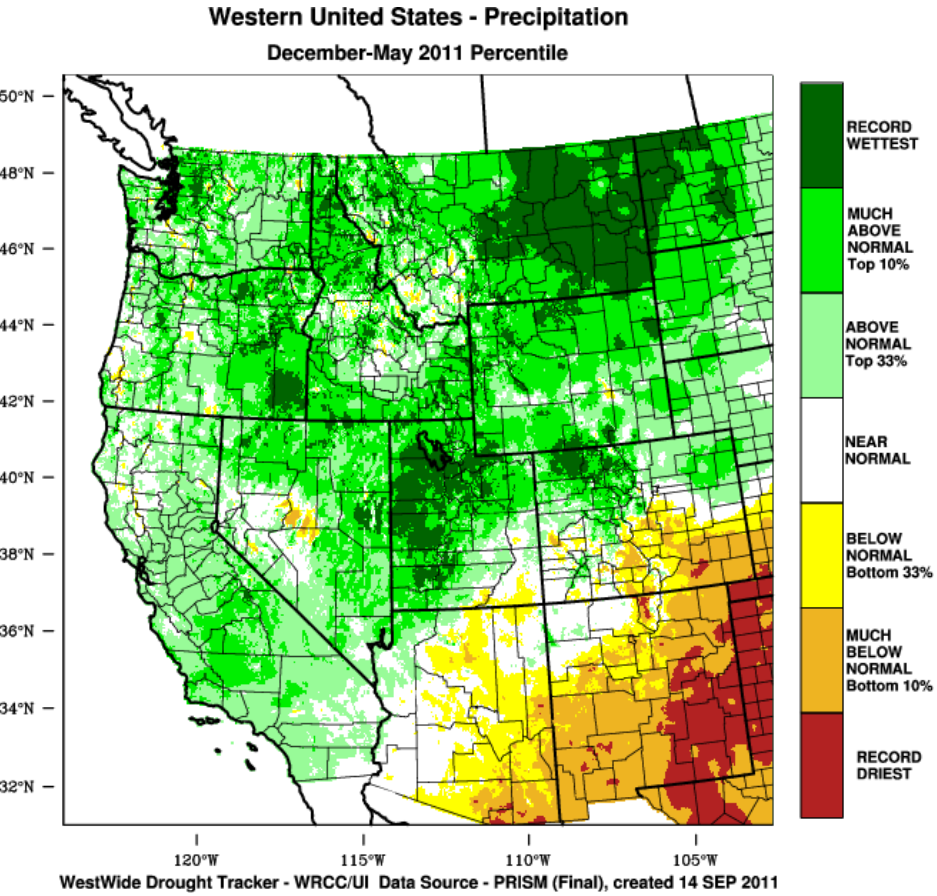
2011 Dec 20 Tenaya Lake ... Skating persisted past mid January 2012

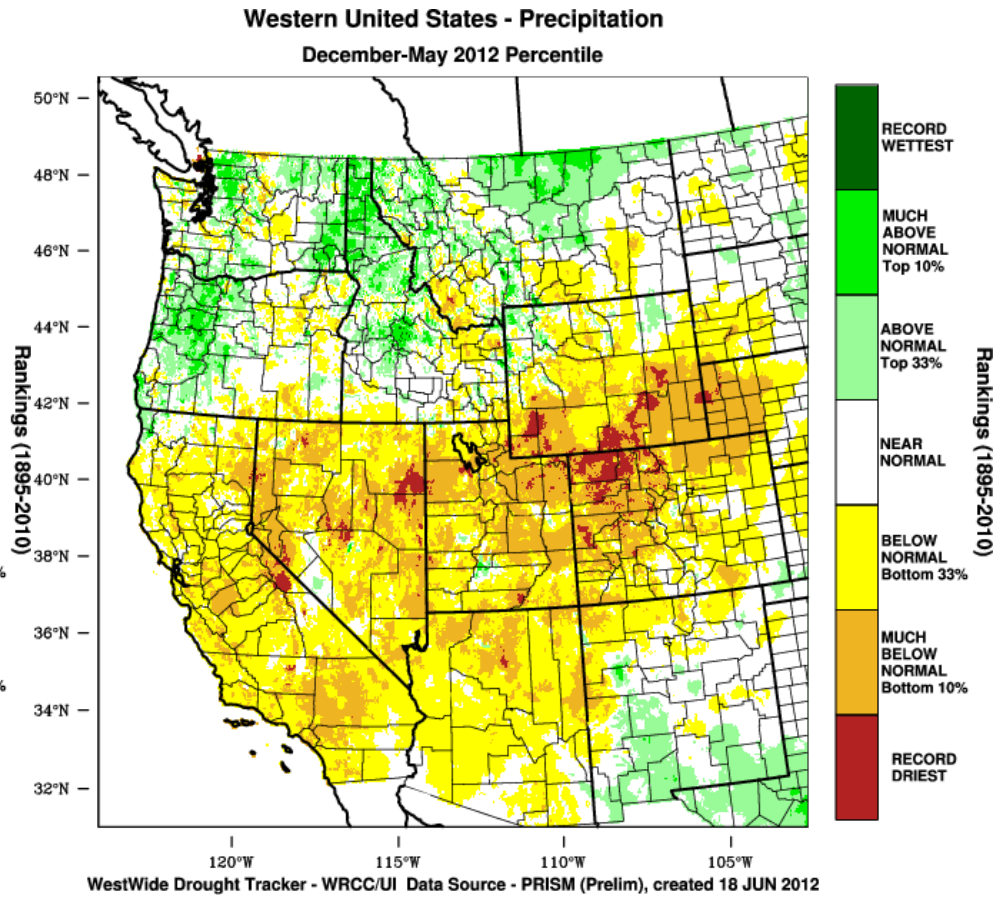
treeinthedoorvideo.blogspot.com

2011 Dec 20 Tenaya Lake ... Skating persisted past mid January 2012

A Tale of Two Winters

December-May 2010-2011 Precip Percentile December-May 2011-12





Leave Feedback

WestWideDroughtTracker

About | Current Maps | Archived Maps | Time Series | Contact

Select Year: 2012 Select Month: 6

Submit

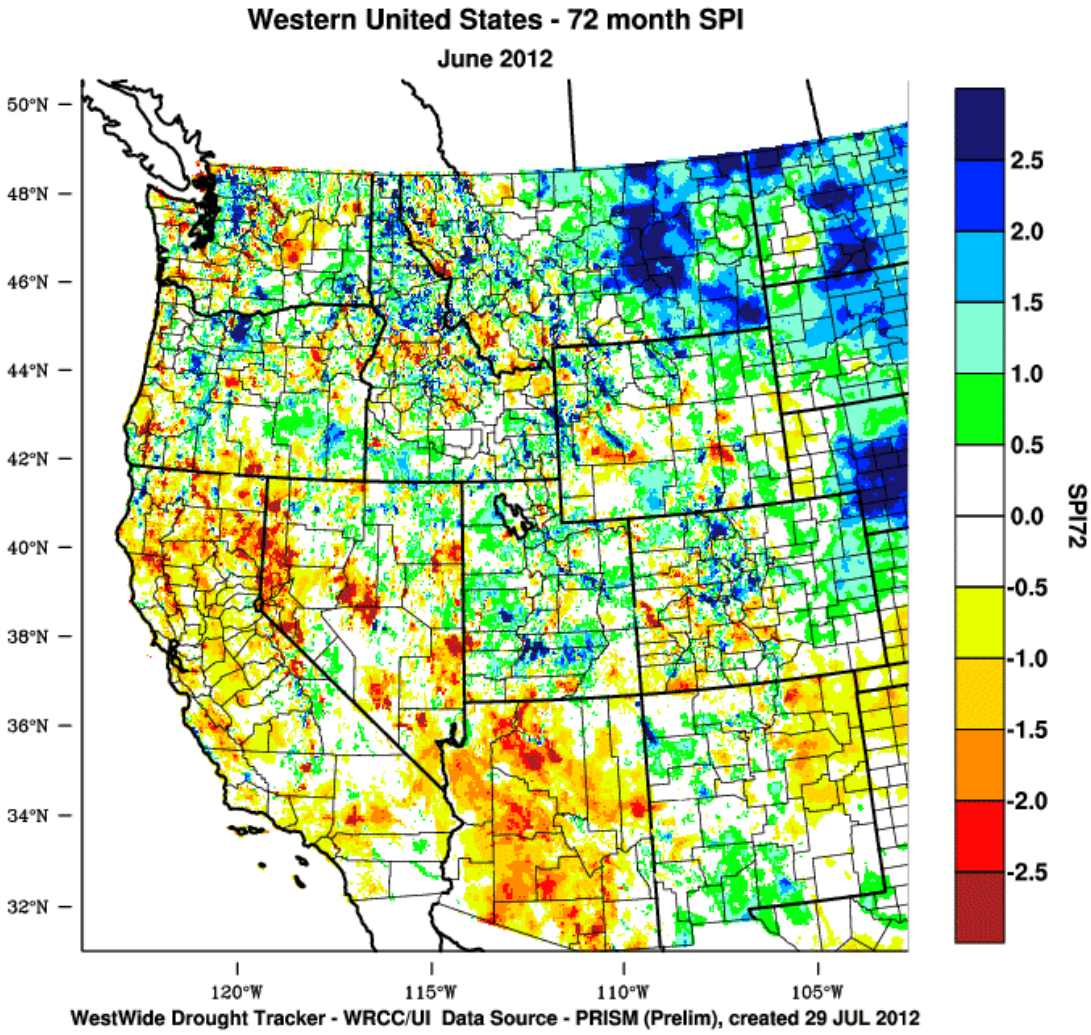
Choose Year/Month, press Submit and then choose product below

Climate Product Options

Expand All | Contract All

- Variable
  - Drought Index
    - Palmer Index
    - SPI
      - 1 Month
      - 2 Months
      - 3 Months
      - 4 Months
      - 5 Months
      - 6 Months
      - 7 Months
      - 8 Months
      - 9 Months
      - 10 Months
      - 11 Months
      - 12 Months
      - 15 Months
      - 18 Months
      - 24 Months
      - 30 Months
      - 36 Months
      - 48 Months
      - 60 Months
      - 72 Months
    - SPEI
  - Climate
- Region
  - Western US
  - Arizona
  - California

Archived Image:
PRISM > 06/2012 > SPI 72 Month > United States



Download PRISM SPI 72 Month NETCDF Data for United States

Download PRISM SPI 72 Month GeoTIFF Data for United States

Archive

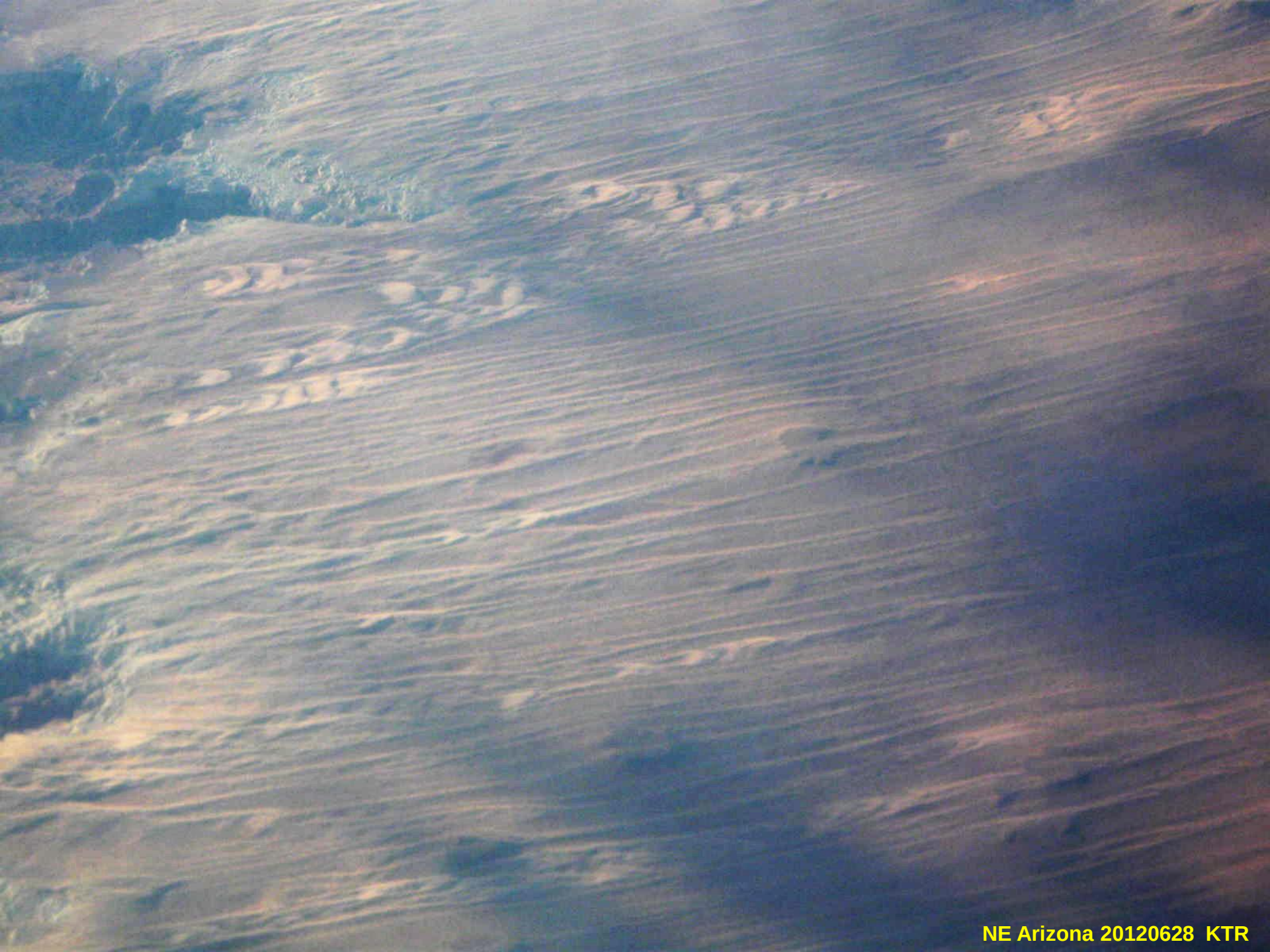
SPI 72-mo Ending June 2012

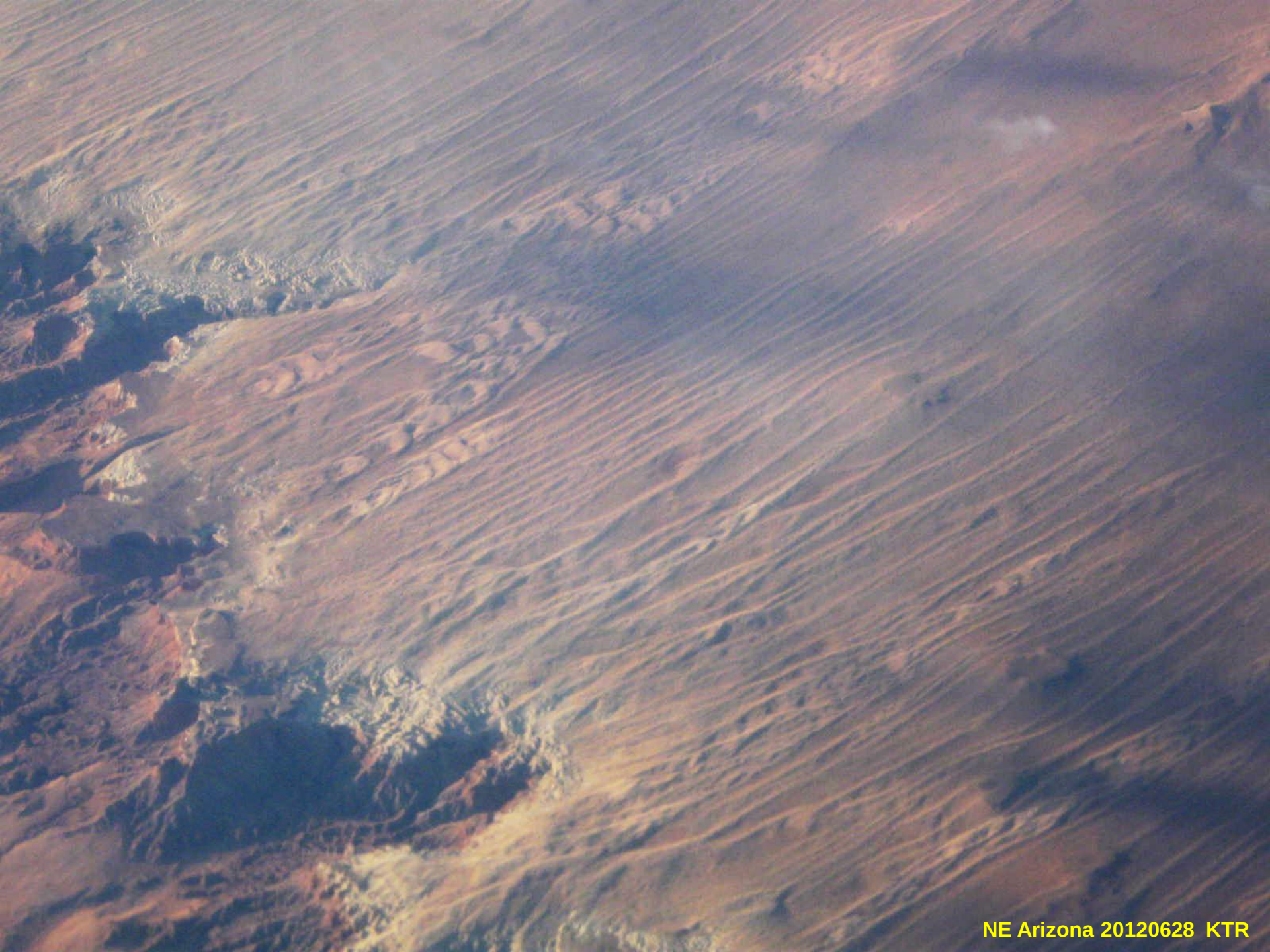
Side Point:

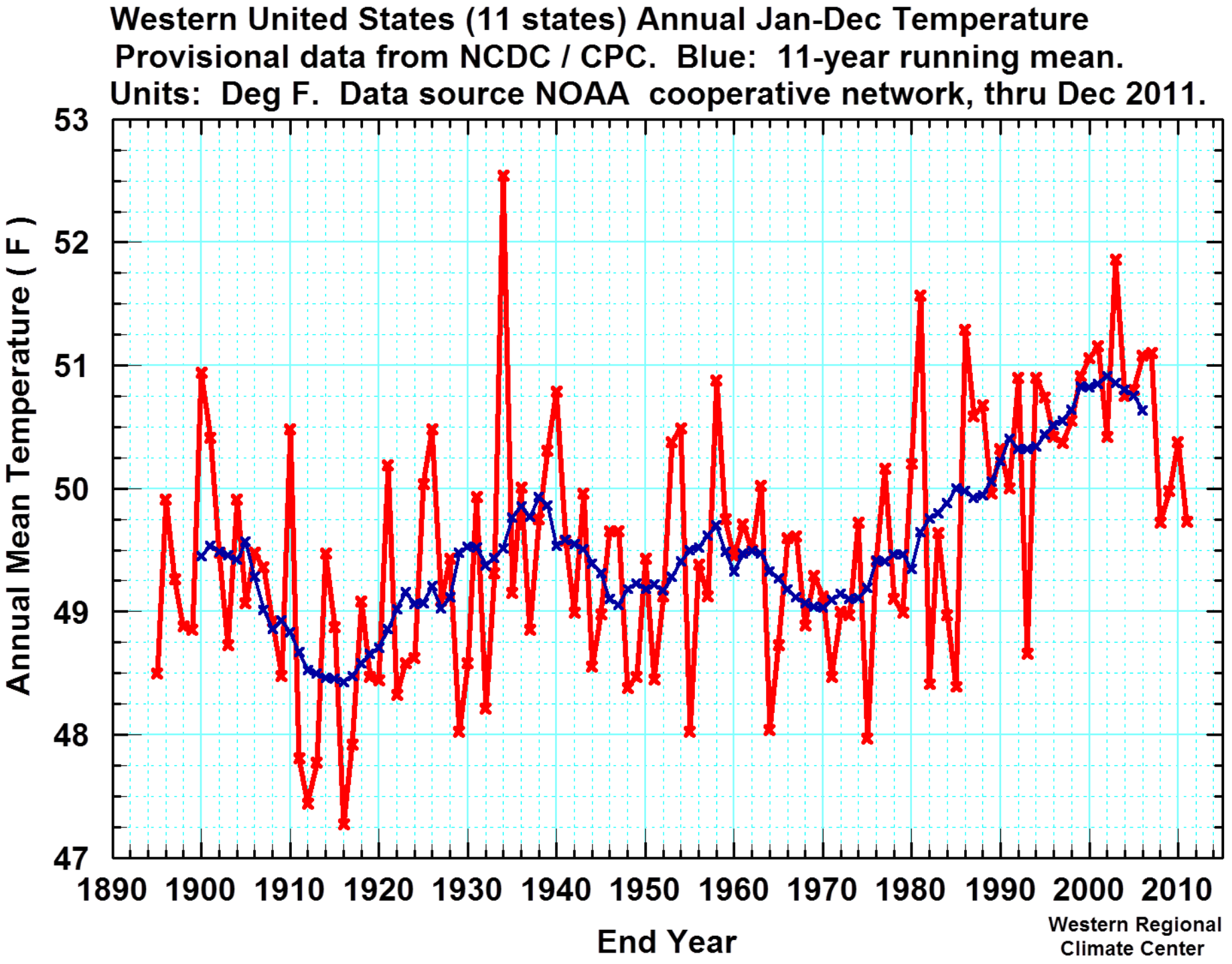
Fine scale structure

Blotchy pattern Is likely realistic but is it this particular pattern ?

NE Arizona 20120628 KTR


NE Arizona 20120628 KTR


NE Arizona 20120628 KTR


Western United States (11 states) Annual Jan-Dec Temperature
Provisional data from NCDC / CPC. Blue: 11-year running mean.
Units: Deg F. Data source NOAA cooperative network, thru Dec 2011.
Annual Mean Temperature (F)
53
52
51
50
49
48
47
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
End Year
Western Regional
Climate Center

Leave Feedback

WestWideDroughtTracker

About | Current Maps | Archived Maps

Select Year: 1934 Select Month: 12

Submit

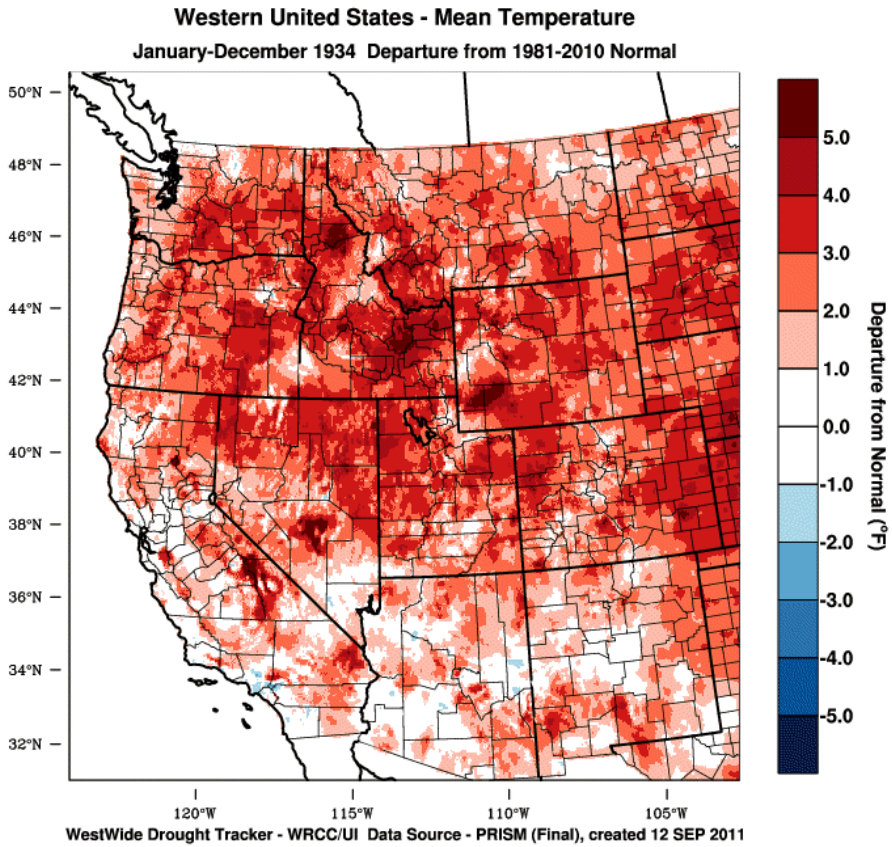
Choose Year/Month, press Submit and then choose product below

Climate Product Options

Expand All | Contract All

- Variable
  - Drought Index
    - Palmer Index
      - PDSI
      - Palmer Z-Index
      - Self-Calibrated PDSI
    - SPI
    - SPEI
  - Climate
    - Temperature
      - Anomaly
        - Last Full Month
        - Last 2-Months
        - Last 3-Months
        - Last 4-Months
        - Last 5-Months
        - Last 6-Months
        - Last 7-Months
        - Last 8-Months
        - Last 9-Months
        - Last 10-Months
        - Last 11-Months
        - Last 12-Months
      - Percentile
    - Precipitation
      - Anomaly
      - Percentile
- Region
  - Western US
  - Arizona
  - California
  - Colorado
  - Idaho
  - Montana
  - Nevada
  - New Mexico
  - Oregon
  - Utah
  - Washington
  - Wyoming
  - United States

Archived Image:
PRISM > 012/1934 > Temperature Anomaly 12 Month > Western US



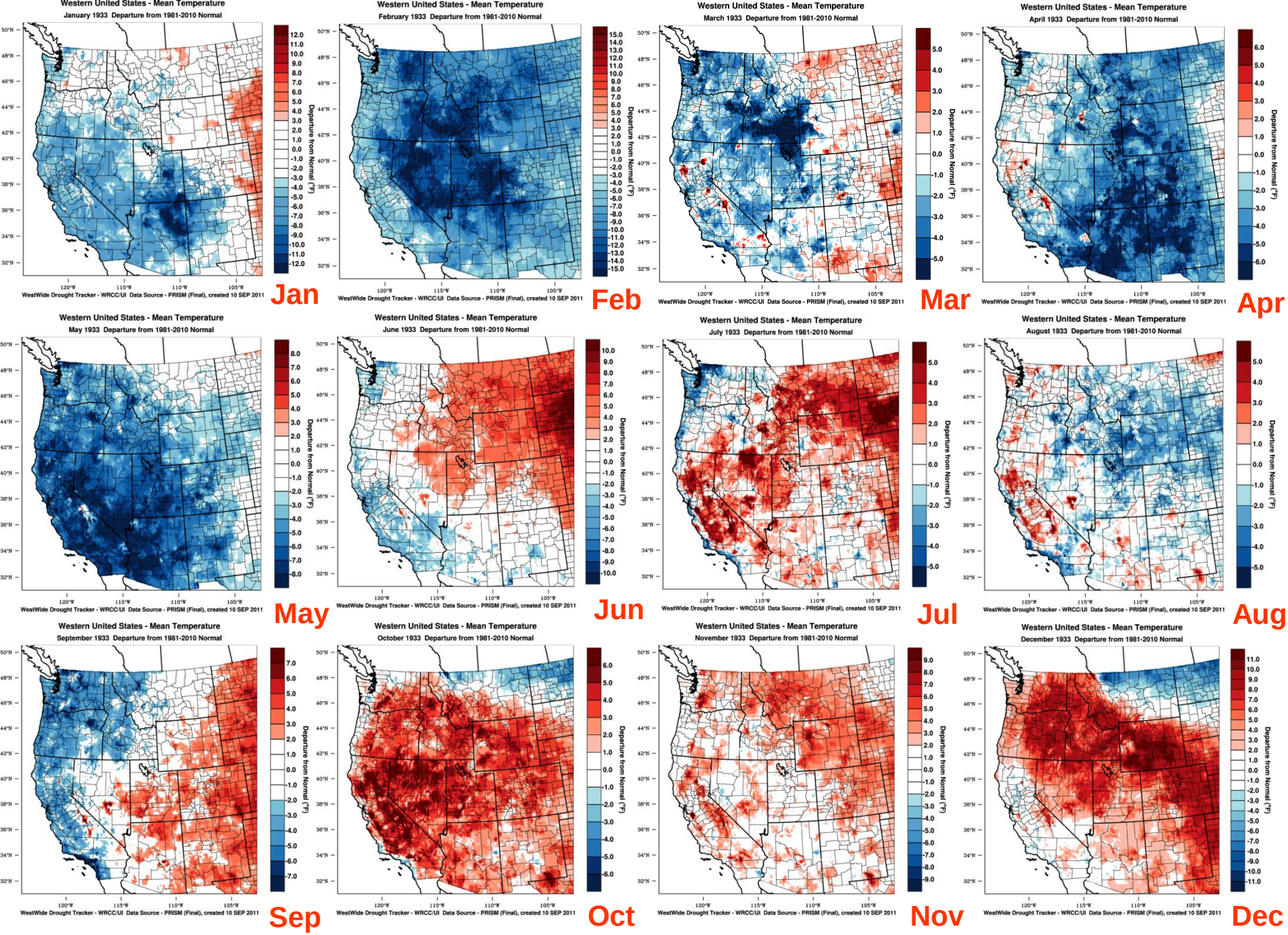
Download PRISM Temperature Anomaly 12 Month NETCDF Data for United States

Download PRISM Temperature Anomaly 12 Month GeoTIFF Data for United States

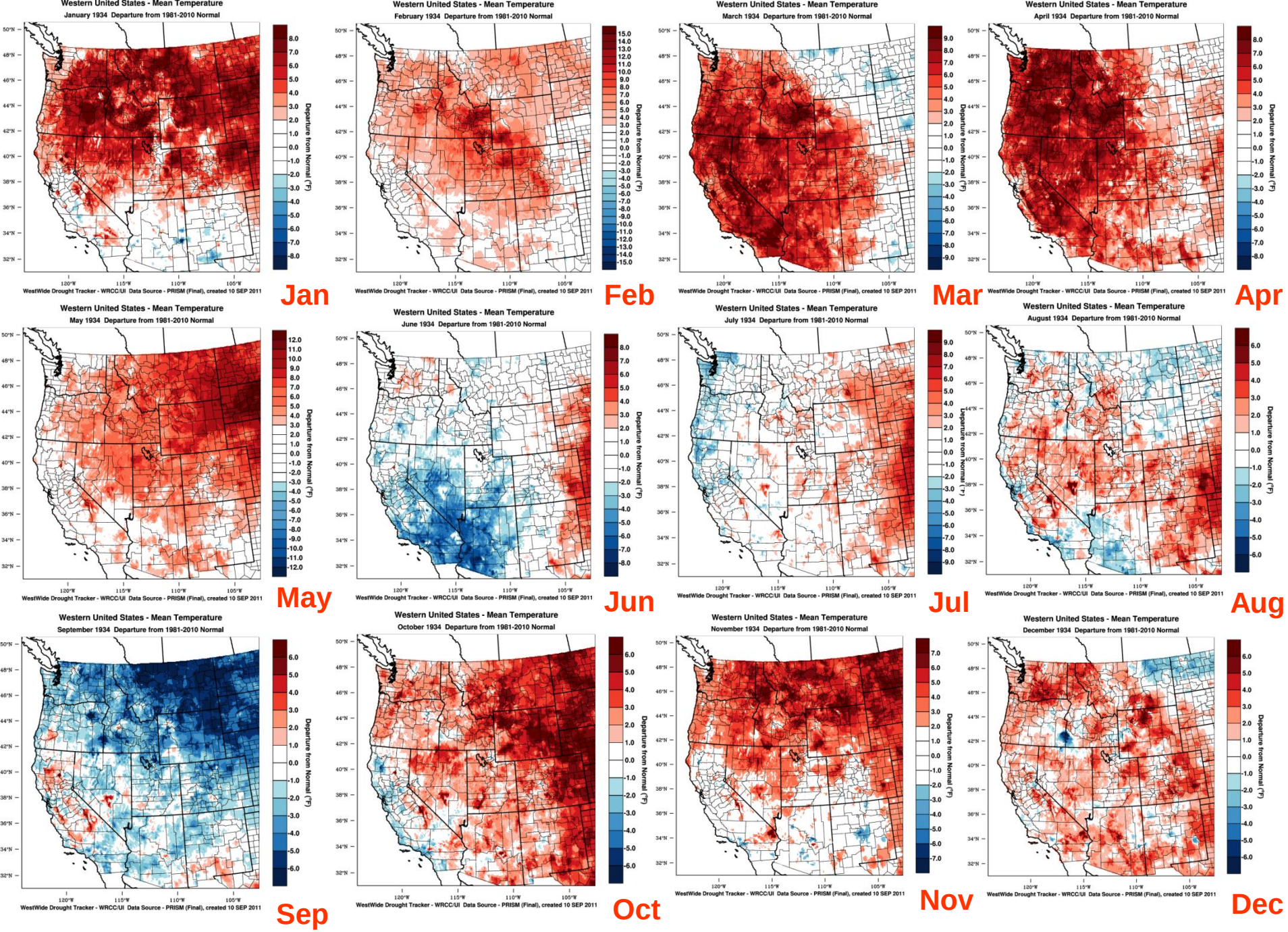
Archive

Temperature Departure

12-mo Ending Dec 1934

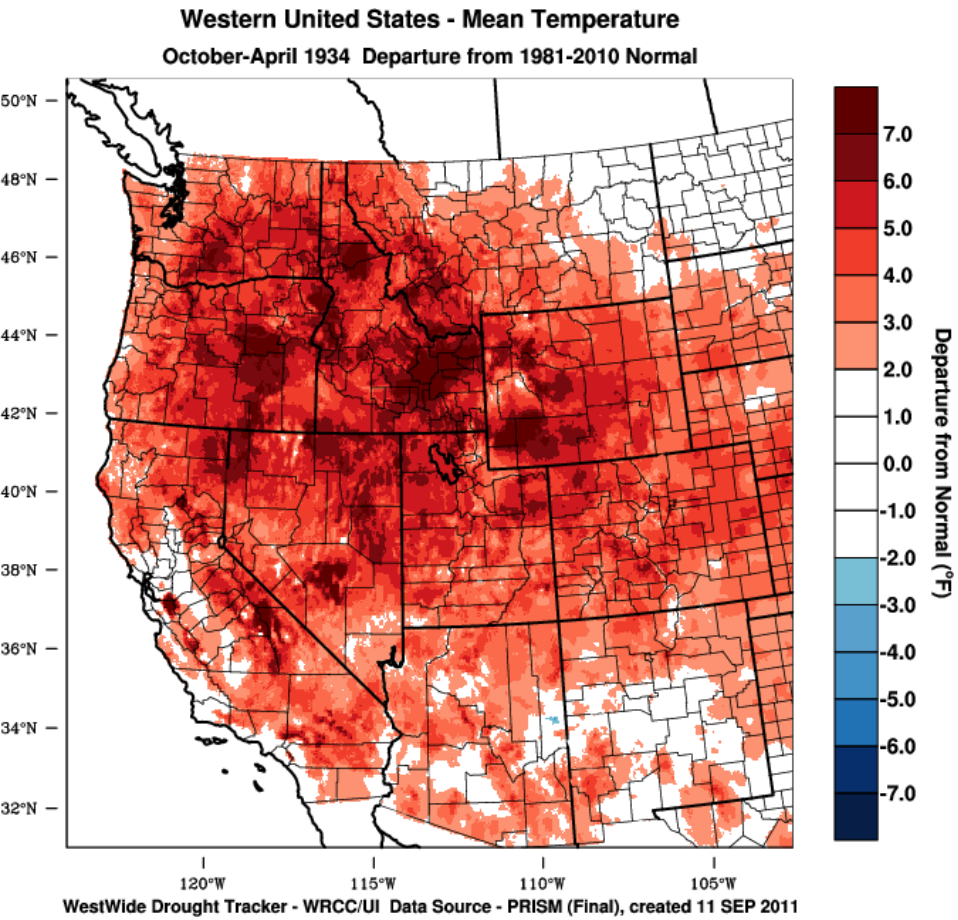


Jan thru Dec 1933

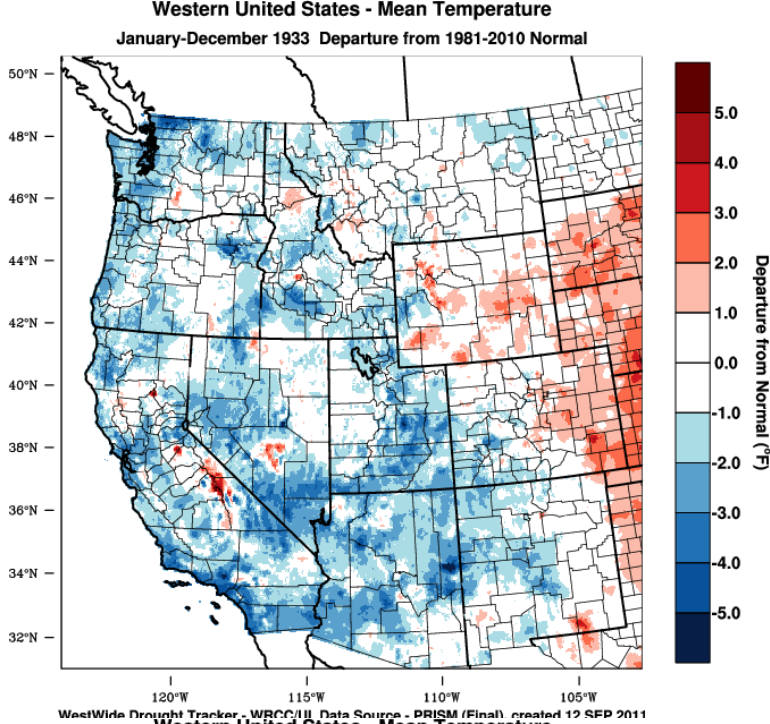


Jan thru Dec 1934

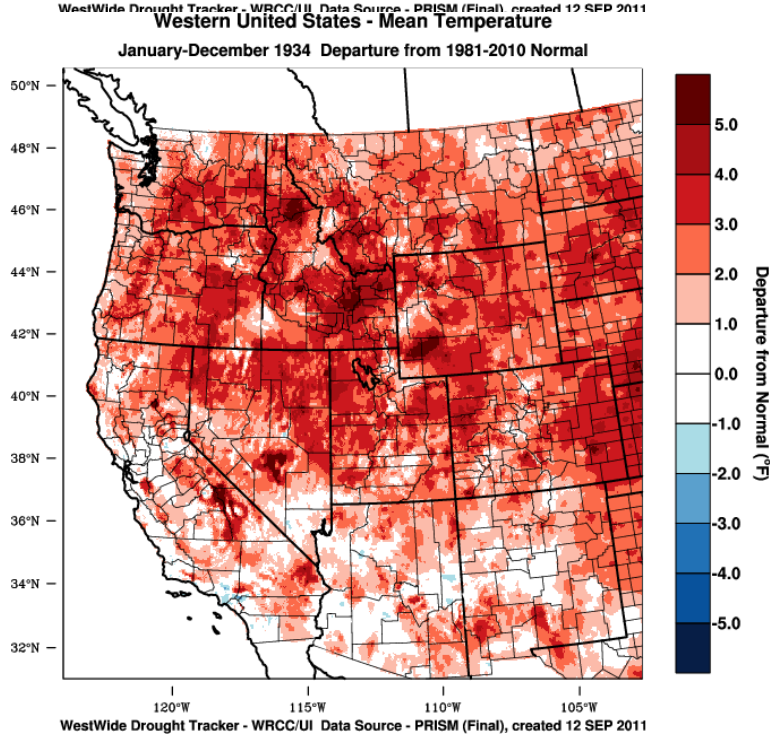
Oct - Apr 1933-34

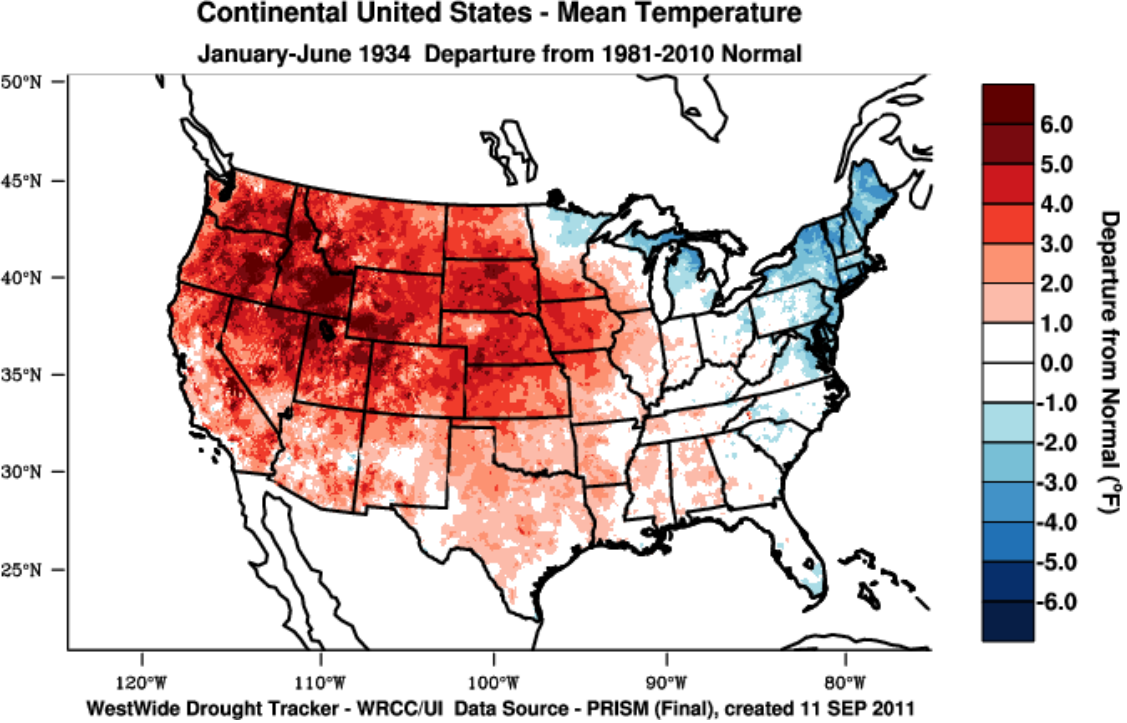


Annual 1933



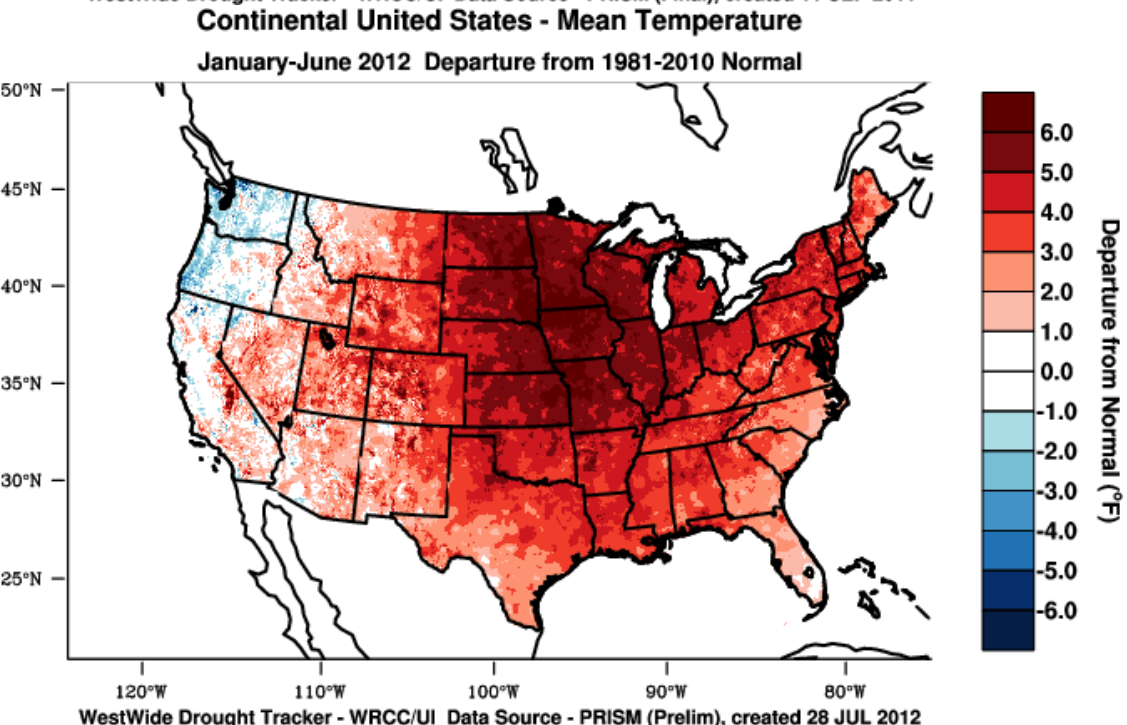
Annual 1934





Jan - Jun 1934

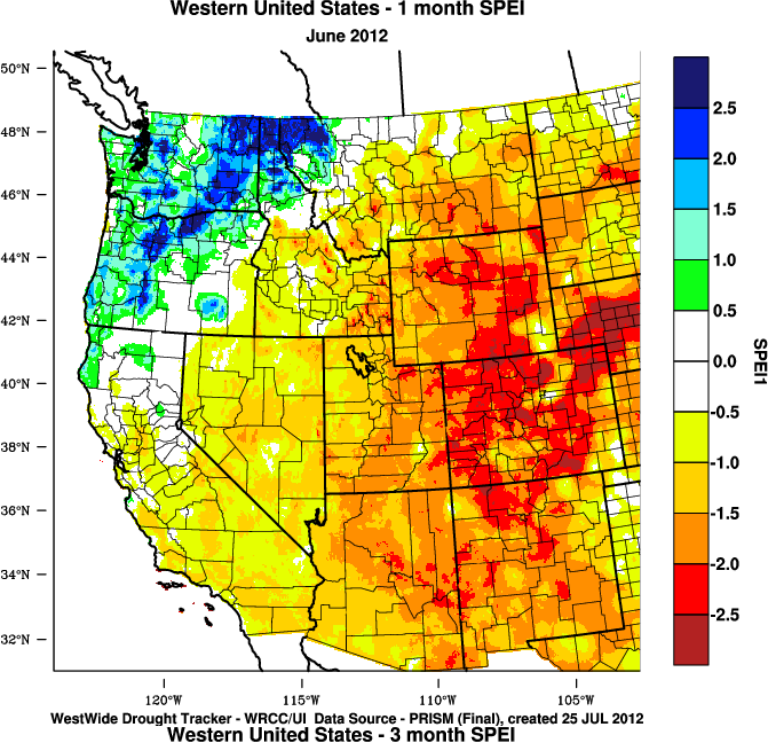
Temp



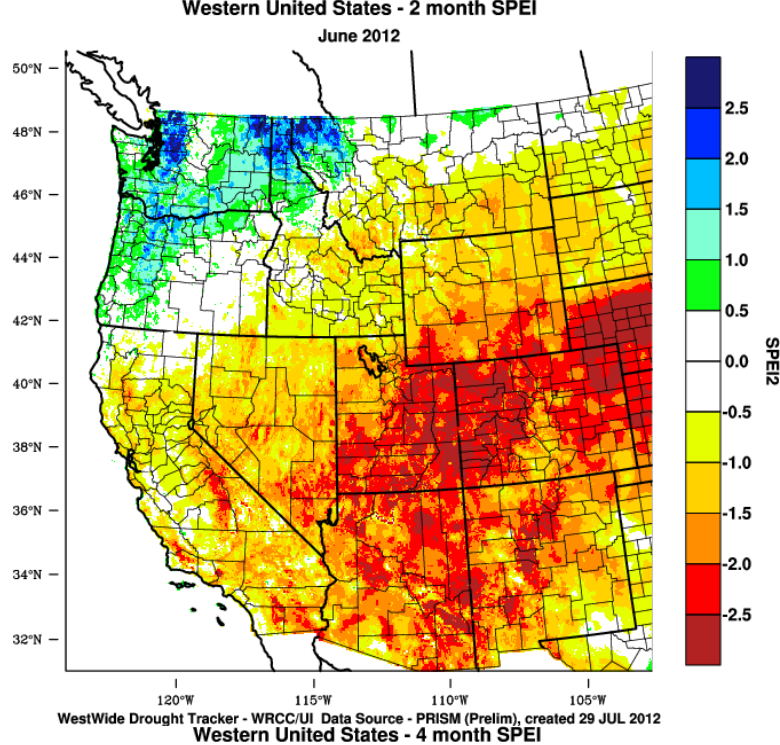
Jan - Jun 2012

Temp

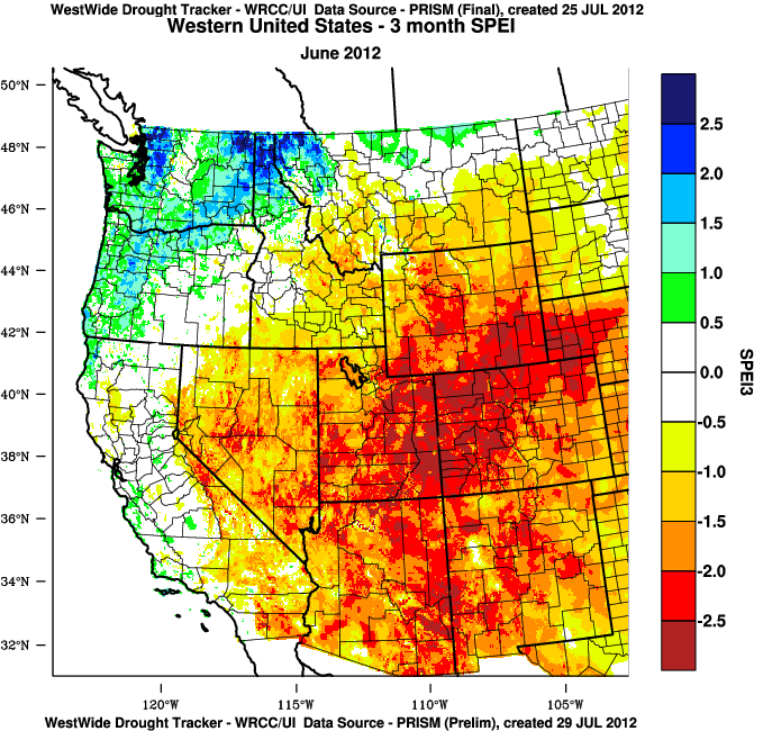
SPEI Thru June 2012



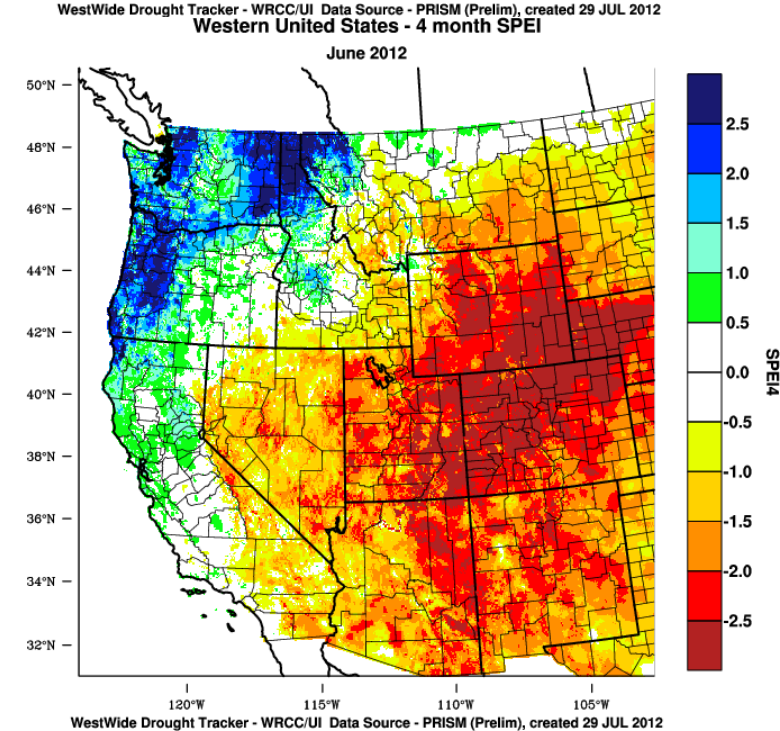
1-mo



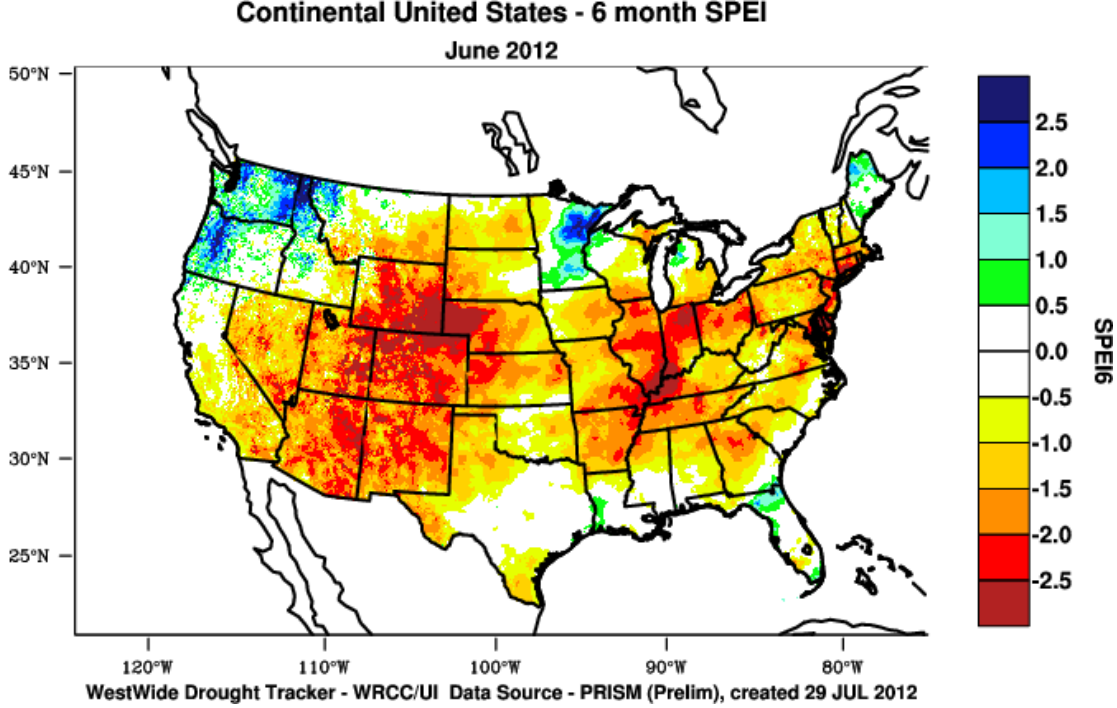
2-mo



3-mo

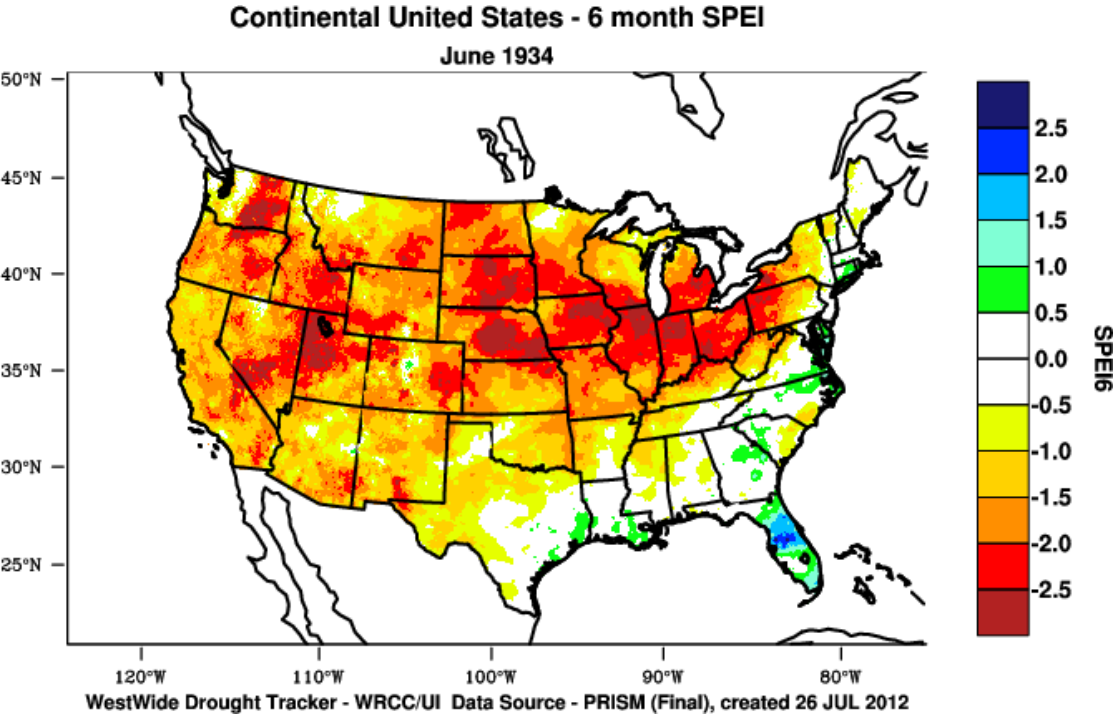


4-mo



Standardized Precipitation Evapotranspiration Index 6-month thru June

2012 6-mo



1934 6-mo

Leave Feedback

WestWideDroughtTracker

About | Current Maps | Archived Maps | Time Series | Contact

Select Year: 1977 Select Month: 4

Submit

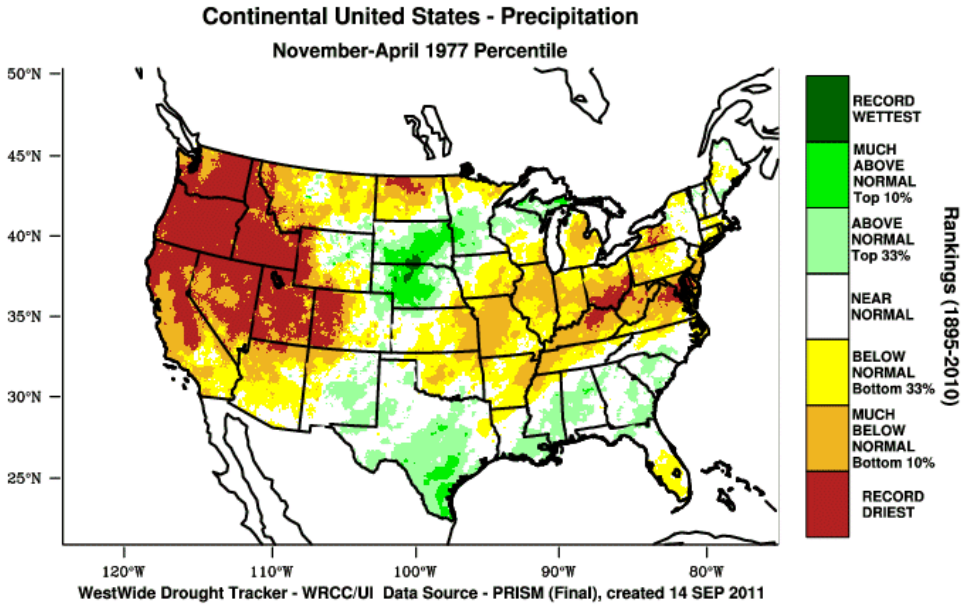
Choose Year/Month, press Submit and then choose product below

Climate Product Options

Expand All | Contract All

- Variable
  - Drought Index
    - Palmer Index
    - SPI
      - 1 Month
      - 2 Months
      - 3 Months
      - 4 Months
      - 5 Months
      - 6 Months
      - 7 Months
      - 8 Months
      - 9 Months
      - 10 Months
      - 11 Months
      - 12 Months
      - 15 Months
      - 18 Months
      - 24 Months
      - 30 Months
      - 36 Months
      - 48 Months
      - 60 Months
      - 72 Months
    - SPEI
  - Climate
    - Temperature
    - Precipitation
      - Anomaly
      - Percentile
        - Last Full Month
        - Last 2-Months
        - Last 3-Months
        - Last 4-Months
        - Last 5-Months
        - Last 6-Months

Archived Image:
PRISM > 04/1977 > Precipitation Percentile 6 Month > United States



Download PRISM Precipitation Percentile 6 Month NETCDF Data for United States

Download PRISM Precipitation Percentile 6 Month GeoTIFF Data for United States

Time Series

of

Points
Areas
Stations

WestWide Drought Tracker: Nationwide Extension

How To Use

Point Data
Click within the contiguous lower 48 states to add a draggable marker to the map. Clicking and dragging the marker will automatically fill in the Latitude/Longitude forms needed to use the time series, all data, and climate span tools located on the right hand side of the page. After the marker has been dragged to a location, the green map represents data that can get pulled whereas a red map means data can not be pulled. It is also possible to enter a latitude and longitude value.

Region/Station Data
Click on the radio button to add the clickable feature datalayer to the map. Clicking the region/station marker will automatically fill in the region drop down menu forms needed to use the time series, all data, and climate span tools located on the right hand side of the page. It is also possible to use the drop down menus to select region/station.

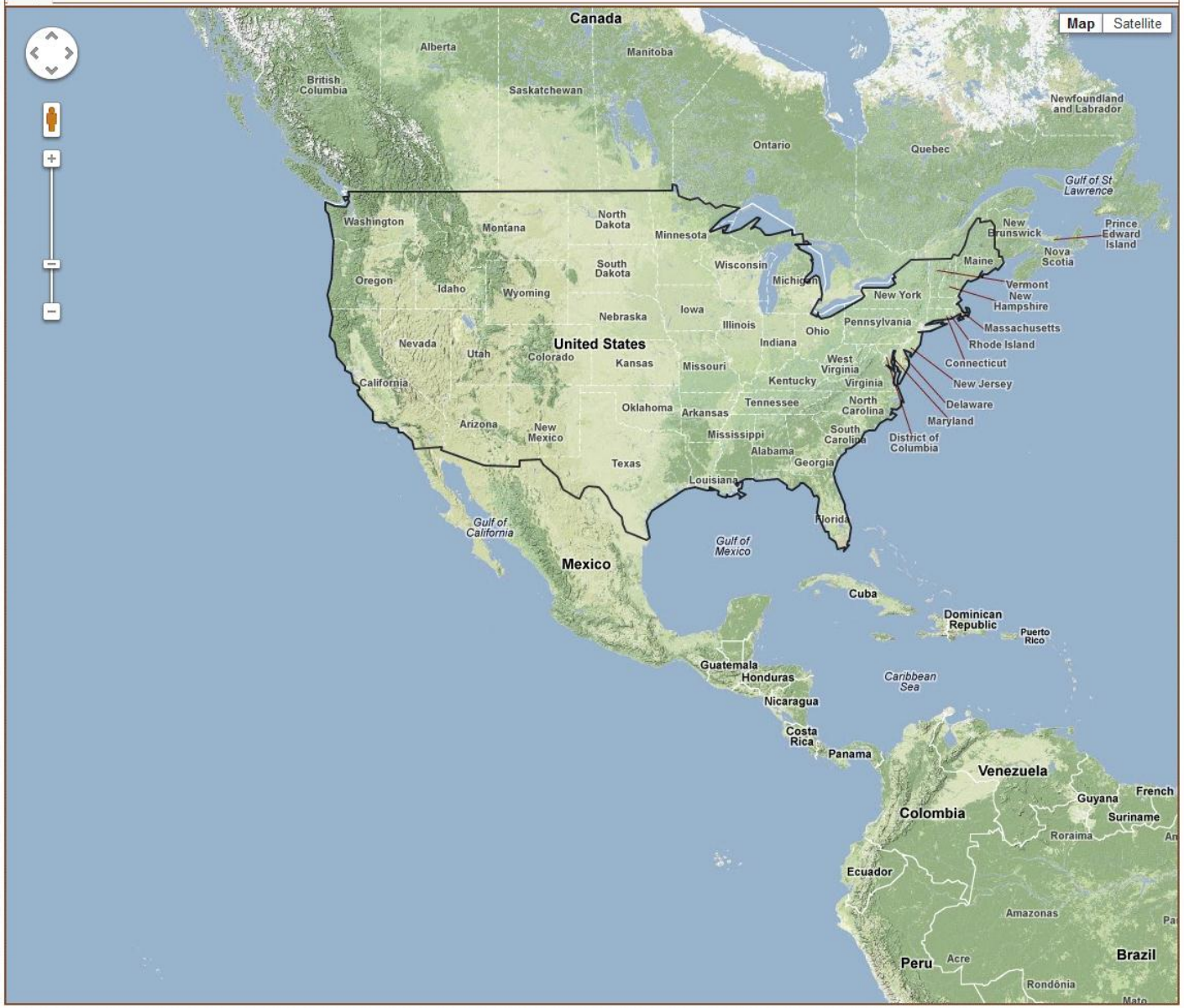
Data Options
Select variables using the dropdown menus.

Getting the Product
Press the submit button located in each of the time series, all data, and climate span tools to generate results for each separate tool. The results will be loaded into a new tab above the map and next to the Map tab.

Contact

Disclaimer

Map



Data Type

- (•) Point 4x4 km Spatial Resolution
- ( ) Lower 48 States and DC
- ( ) County and Equivalent Areas
- ( ) Hydrologic Units
- ( ) Climate Divisions (DIV)
- ( ) Predictive Services Areas
- ( ) Stations

Time Series

Climate Spans

All Data

HUCs - Willamette, Colorado Headwaters

WestWide Drought Tracker: Nationwide Extension

How To Use

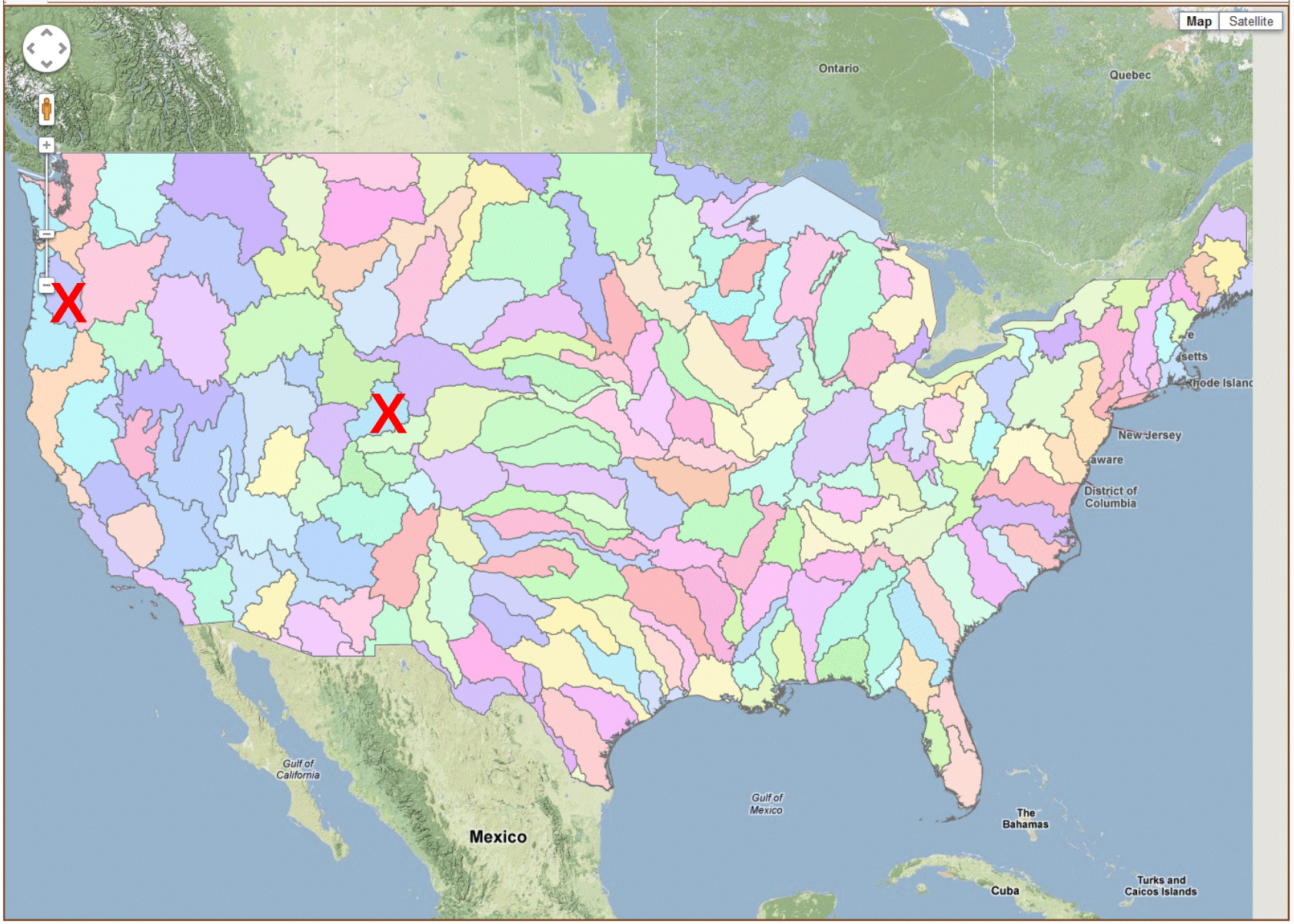
Point Data *Click within the contiguous lower 48 states to add a draggable marker to the map. Clicking and dragging the marker will automatical fill in the Latitude/Lor forms needed to use the time series, all data, and climate span tools located on the right hand side of the page. After the marker has been dragged to a location, the green map represents data that can get pulled whereas a red map means data can not be pulled. It is also possible to enter a latitude and longitude value.*

Region/St Data *Click on the radio button to add the clickable feature datalayer to the map. Clicking the region/stati marker will automatical*

Contact

Disclaim

Map



Data Type

Time Series

Variable Information

Region: Select

Variable: Tempe

Start Year: 1895

End Year: 2012

Month: Januar

Span: 1-Mont

Running Average (Years):

Submit!

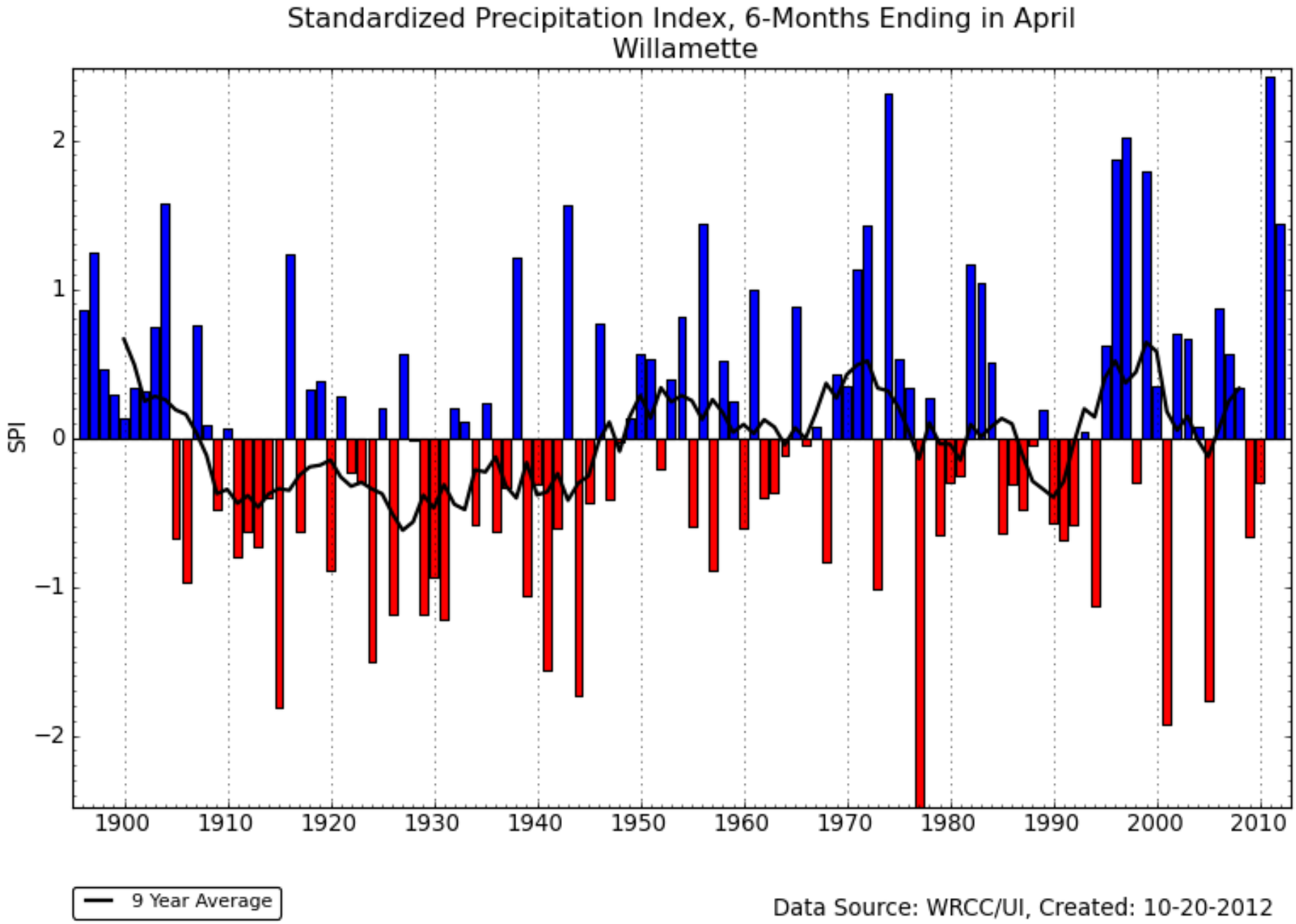
Time Series Box

Function: generate a time series of select variables from 1895 through the most recent complete month.

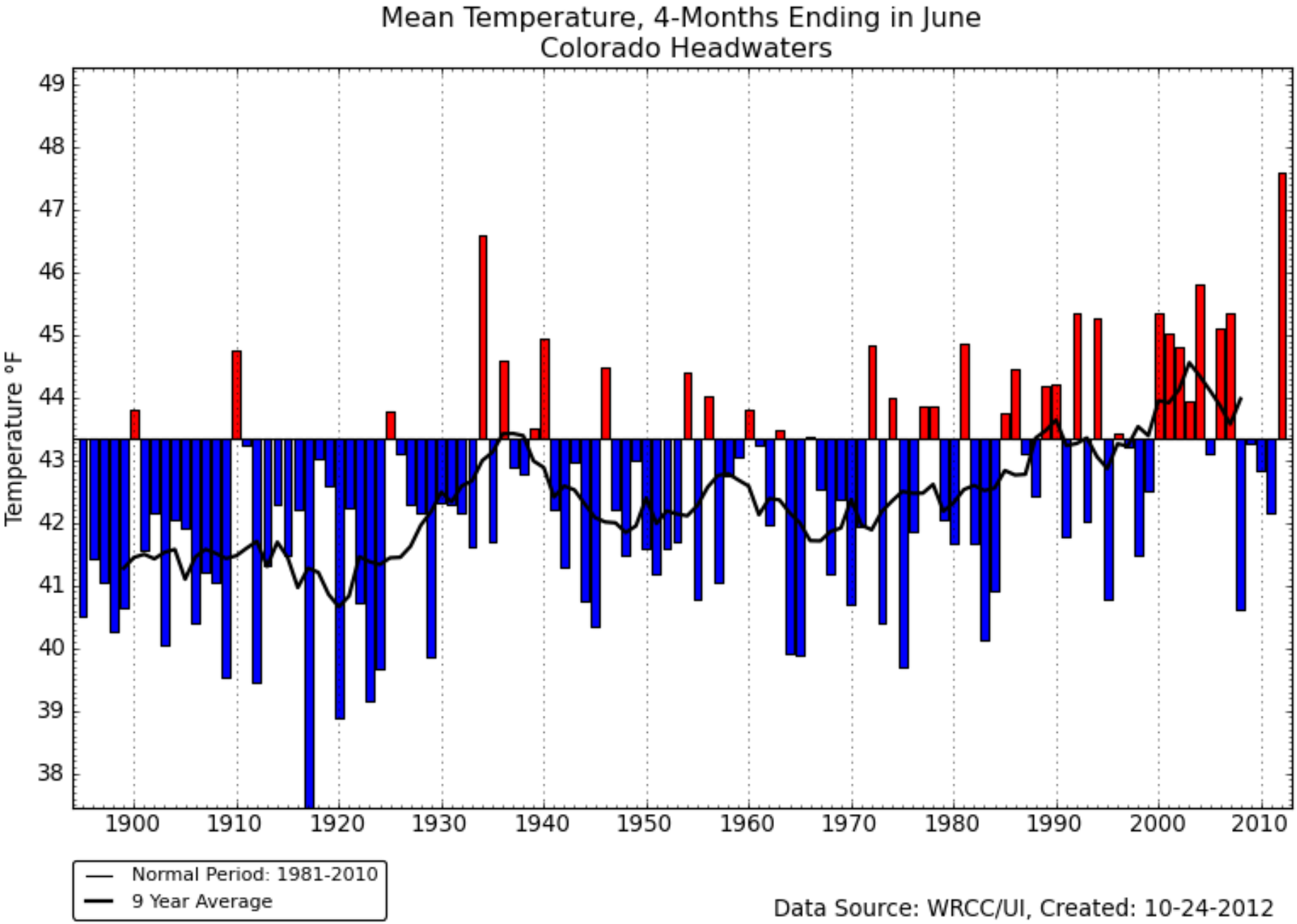
Climate Spans

All Data

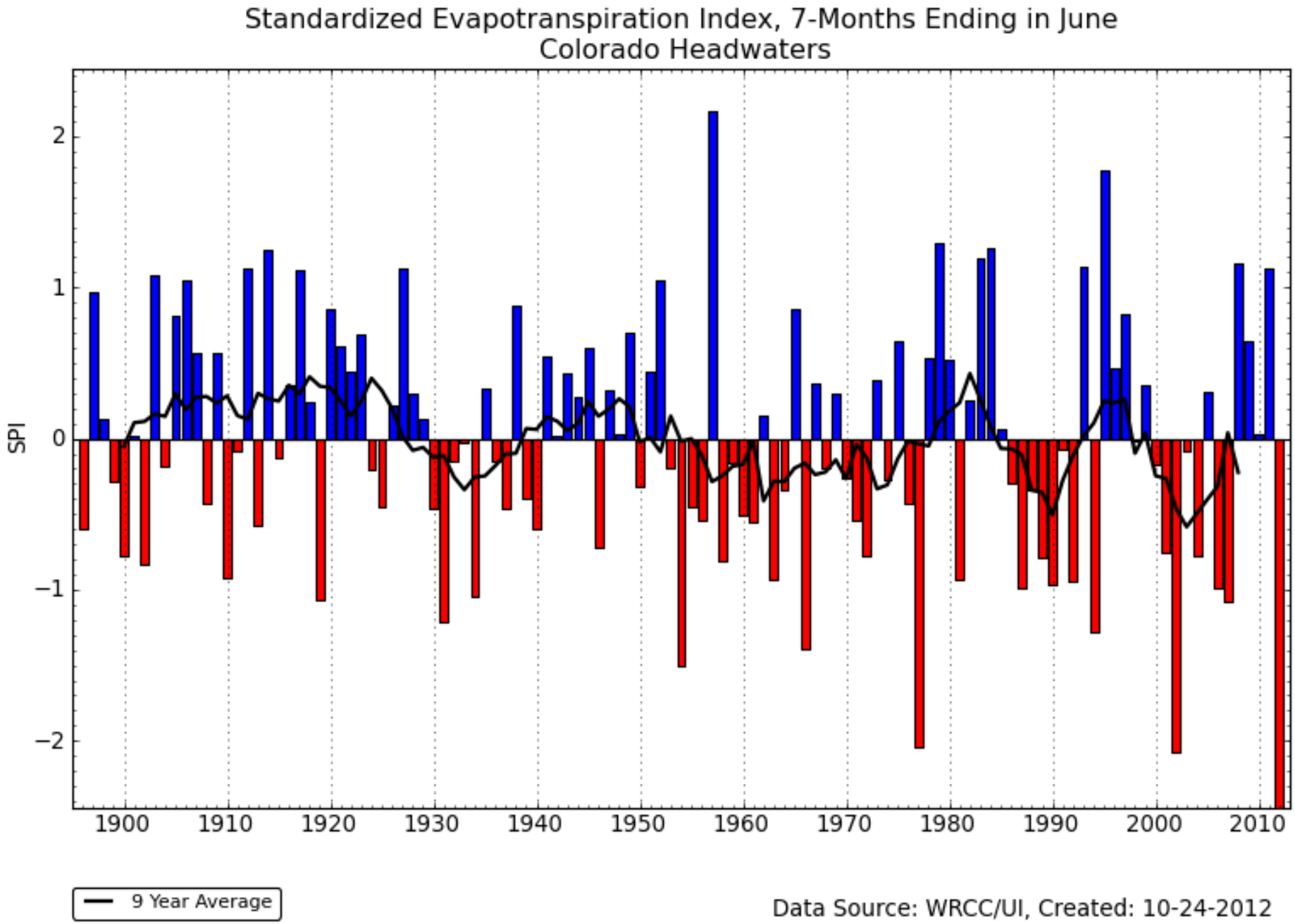
Standardized Precipitation Index 6-mo ending April. Willamette Basin.

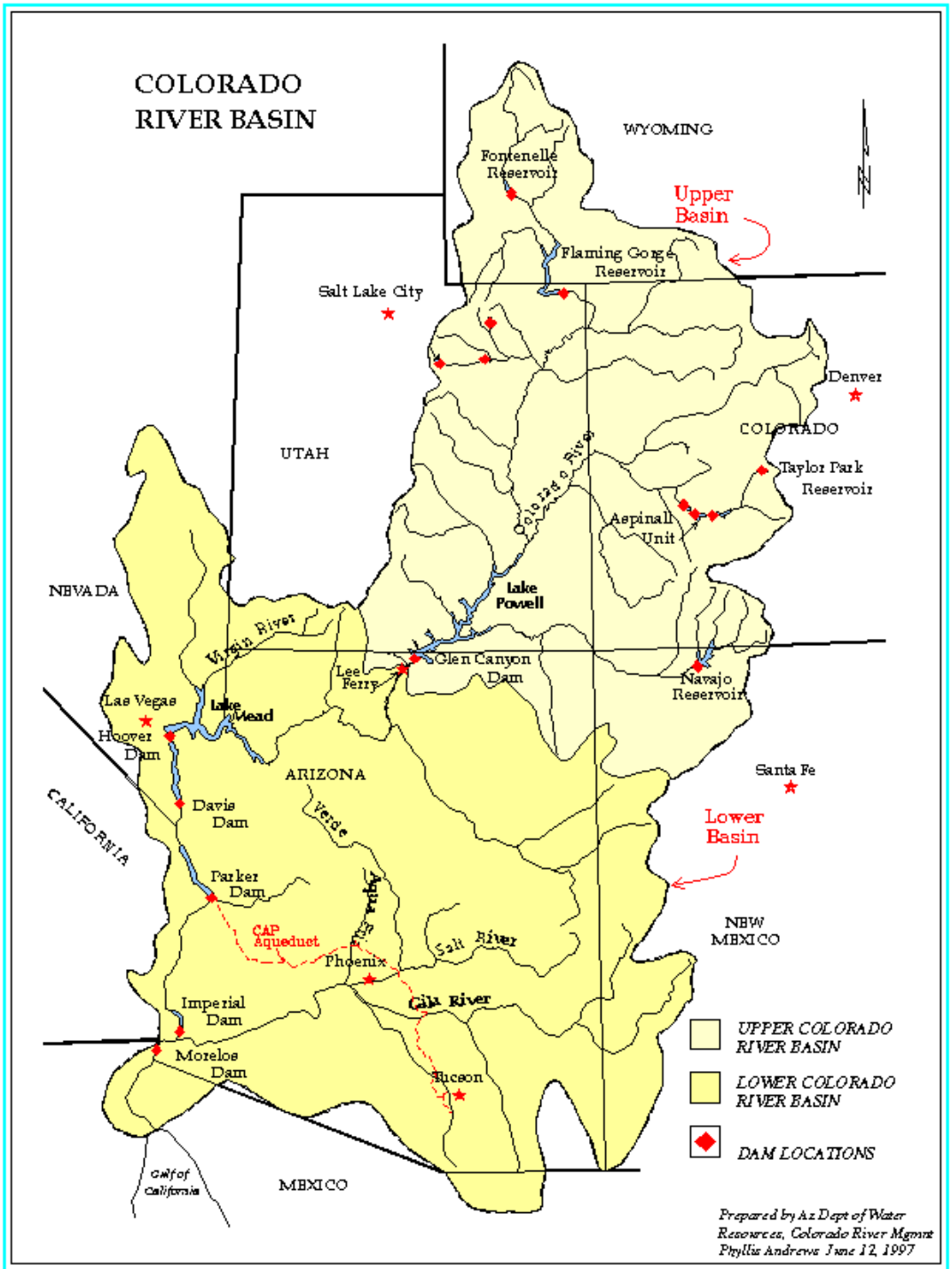


Temperature Departure 4-mo ending June. Upper Colorado River Basin.

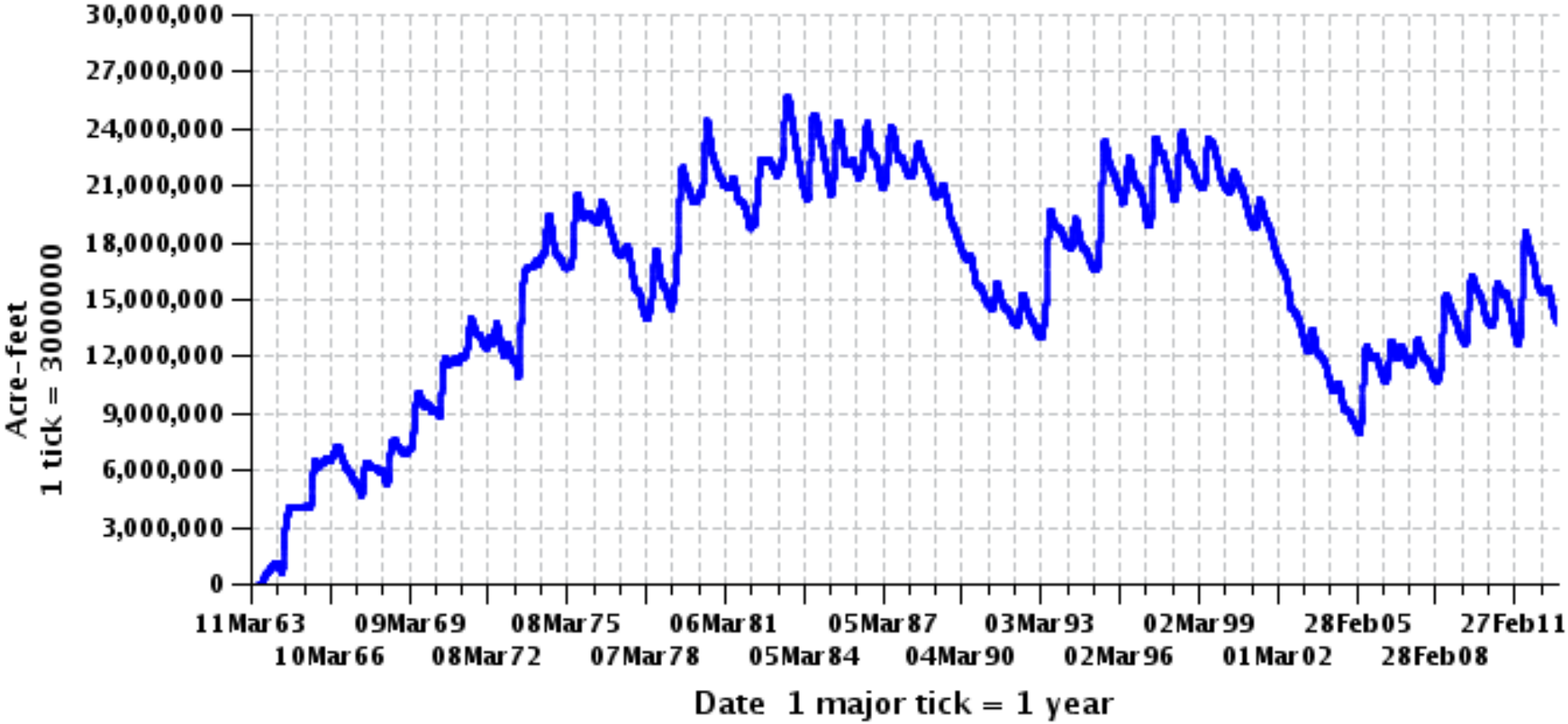


SPEI 7-mo ending June. Upper Colorado River Basin.




COLORADO
RIVER BASIN
WYOMING
Fontenelle Reservoir
Upper Basin
Flaming Gorge Reservoir
Salt Lake City
Denver
COLORADO
UTAH
Taylor Park Reservoir
Colorado River
Aspinall Unit
NEVADA
Lake Powell
Virgin River
Glen Canyon Dam
Lee Ferry
Navajo Reservoir
Las Vegas
Lake Mead
Hoover Dam
ARIZONA
Santa Fe
CALIFORNIA
Davis Dam
Verde
Lower Basin
Parker Dam
Salt River
CAP Aqueduct
Phoenix
NEW MEXICO
Gila River
Imperial Dam
Morelos Dam
Tucson
UPPER COLORADO RIVER BASIN
LOWER COLORADO RIVER BASIN
DAM LOCATIONS
Gulf of California
MEXICO
Prepared by Az Dept of Water Resources, Colorado River Mgmnt
Phyllis Andrews June 12, 1997

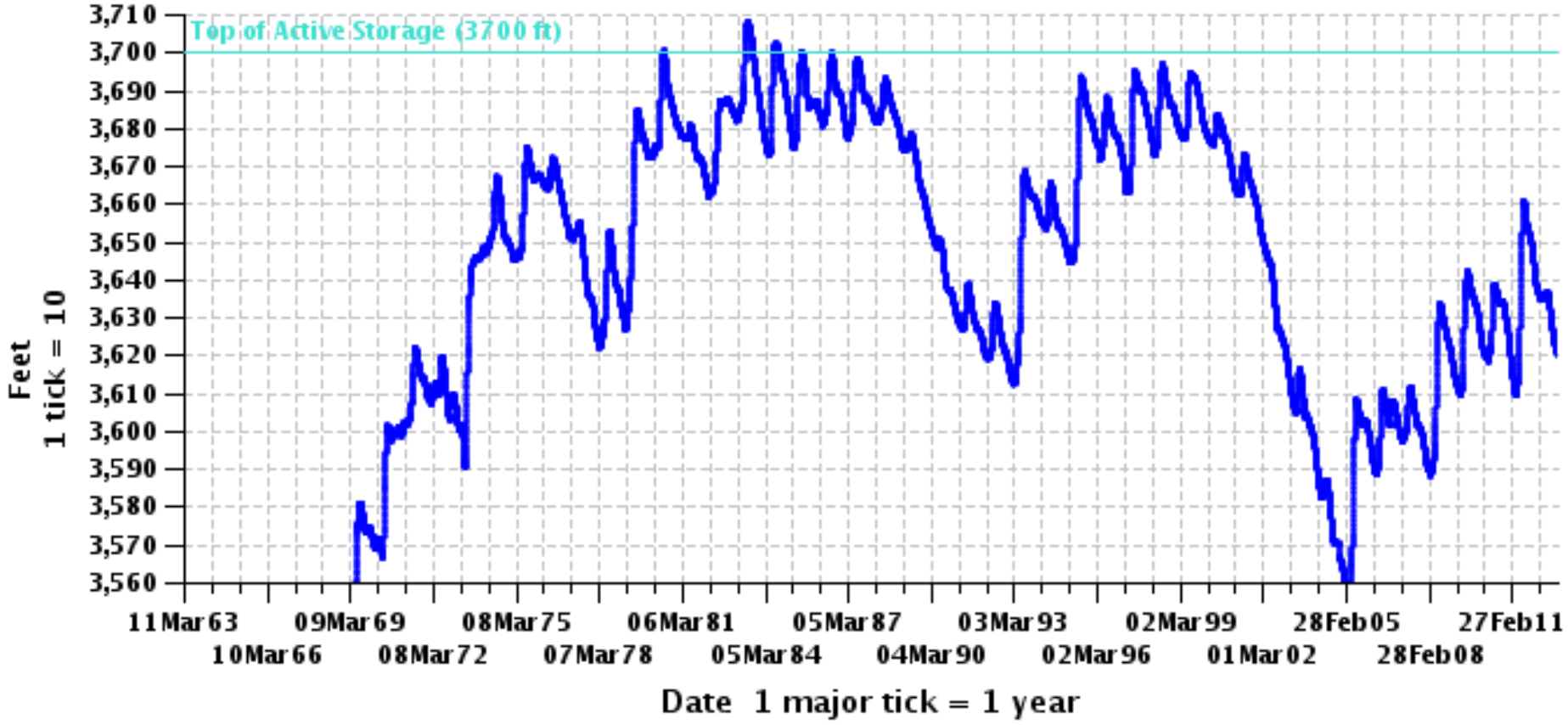
Lake Powell Storage Through October 21, 2012



Currently 57 % full **(capacity 24.17 MAF)**

Minimum: 33 % full on April 8, 2005

Lake Powell Elevation Through October 21, 2012



Water level on Oct 21, 2012 was 3620.18 ft, - 80 ft below full.

Minimum level on April 8, 2005 was 3555 ft, -145 ft below full.

Source: www.usbr.gov/uc/water/index.htl

Counties - Logan

WestWide Drought Tracker: Nationwide Extension

How To Use

Point Data
Click within the contiguous lower 48 states to add a draggable marker to the map. Clicking and dragging the marker will automatically fill in the Latitude/Longitud forms needed to use the time series, all data, and climate span tools located on the right hand side of the page. After the marker has been dragged to a location, the green map represents data that can get pulled whereas a red map means data can not be pulled. It is also possible to enter a latitude and longitude value.

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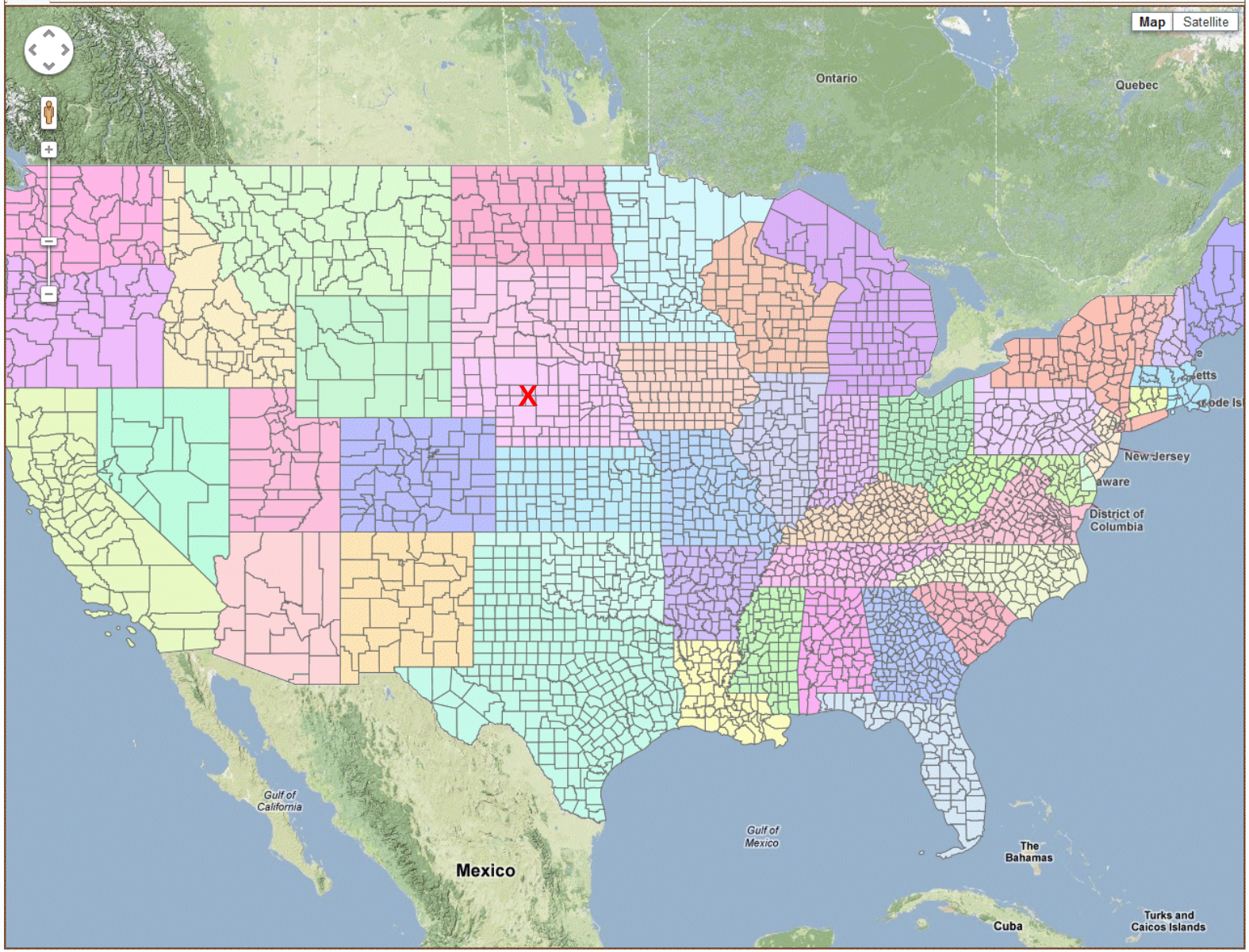
Data Options
Select variables using the dropdown menus.

Contact

Disclaimer

Map



Data Type

Time Series

Variable Information

Region:	Select County
Variable:	Temperature
Start Year:	1895
End Year:	2012
Month:	January
Span:	1-Month
Running Average (Years):	

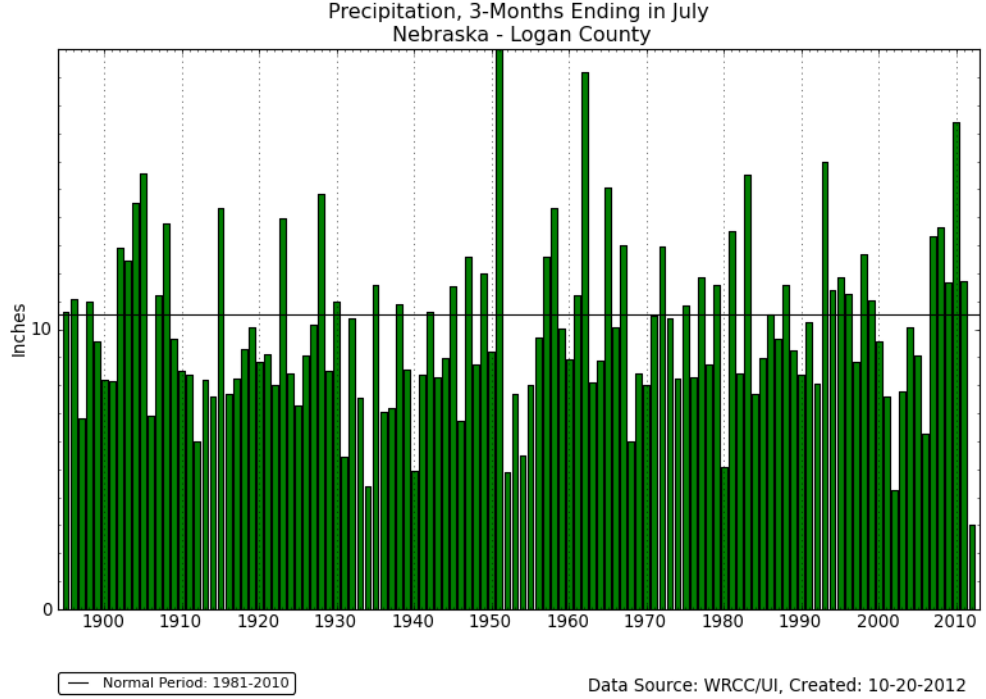
Submit!

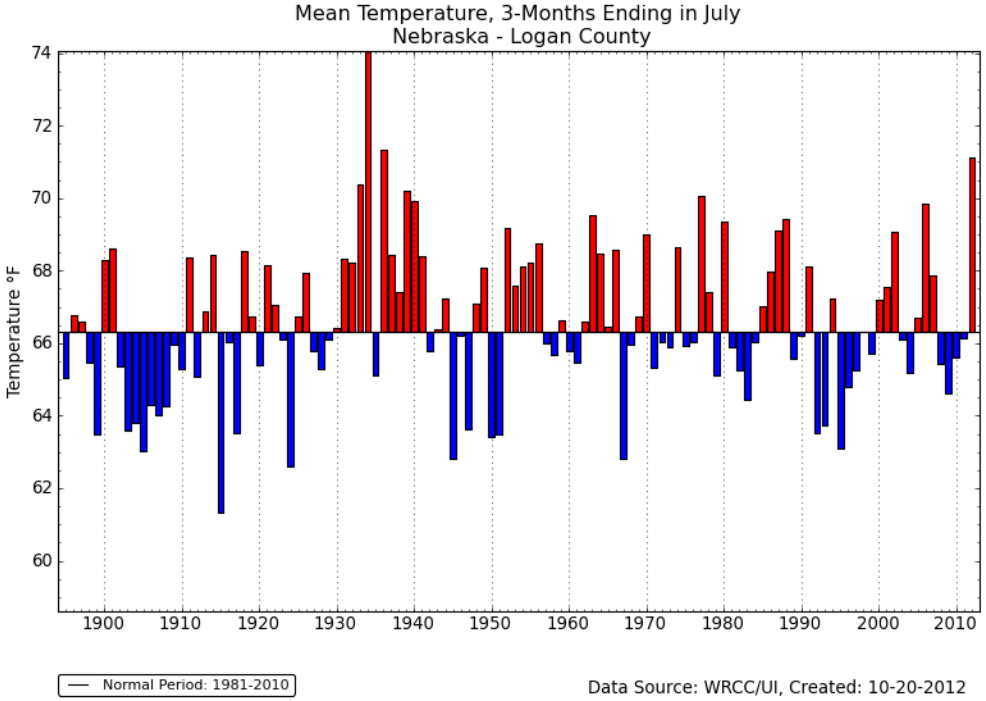
Time Series Box

Function: generate a time series of select variables from 1895 through the most recent complete month.

Climate Spans

All Data





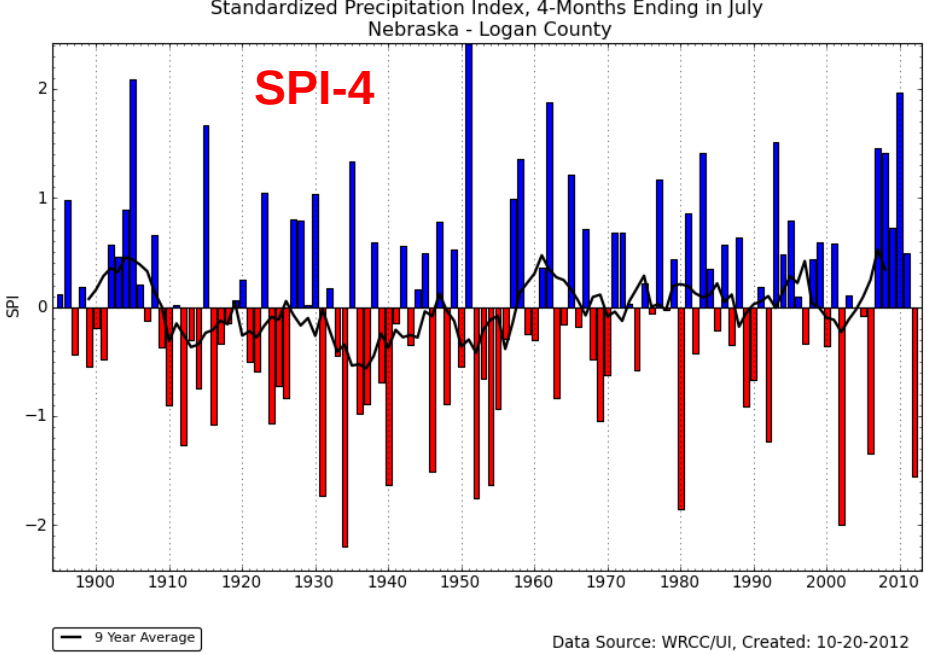
Logan County Nebraska

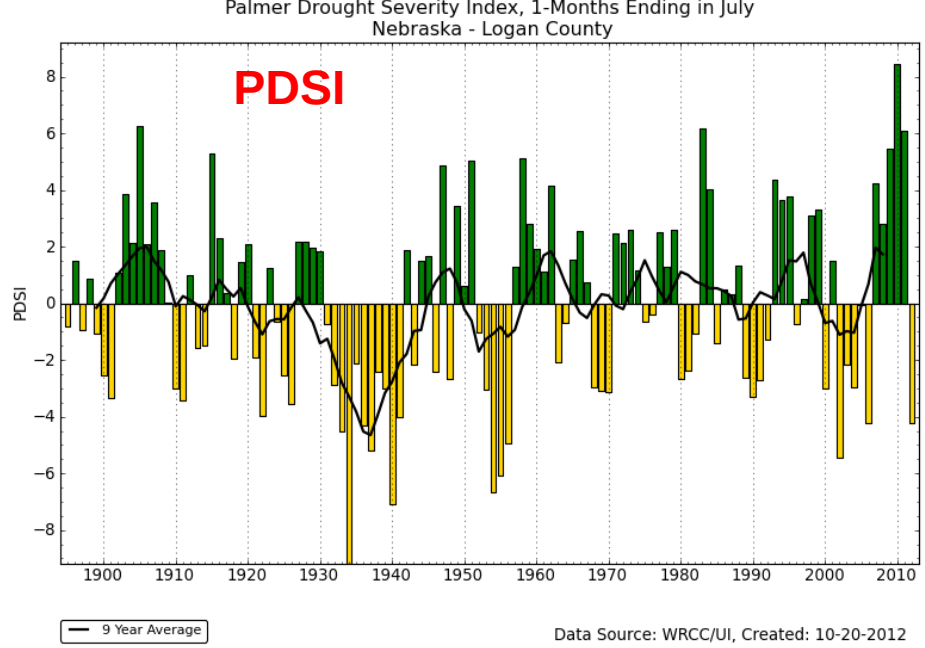
1895-2012

May-Jun-Jul

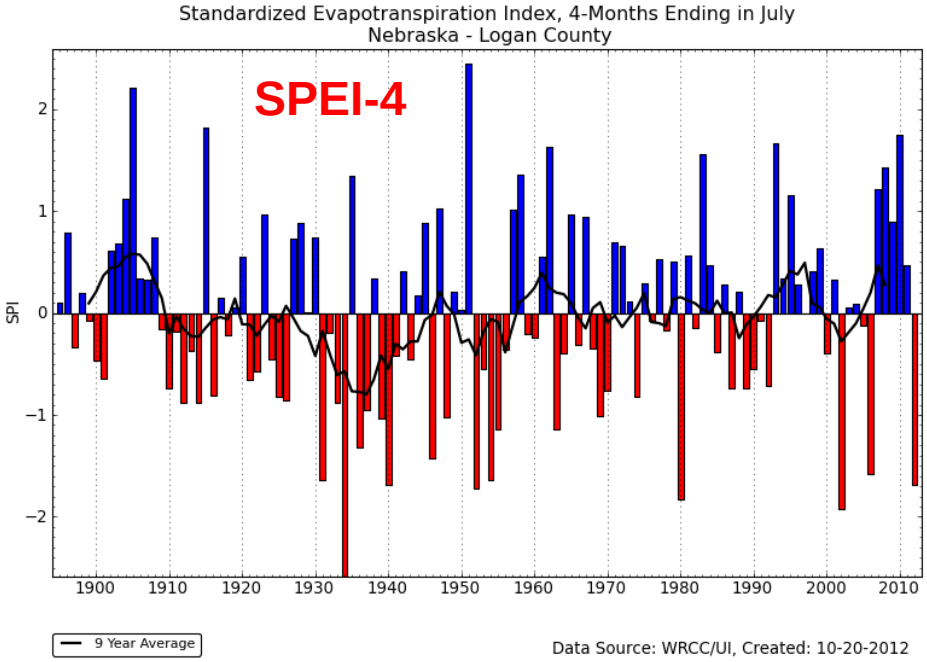
Precipitation

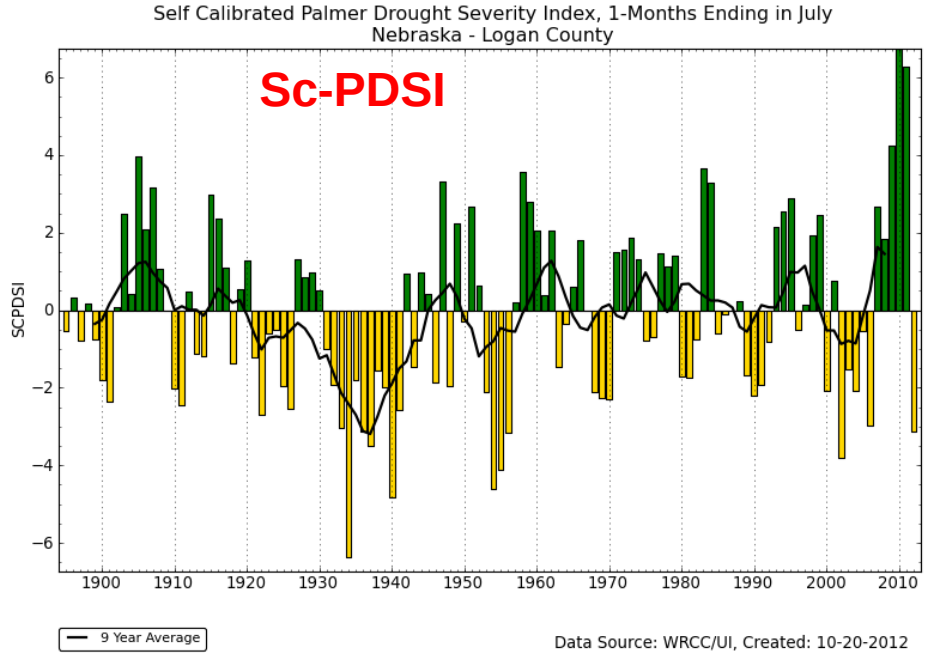
Mean Temperature





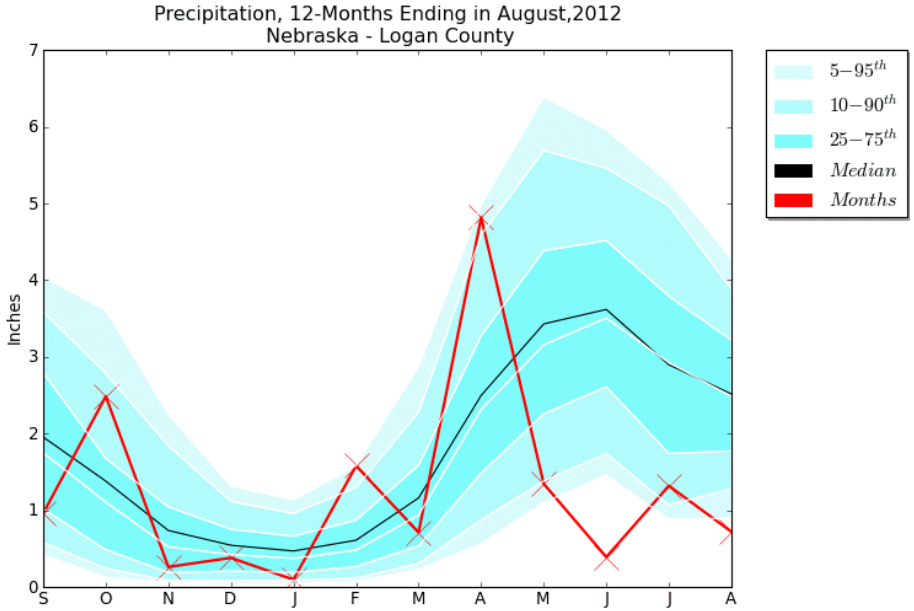
Logan County Nebraska end of July 2012



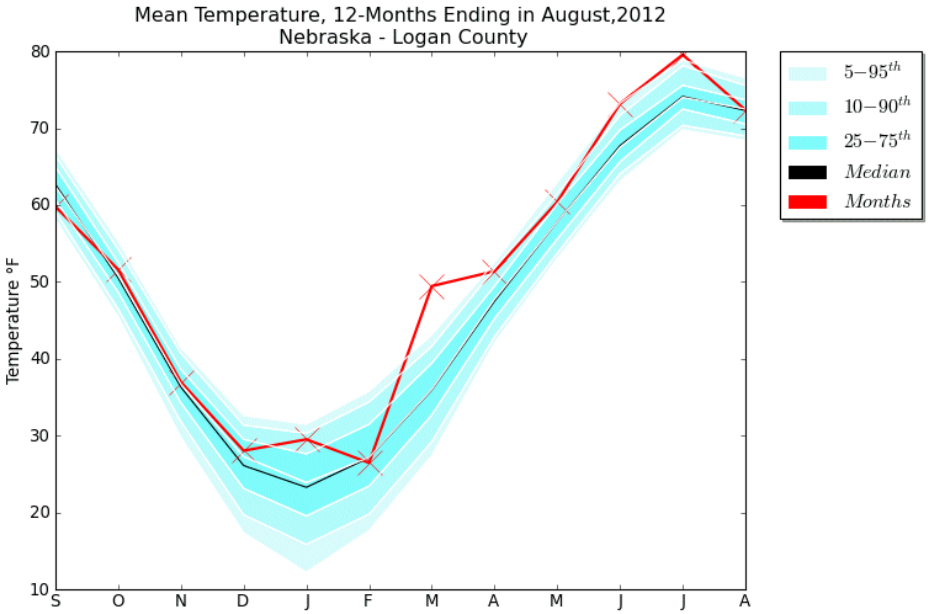


Logan County Nebraska

Precipitation — 12 months preceding August 2012 — Temperature



Data Source: WRCC/UI, Created: 10-20-2012



Data Source: WRCC/UI, Created: 10-20-2012

Month,Year,Value,Mean,5th,95th,10th,90th,25th,75th
9,2011,0.96,1.95,0.42,4.04,0.58,3.59,1.02,1.75
10,2011,2.49,1.38,0.13,3.60,0.24,2.78,0.48,1.11
11,2011,0.26,0.74,0.06,2.25,0.09,1.84,0.19,0.52
12,2011,0.38,0.54,0.04,1.31,0.08,1.11,0.21,0.42
1,2012,0.09,0.47,0.05,1.13,0.09,0.96,0.19,0.37
2,2012,1.58,0.61,0.07,1.58,0.11,1.30,0.27,0.48
3,2012,0.71,1.16,0.23,2.87,0.31,2.28,0.54,0.94
4,2012,4.82,2.50,0.56,4.98,0.87,4.59,1.49,2.31
5,2012,1.34,3.43,1.10,6.39,1.38,5.69,2.26,3.16
6,2012,0.39,3.62,1.46,5.96,1.74,5.46,2.61,3.51
7,2012,1.32,2.90,0.88,5.27,1.07,4.97,1.74,2.92
8,2012,0.72,2.52,0.90,4.28,1.28,3.88,1.77,2.49

Numbers available, too, for replotting

Month,Year,Value,Mean,5th,95th,10th,90th,25th,75th
9,2011,59.80,62.70,58.06,67.35,59.12,66.38,60.64,62.43
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12,2011,28.04,26.10,17.33,32.61,19.69,31.37,23.13,27.27
1,2012,29.51,23.27,12.21,31.47,15.84,30.30,19.55,23.89
2,2012,26.45,27.12,17.62,35.76,19.76,34.37,23.43,27.16
3,2012,49.46,35.92,27.37,43.11,29.23,41.62,32.71,36.00
4,2012,51.39,47.50,42.05,52.53,42.91,51.75,45.25,47.73
5,2012,60.41,57.82,53.01,62.94,53.75,61.45,55.59,57.83
6,2012,73.18,67.73,63.07,73.26,64.09,71.68,65.65,67.53
7,2012,79.58,74.14,69.77,78.87,70.38,78.14,72.50,74.02
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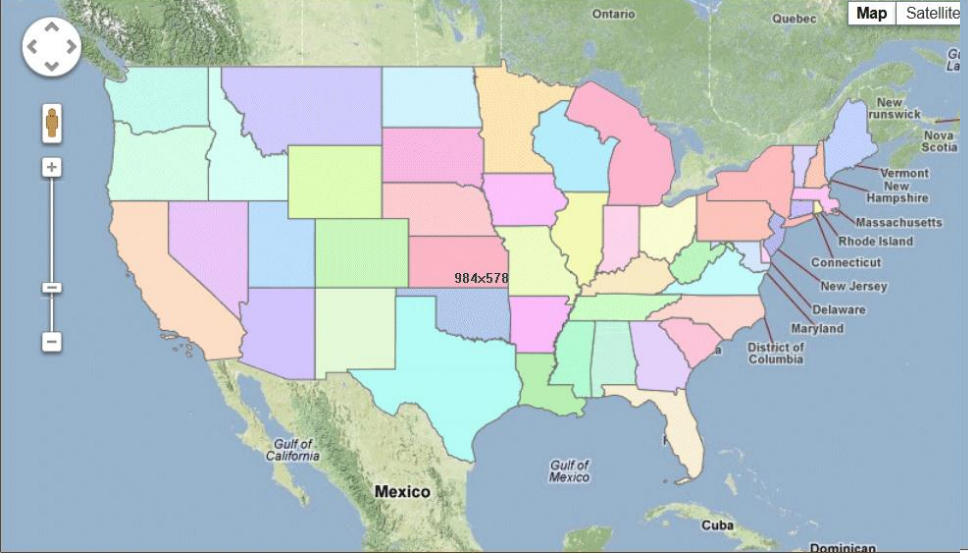
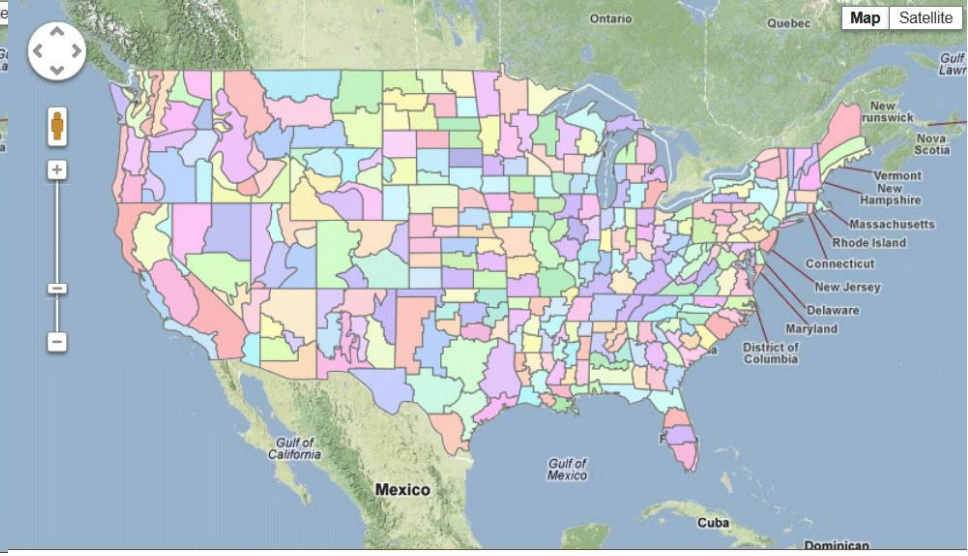
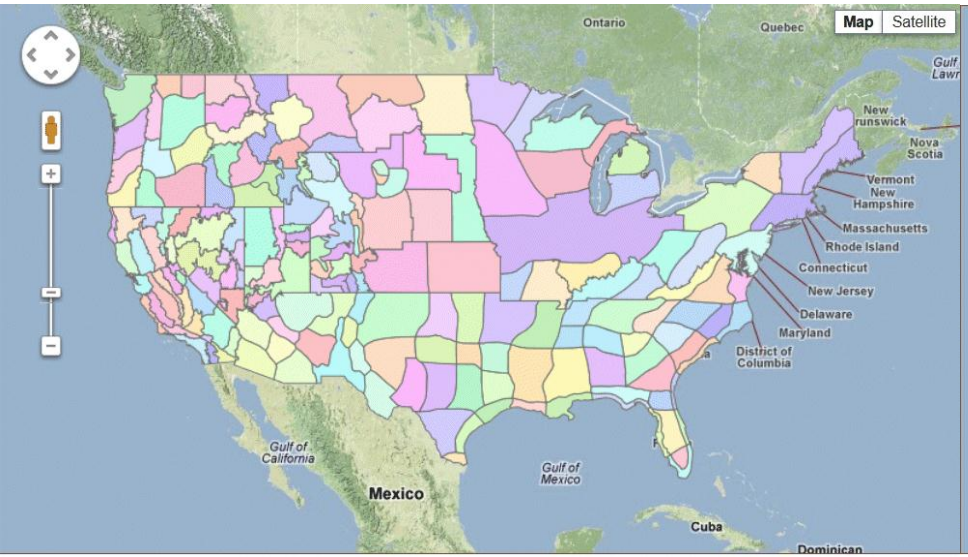


States



Climate Divisions



Predictive Services Regions (Fire)

HCN Stations

What's next ?

Replacement of current PRISM time series with aggregation from 800-m version

Still testing newer version for differences with current version

Newer version appears better in earlier years, same in later years

Maps and time series from PRISM are only as good as the data that drive it

Need side efforts to improve temporal consistency of data input

A major sustained long-term effort

Discussions and initial efforts under way with PRISM Group

Projects supported by Department of Interior and USDA to begin this

Ability to work with absolute or relative elevation bands

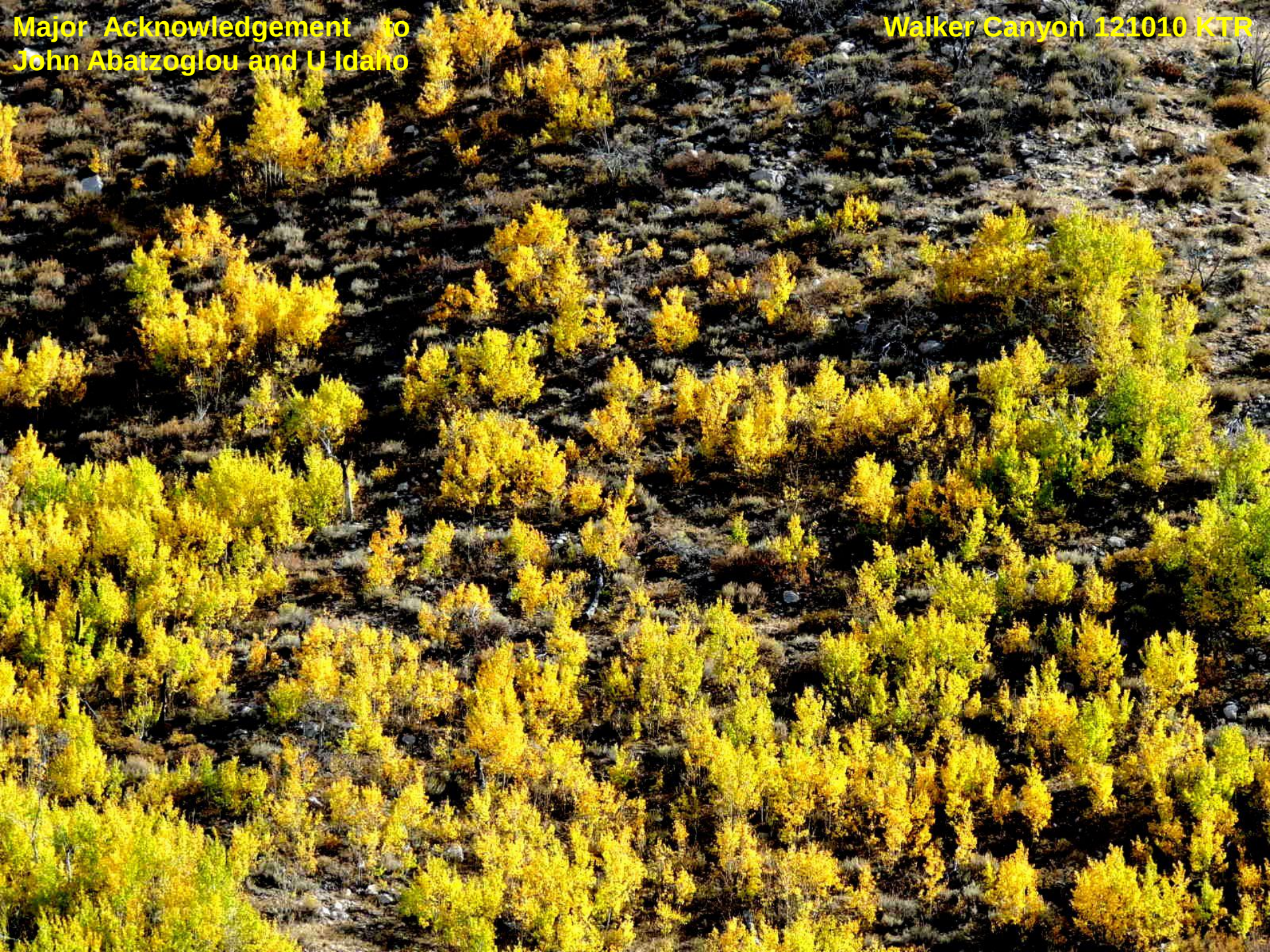
Other elevation-specific products

Soil moisture and streamflow

Original intent, logistical difficulties

Basic scale of drought monitoring: daily, more linkages needed there

Major Acknowledgement to
John Abatzoglou and U Idaho



Acknowledgements to NOAA TRACS

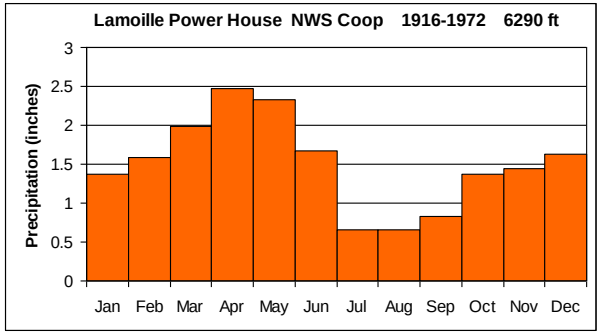
RMNP KTR 20120930

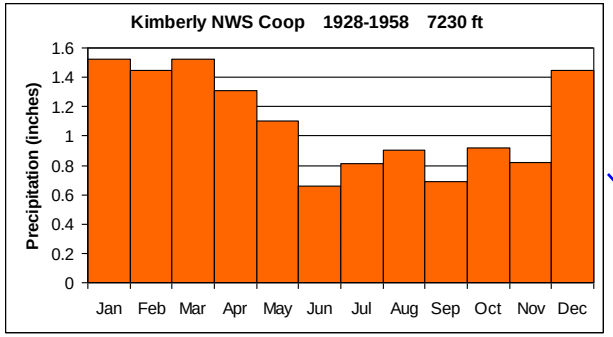
Mt Stratus
Mt Nimbus
Mt Cumulus
Mt Cirrus
KTR 20120930

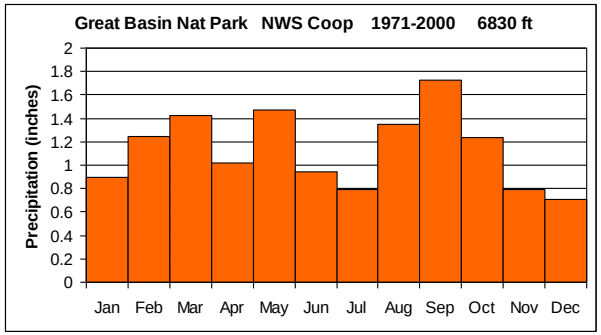
Thank You !
Mather RAWS Station
Great Basin Nat Park

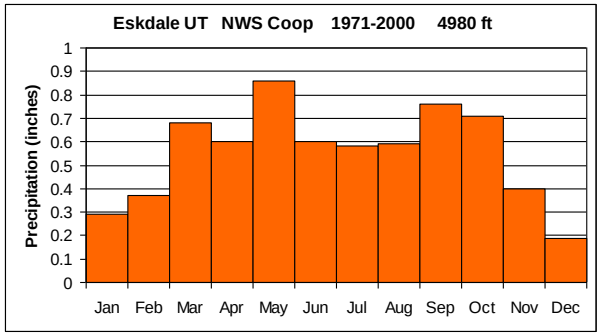
DISCARDS
and
EXTRAS
and
ELABORATIONS

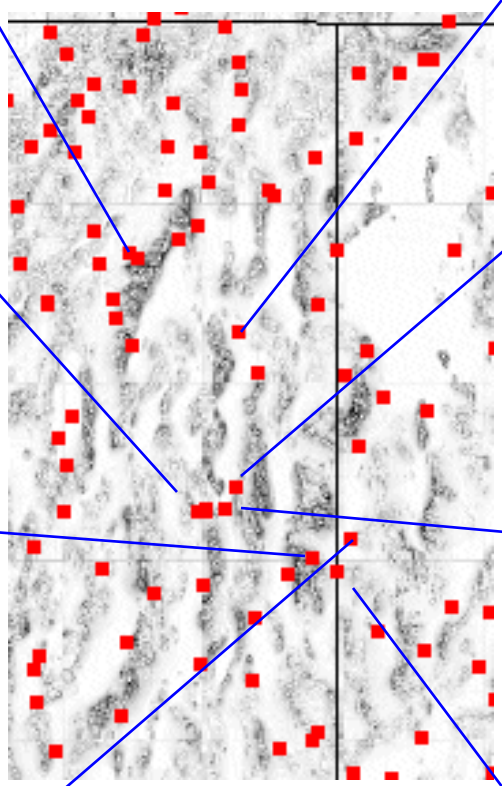
Seasonal Precipitation
NWS Cooperative Network
Mostly valleys

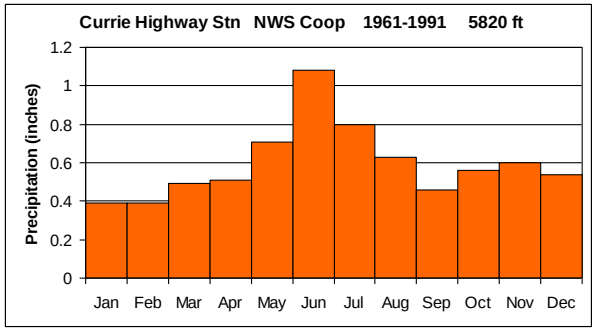


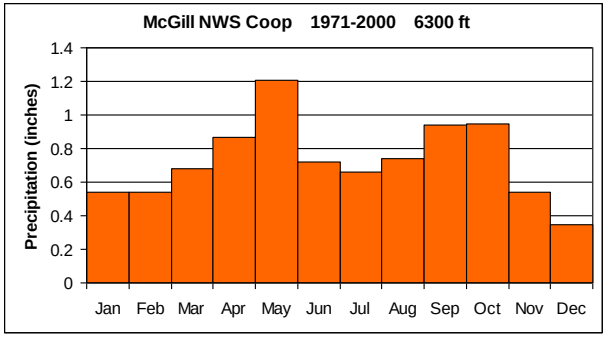


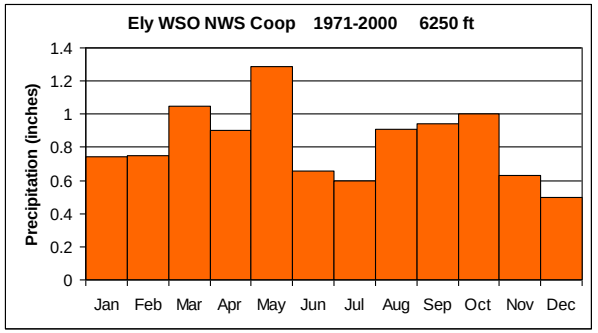


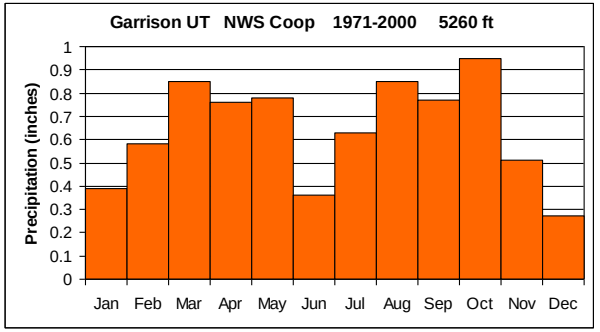




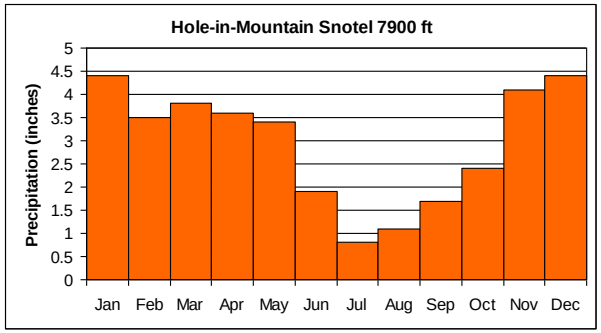


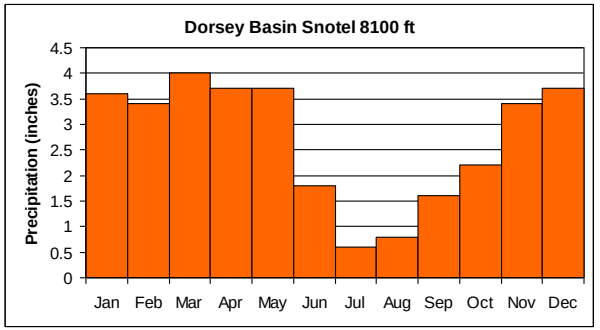


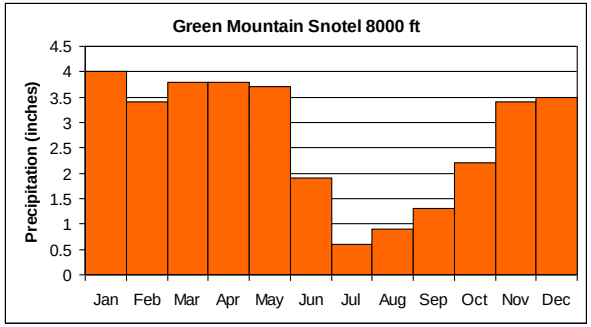


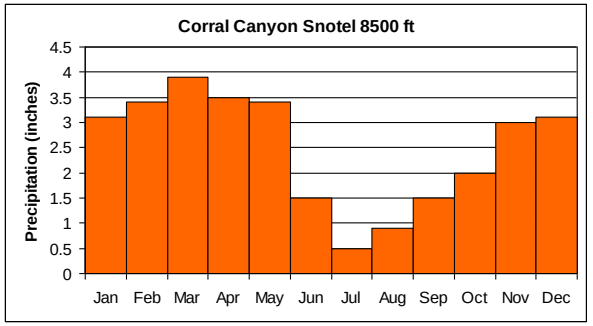


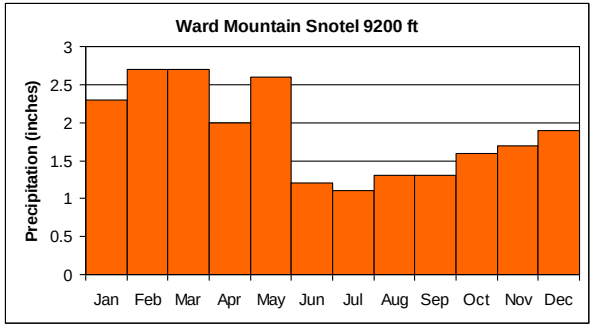
Seasonal Precipitation
NRCS Snotel Network
Mountains

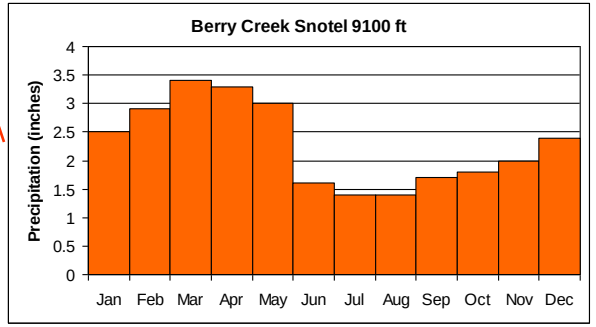


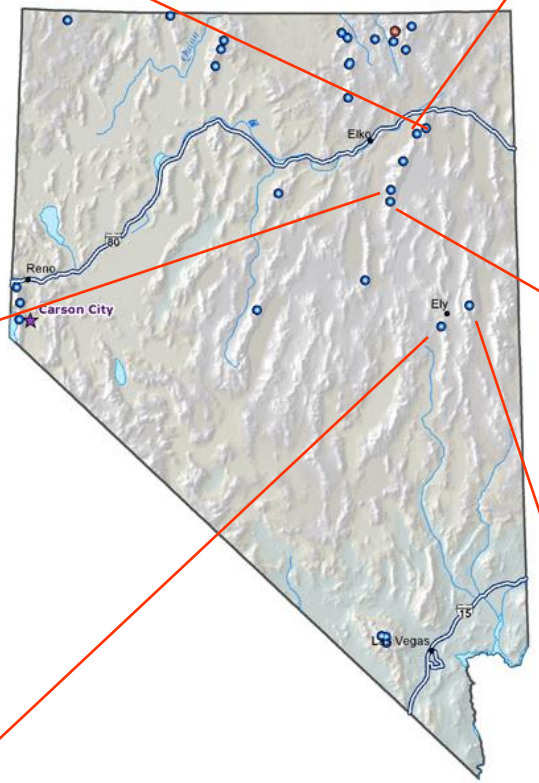




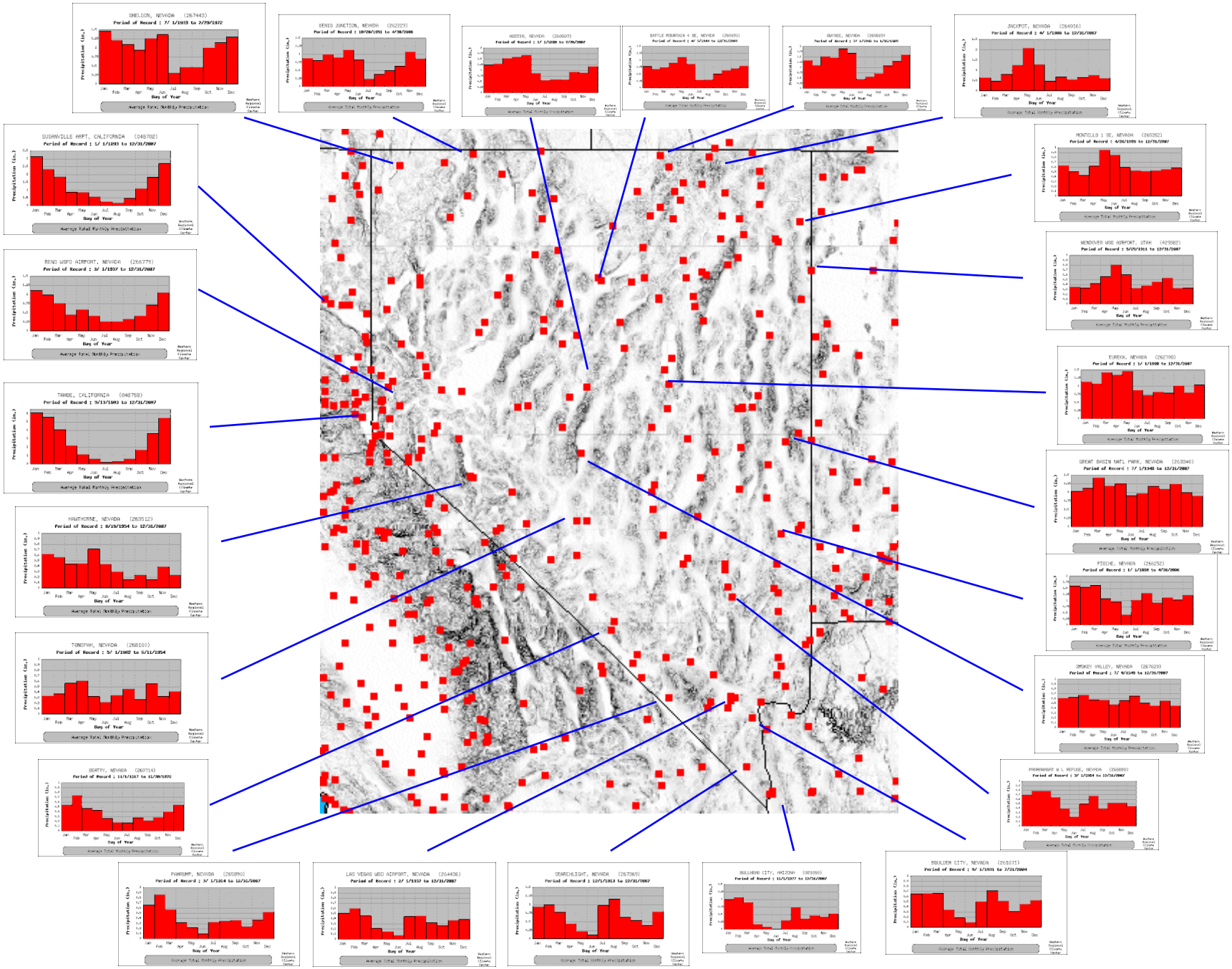








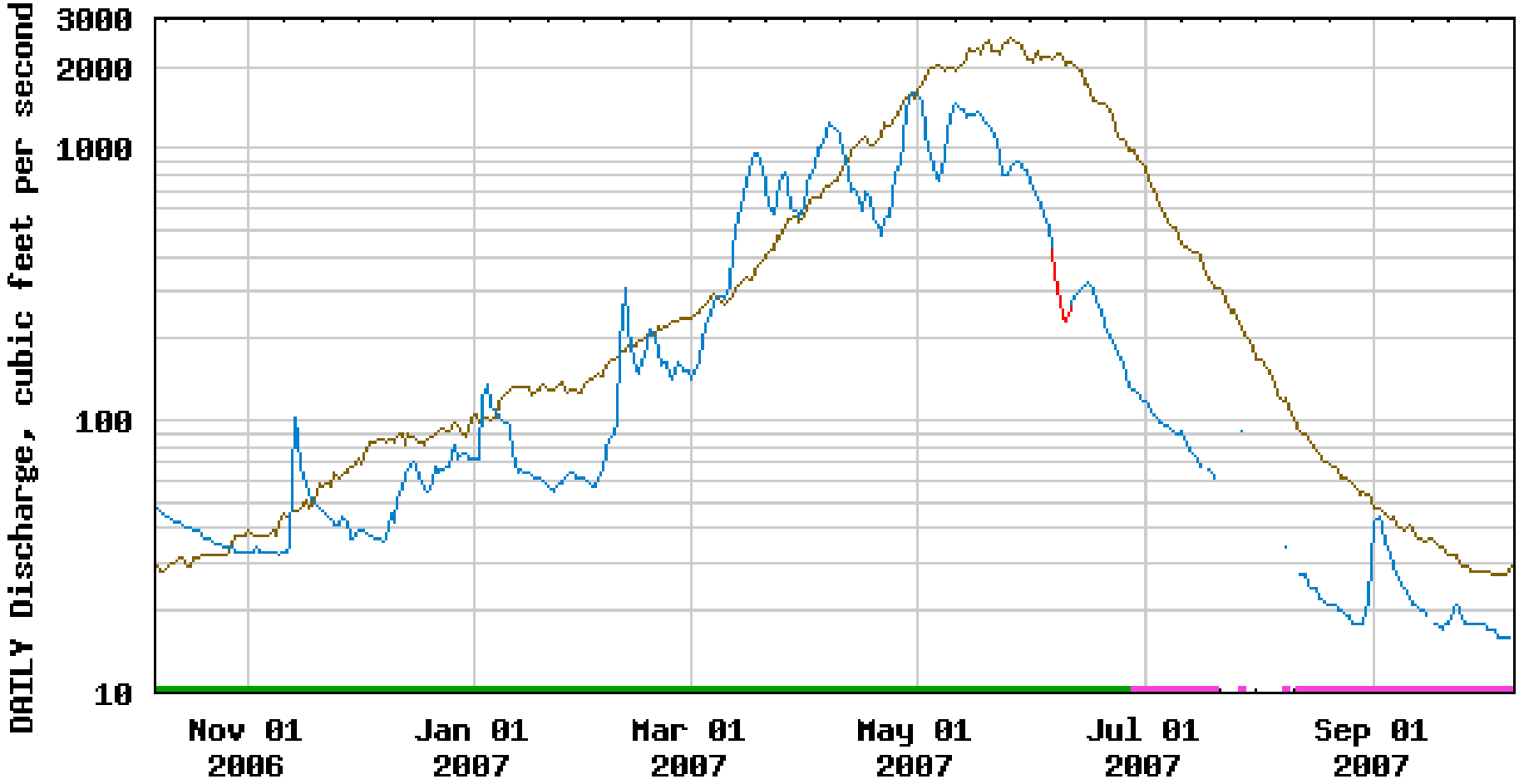
Nevada Annual Precipitation Cycle



El Rio de las Mercedes
The River of Mercy
Merced River, California
6 October 2007

USGS

USGS 11266500 MERCED R A POHONO BRIDGE NR YOSEMITE CA



Median daily statistic (90 years)
Daily mean discharge
Estimated daily mean discharge
Period of approved data
Period of provisional data

White Mtns Tioga Pass 121013 KTR

KTR 20120930

KTR 20120930