

**Spring  
2011**



**June 28<sup>th</sup>, 2011**

**NIDIS - UPPER COLORADO BASIN PILOT PROJECT**

**Weekly Climate, Water & Drought Assessment**

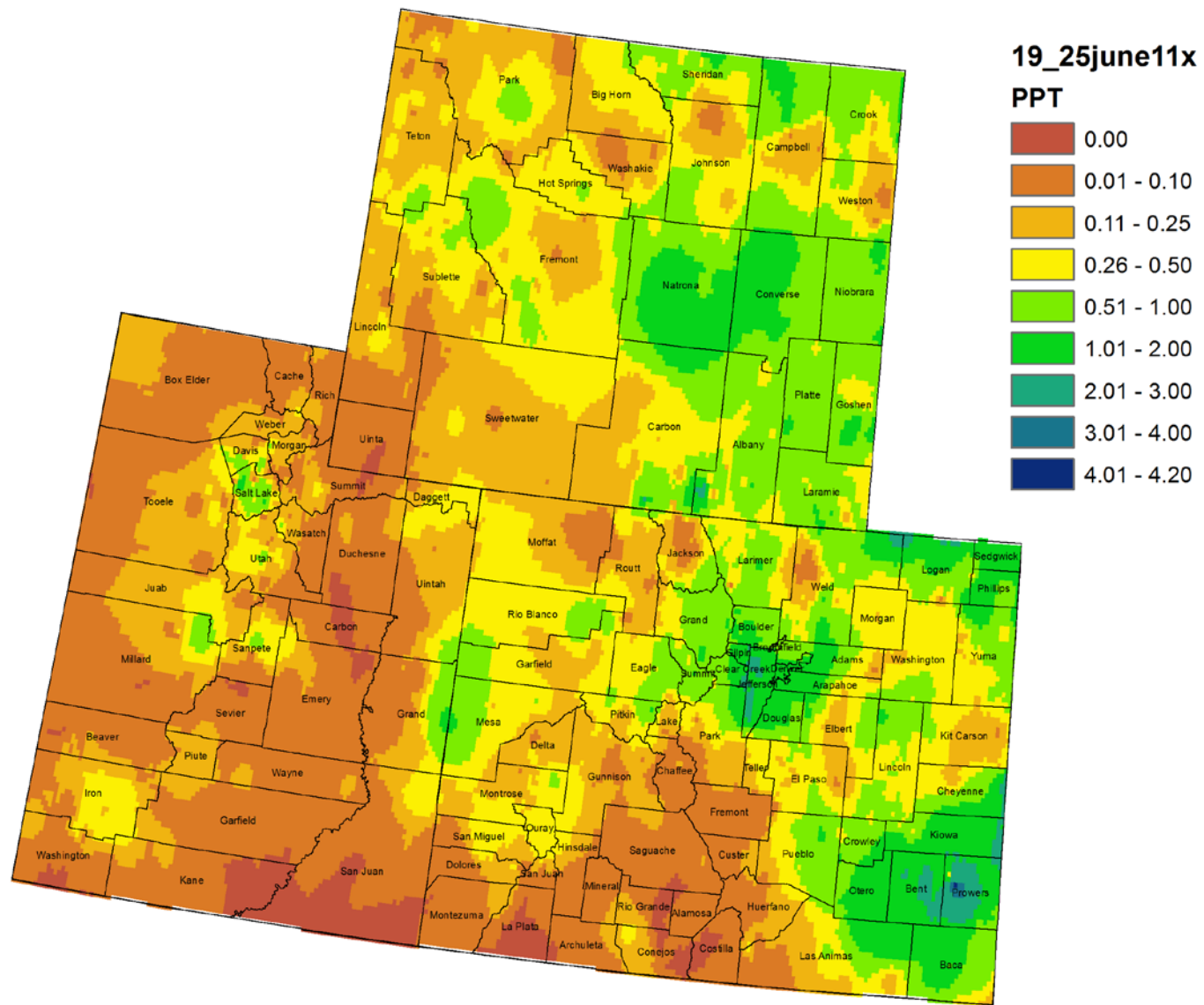
# Today's Agenda

- Assessment of current water conditions
- Precipitation Forecast
- Recommendations for Drought Monitor

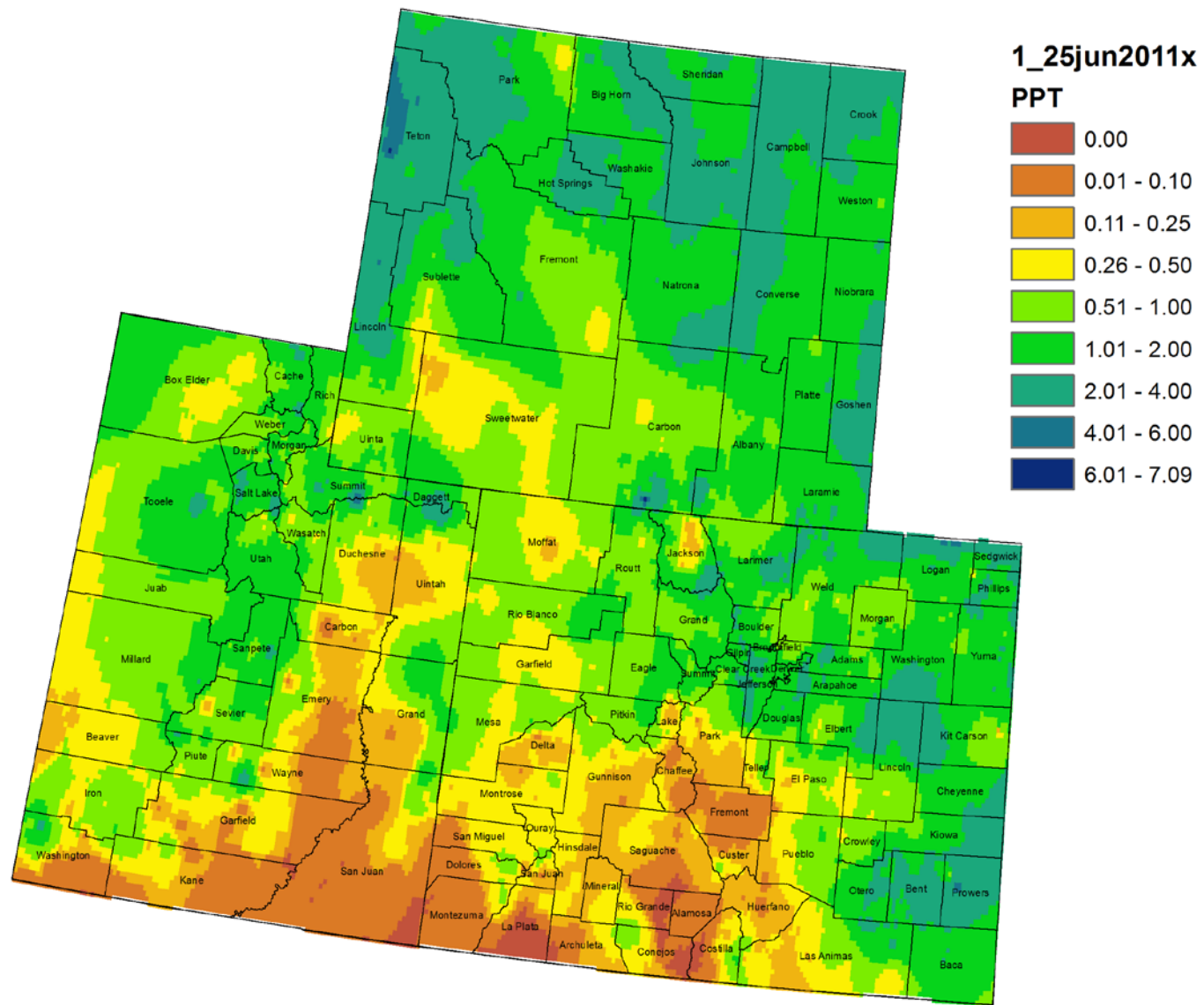
# Precipitation/Snowpack Update



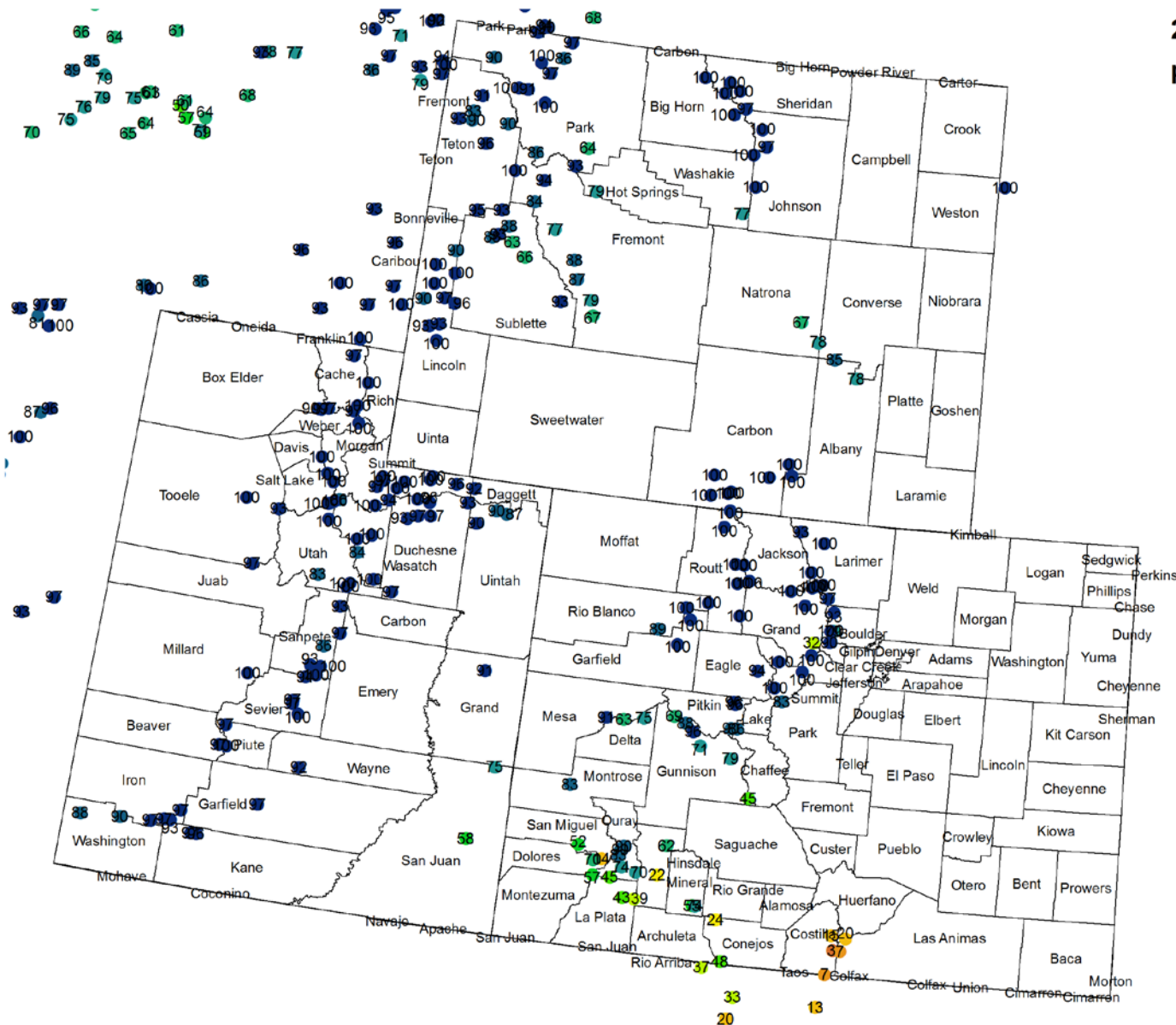
# Colorado, Utah and Wyoming 7 Day Precipitation (in) 19-25 June 2011



# Colorado, Utah and Wyoming Month to Date Precipitation (in) 1-25 June 2011



# Snotel Water Year Precipitation Percentile Ranking for 28 June 11 (Stations with 20+ years of data only)

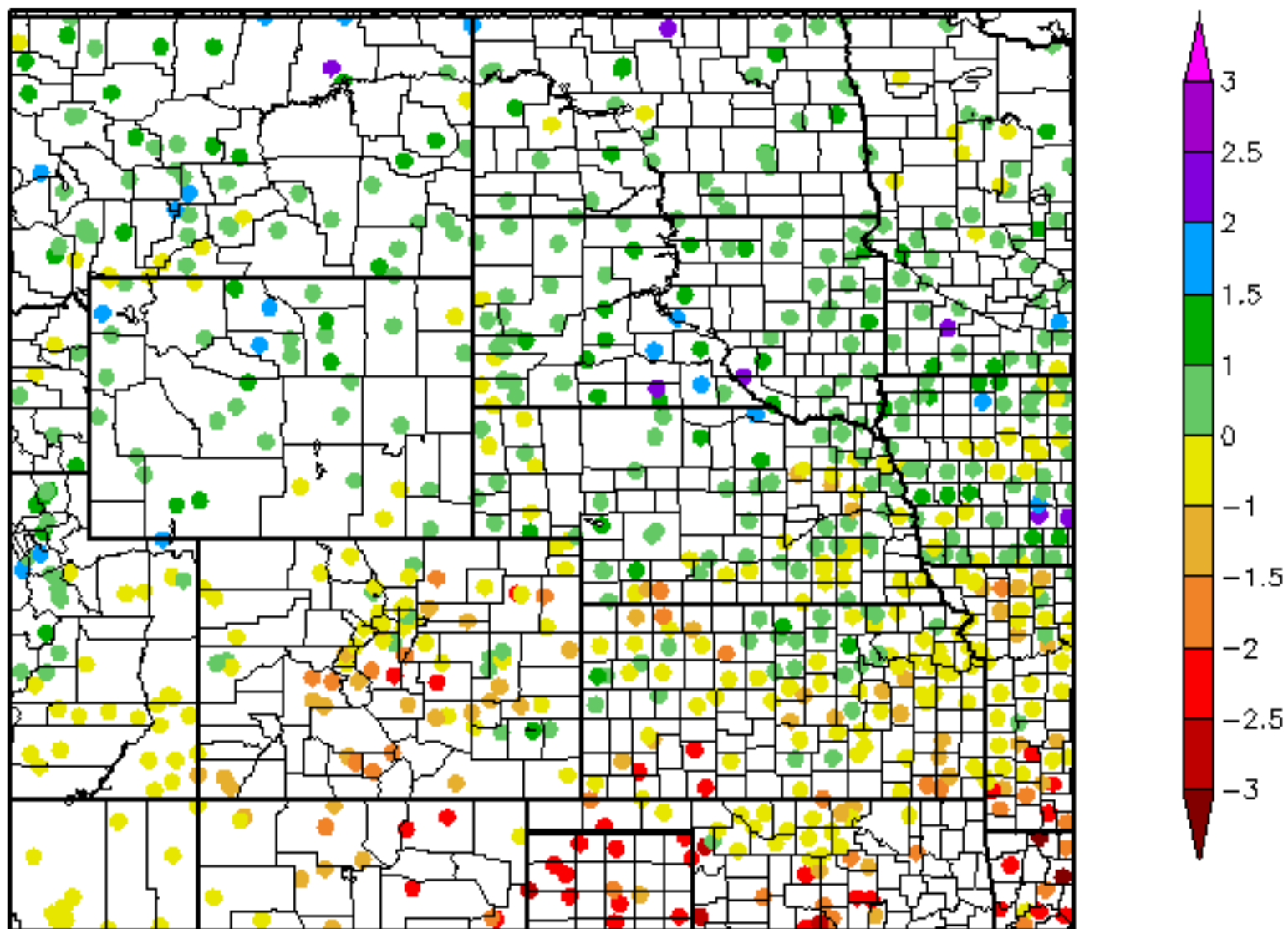


## 28Jun11\_ptile.tab Events pctile

- D4: 0 - 2
- D3: 3 - 5
- D2: 6 - 10
- D1: 11 - 20
- D0: 21 - 30
- Uncategorized: 31 - 40
- Uncategorized: 41 - 50
- Uncategorized: 51 - 60
- Uncategorized: 61 - 70
- Uncategorized: 71 - 80
- Uncategorized: 81 - 90
- Uncategorized: 91 - 100

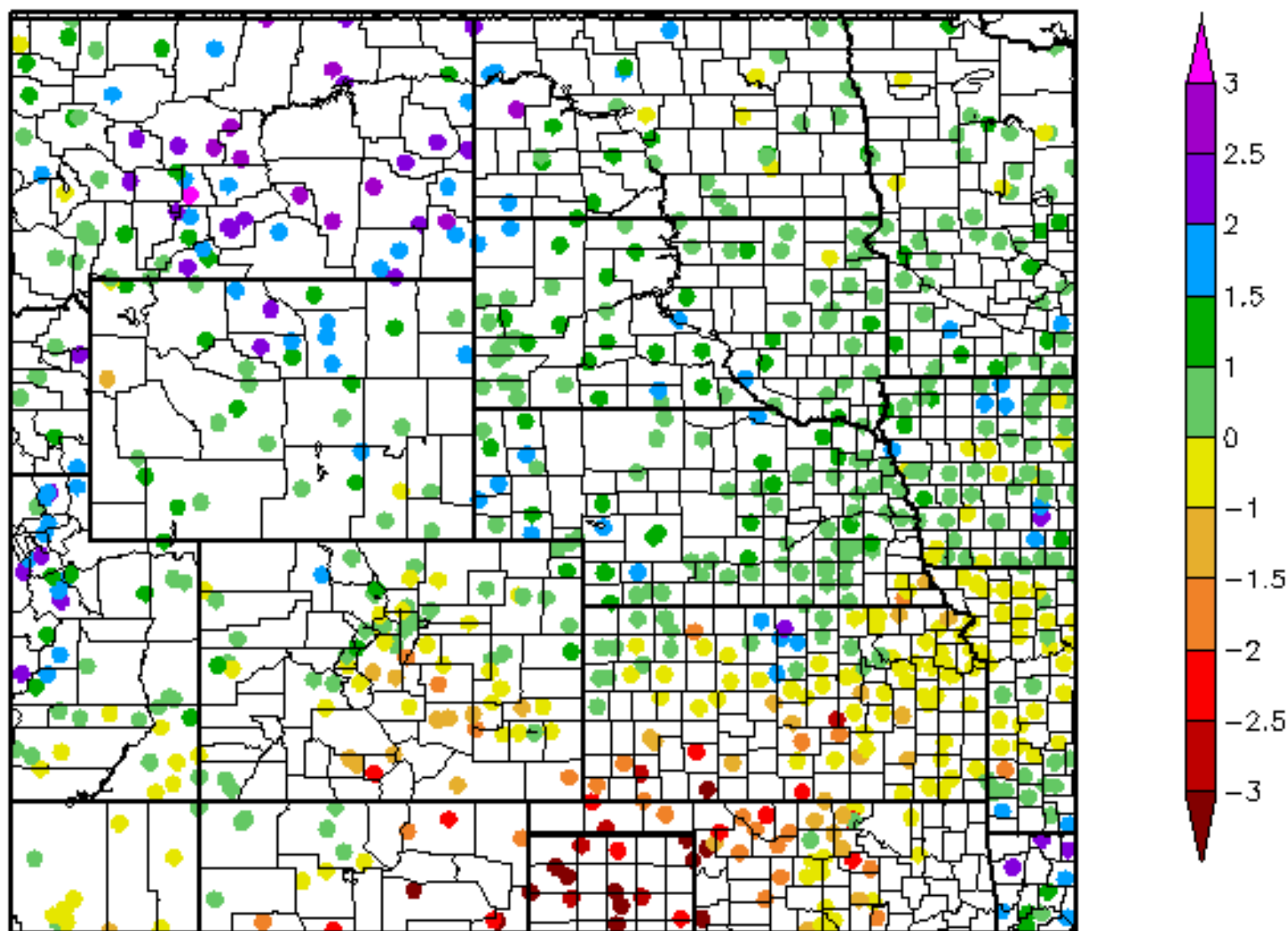
# 30 Day SPI

5/29/2011 - 6/27/2011



# 90 Day SPI

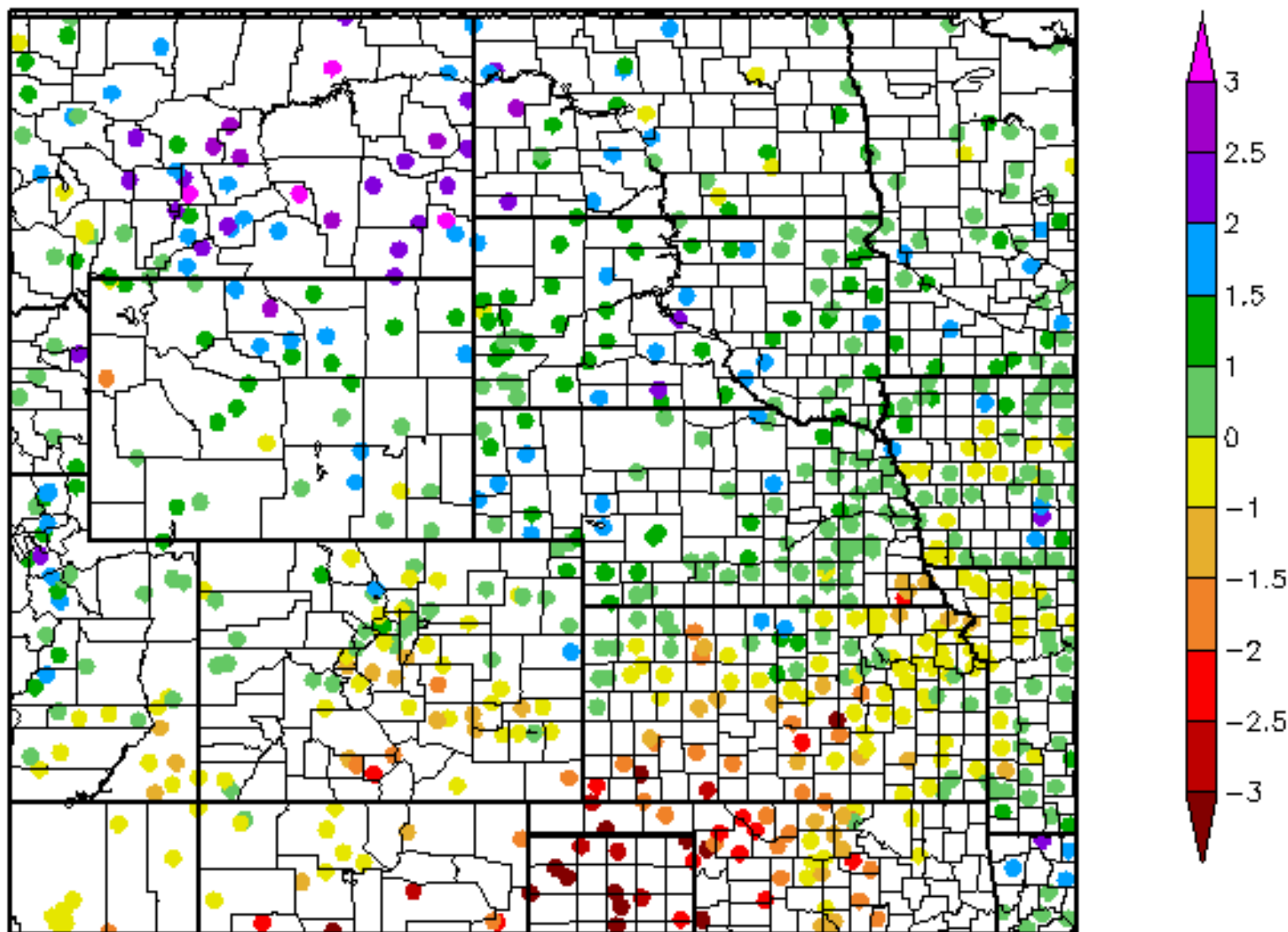
3/30/2011 - 6/27/2011





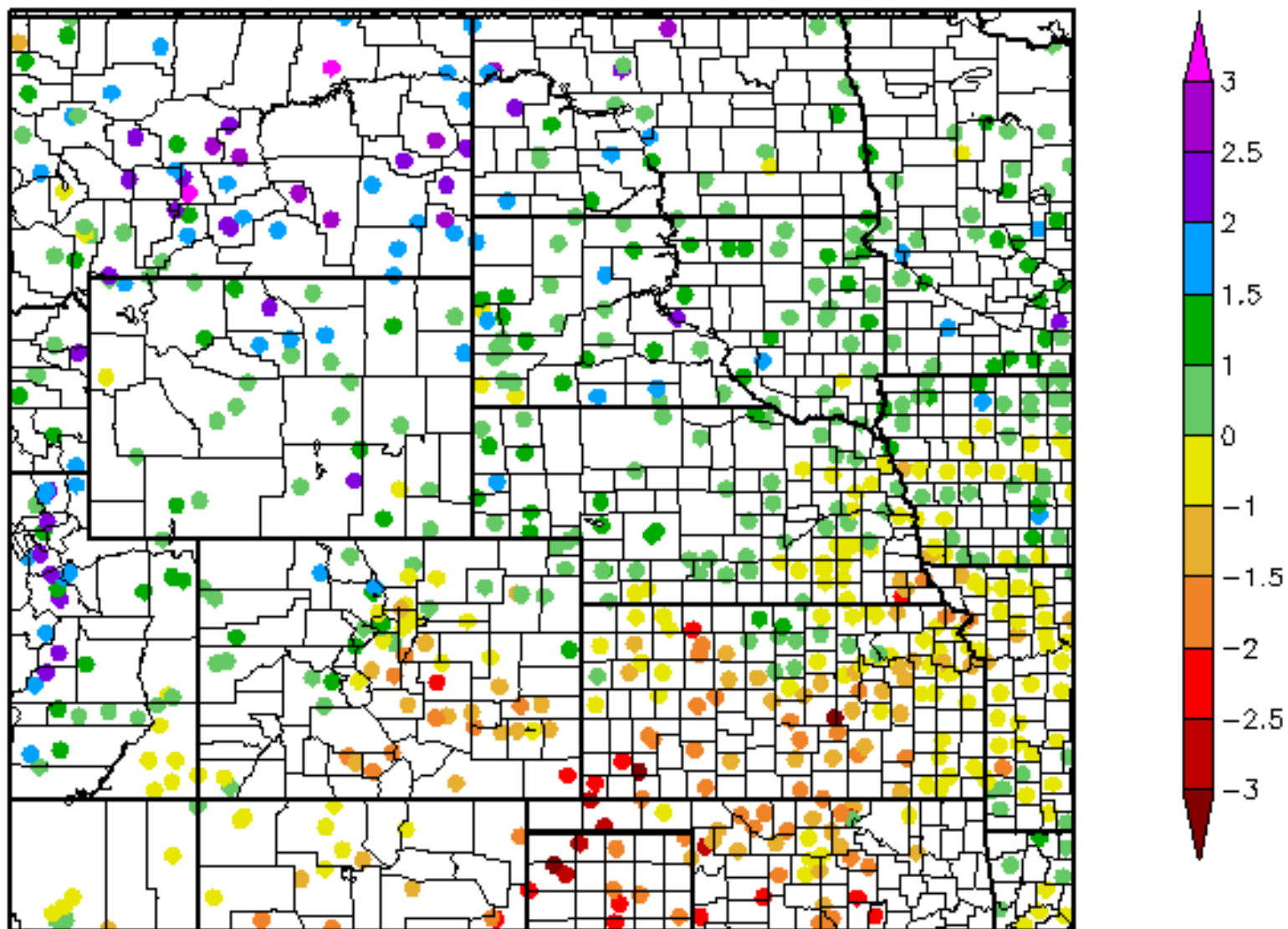
# 6 Month SPI

12/28/2010 – 6/27/2011

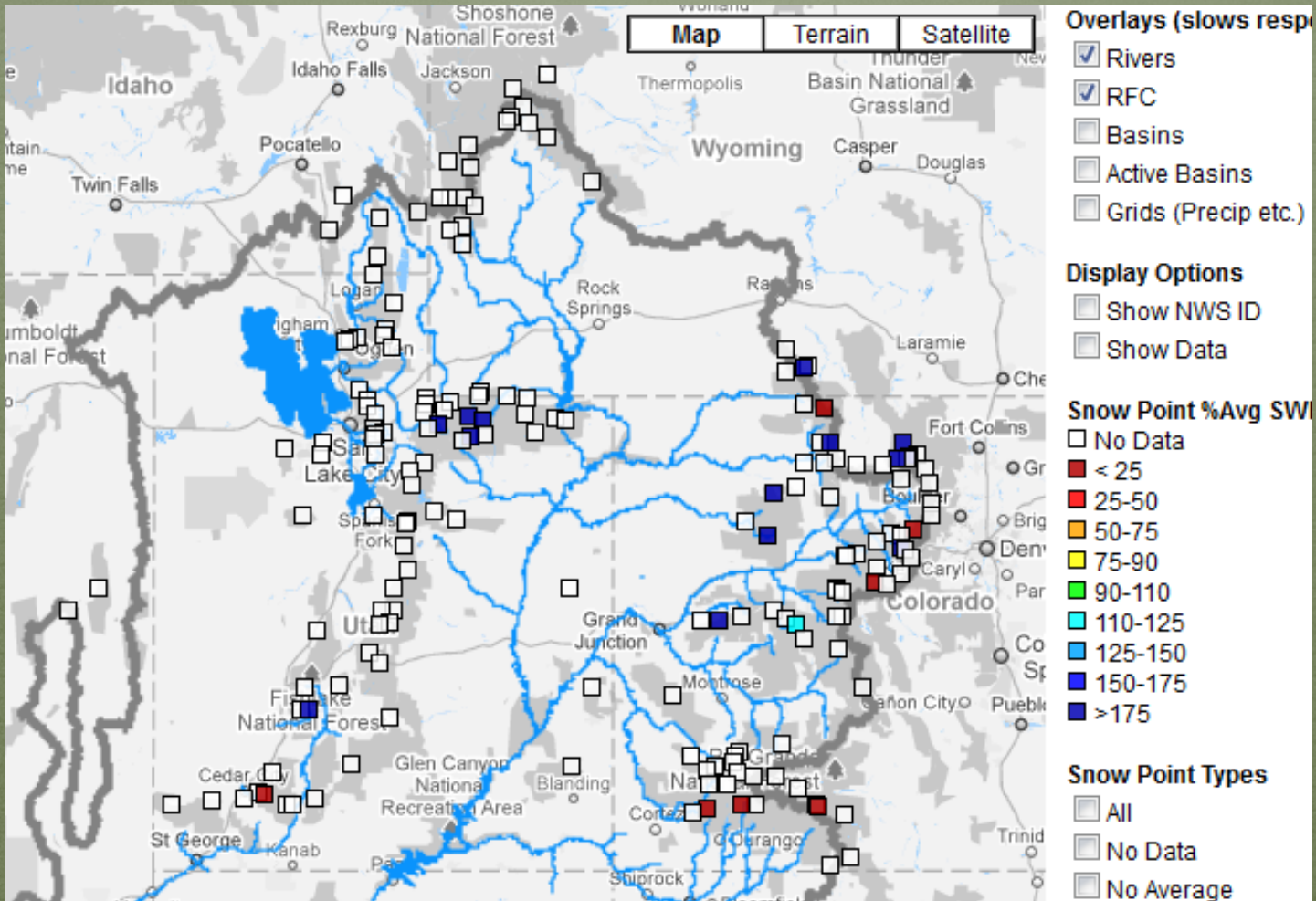


# Water Year SPI

10/1/2010 – 6/27/2011

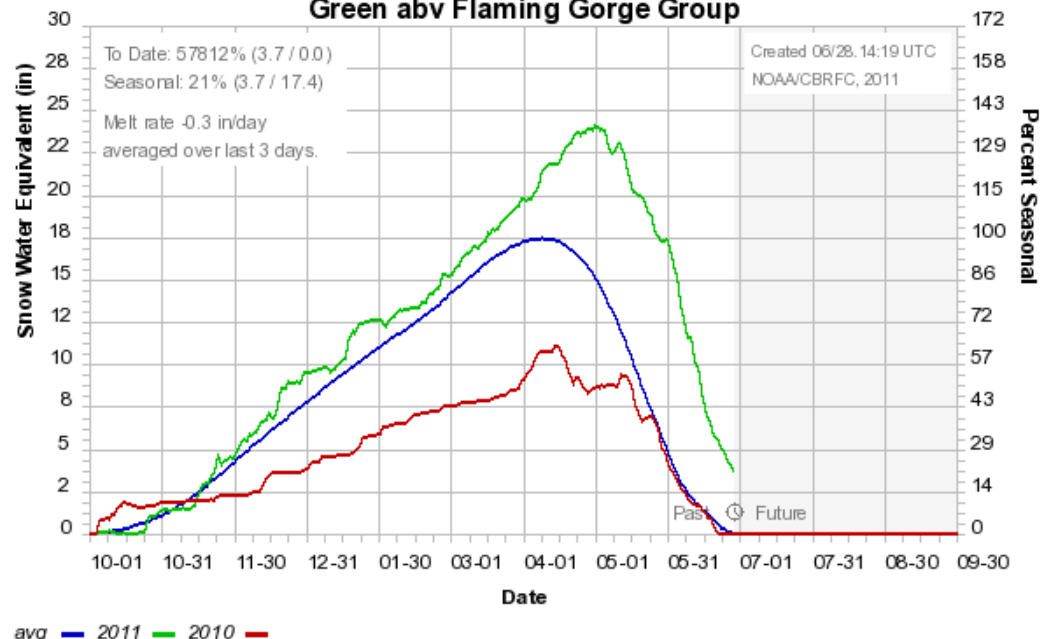


# Upper Colorado River Basin Snowpack



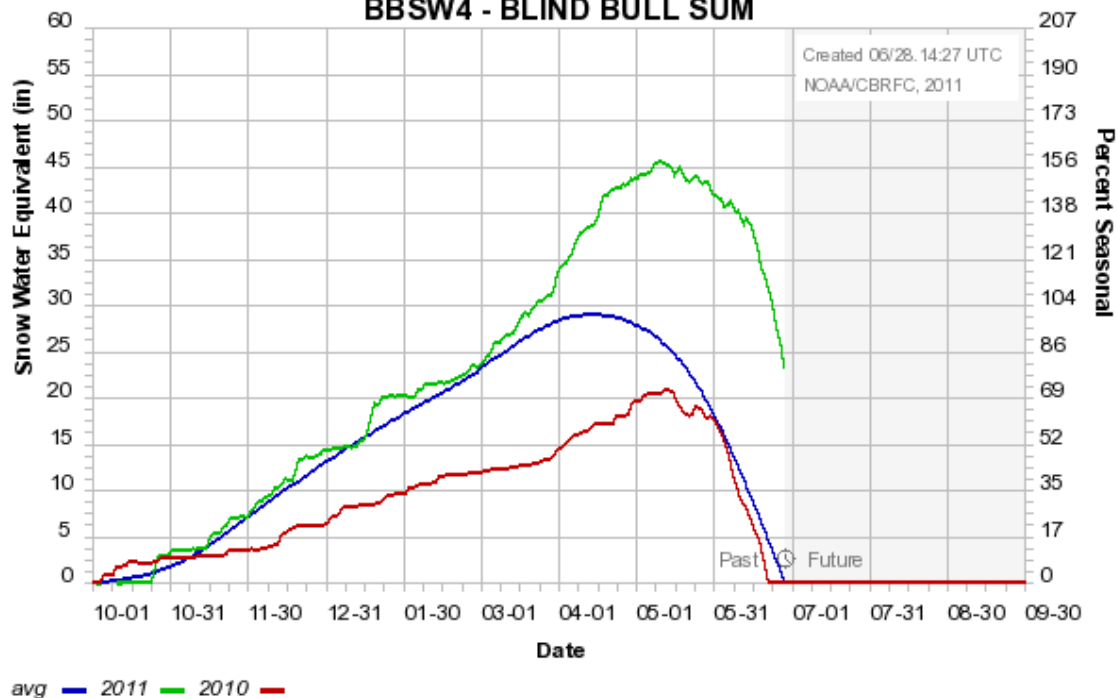
### Colorado Basin River Forecast Center

#### Green abv Flaming Gorge Group



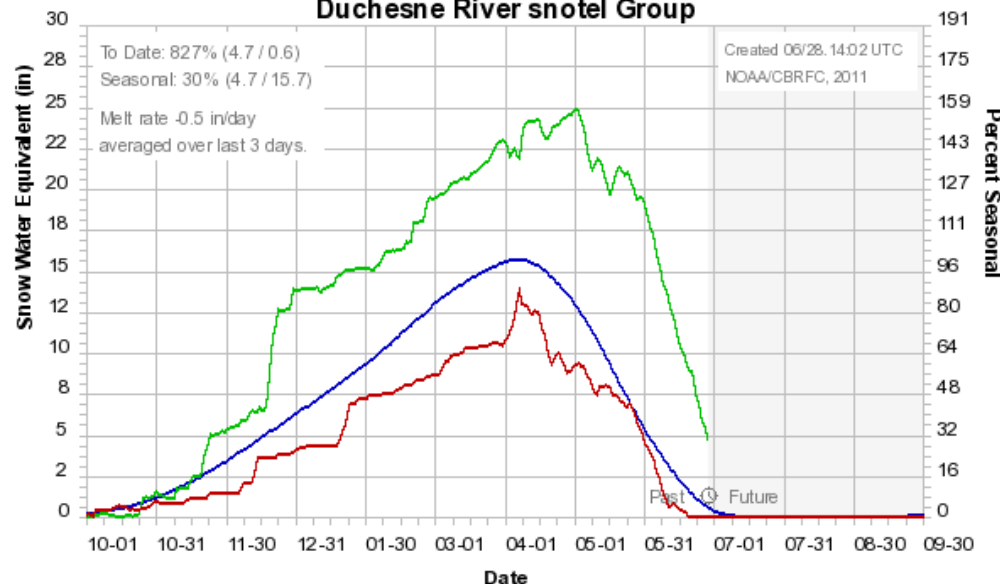
### Colorado Basin River Forecast Center

#### BBSW4 - BLIND BULL SUM



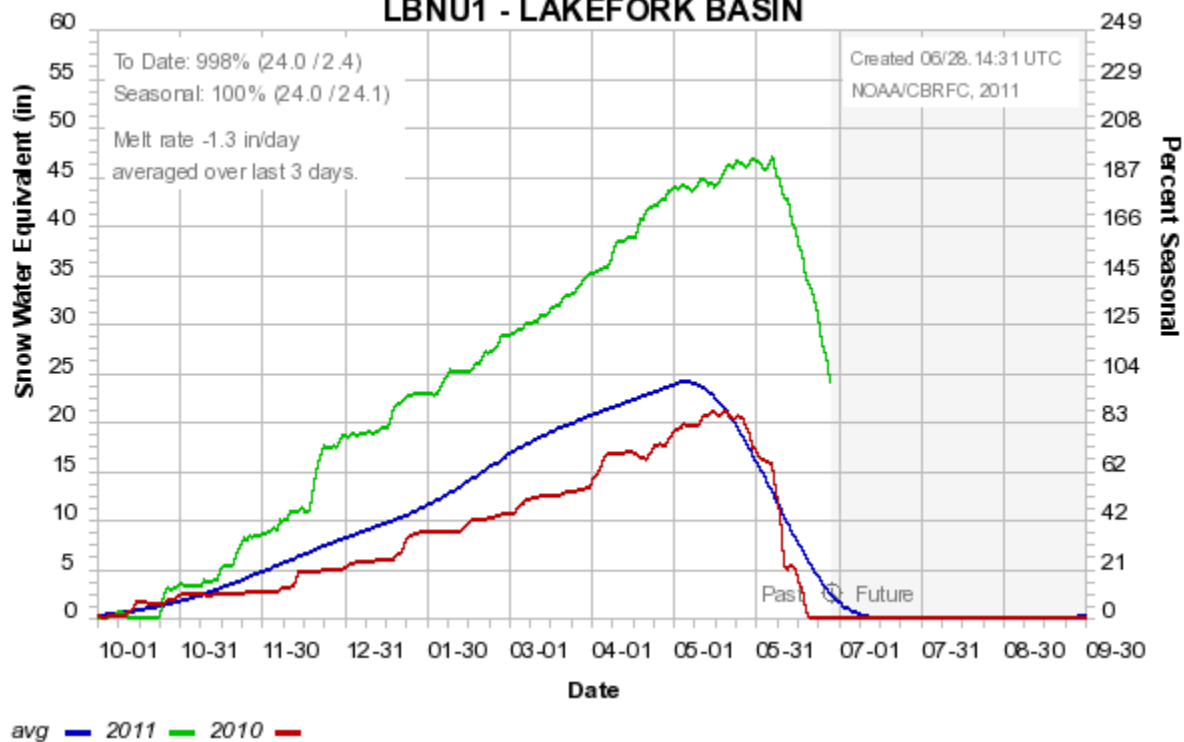
### Colorado Basin River Forecast Center

#### Duchesne River snotel Group



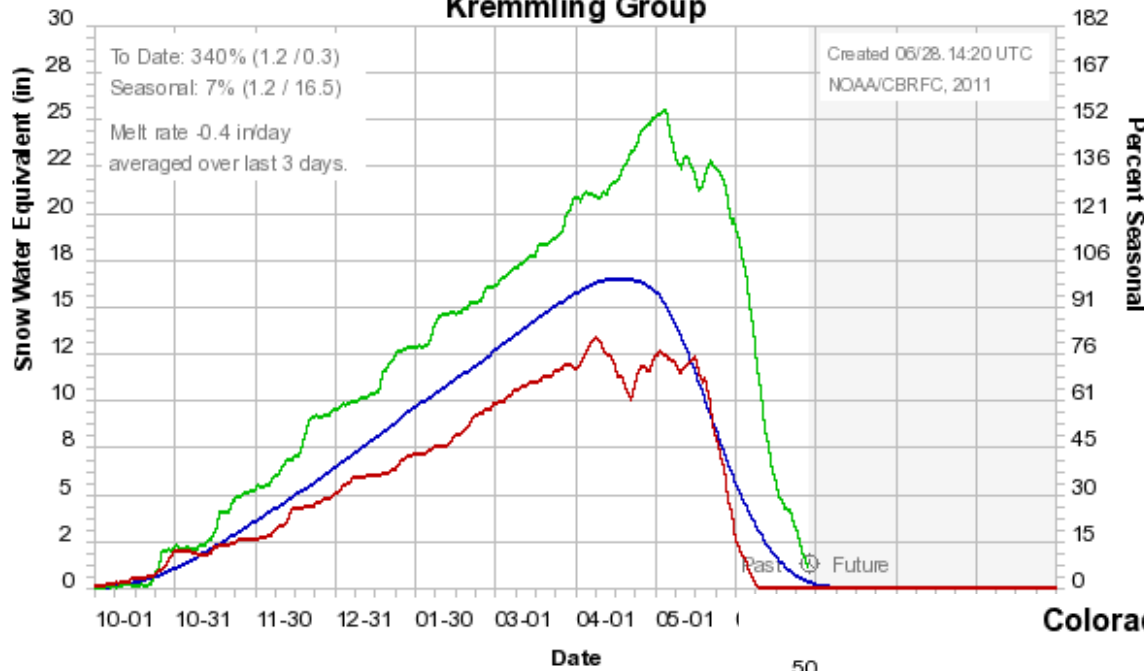
### Colorado Basin River Forecast Center

#### LBNU1 - LAKEFORK BASIN



# Colorado Basin River Forecast Center

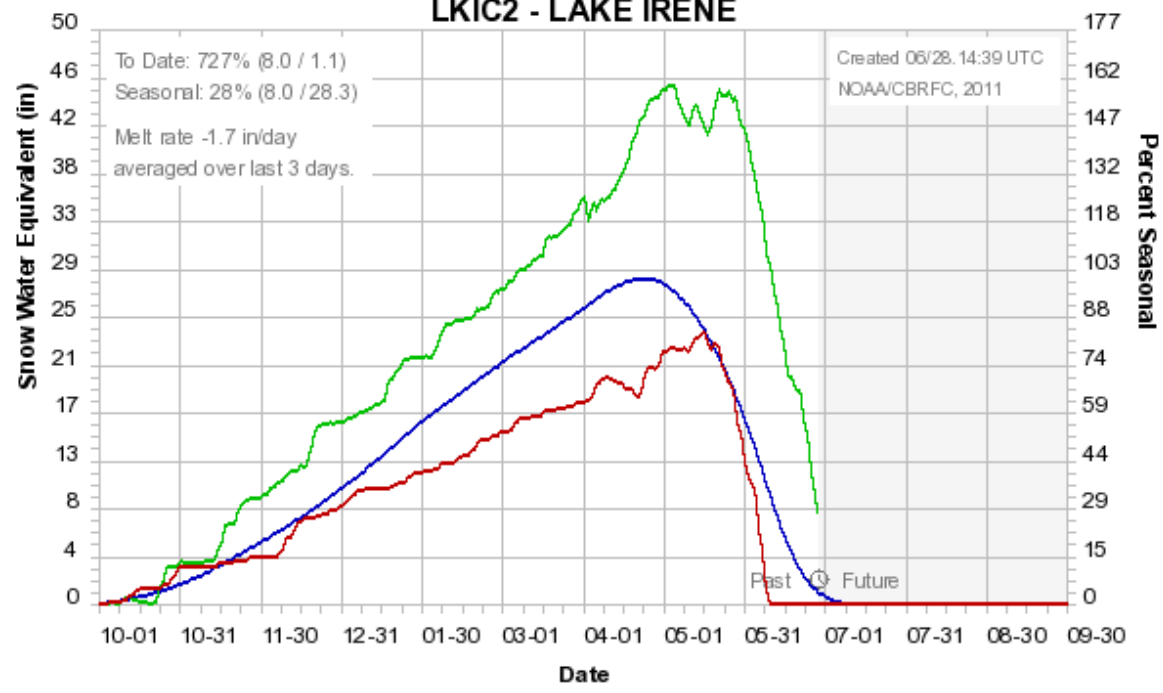
## Kremmling Group



avg — 2011 — 2010 —

# Colorado Basin River Forecast Center

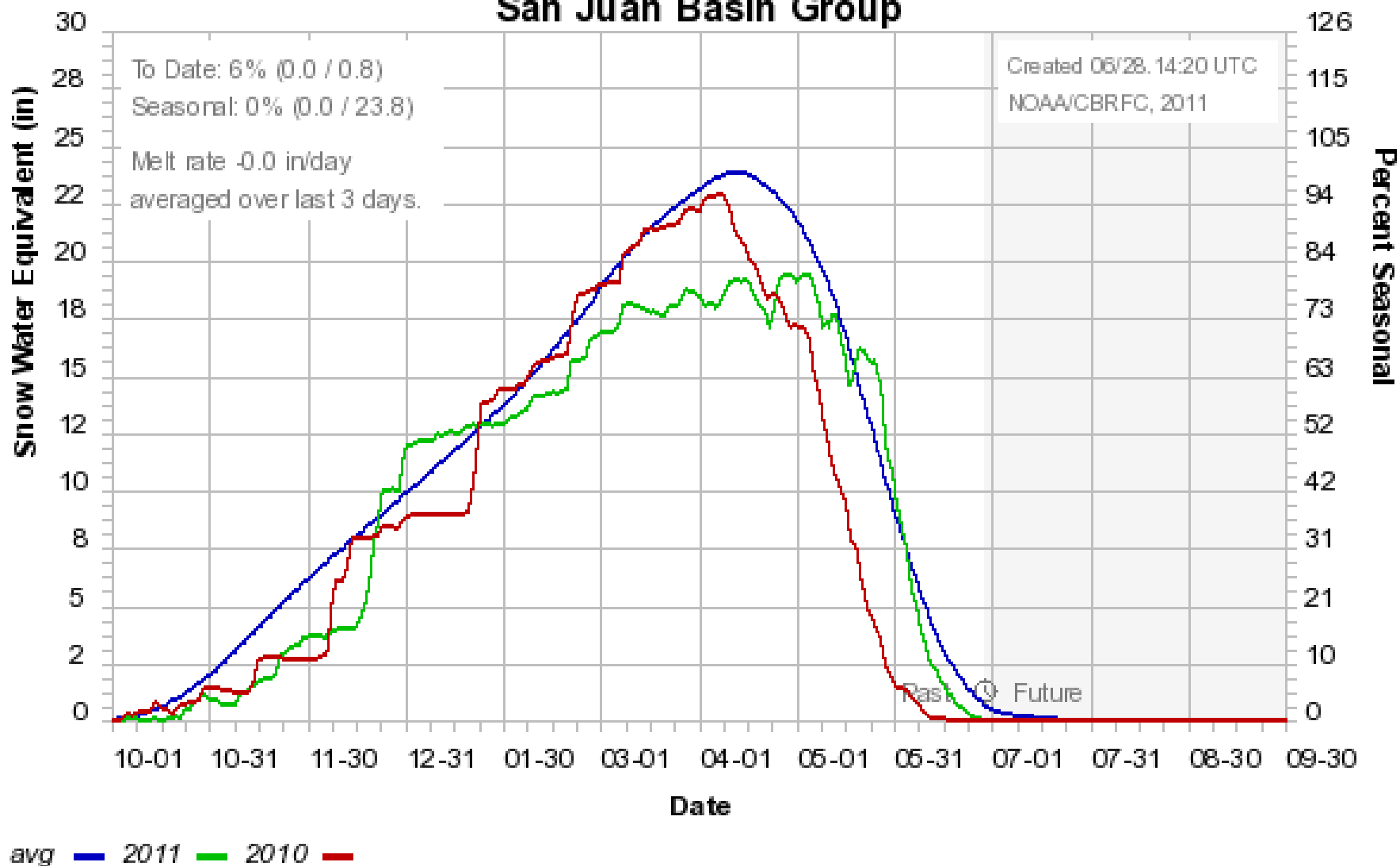
## LKIC2 - LAKE IRENE



avg — 2011 — 2010 —

# Colorado Basin River Forecast Center

## San Juan Basin Group



Peak snowpack 82% of average peak

# Streamflow Update

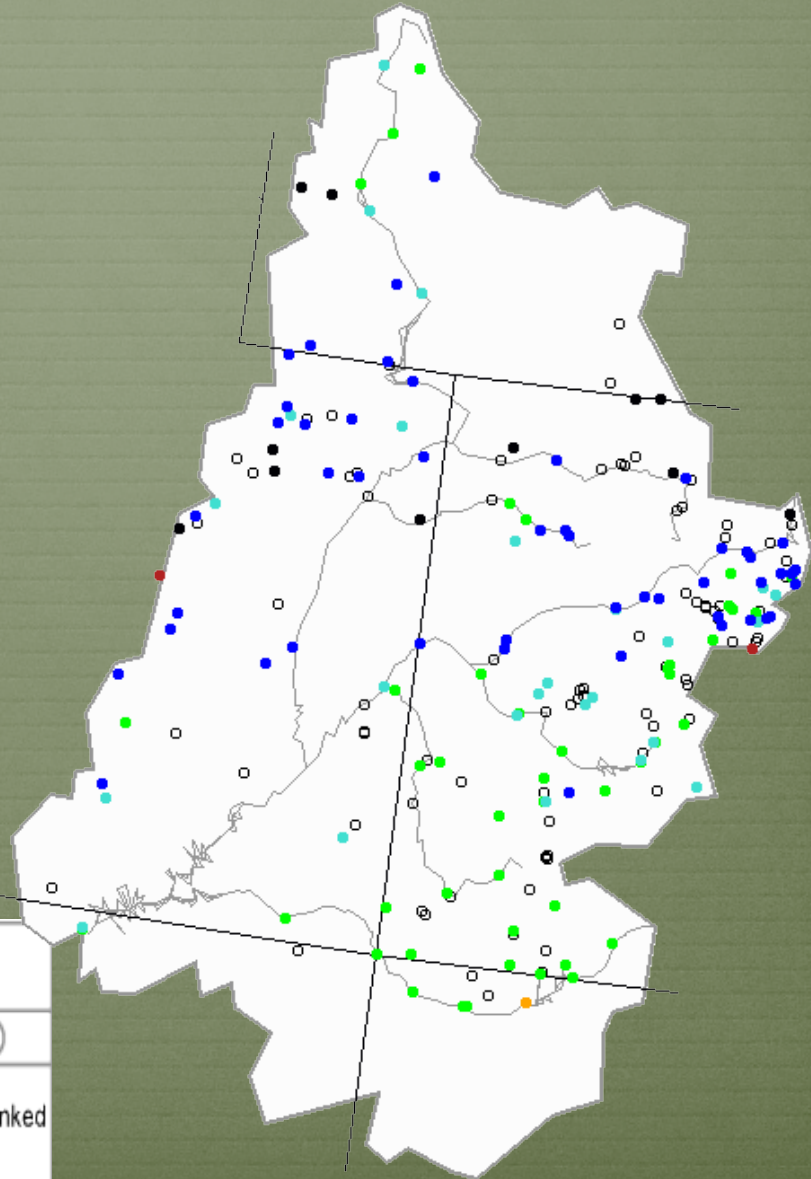
Michael Lewis USGS





# 7-day average discharge compared to historical discharge for the day of the year (June 20th)

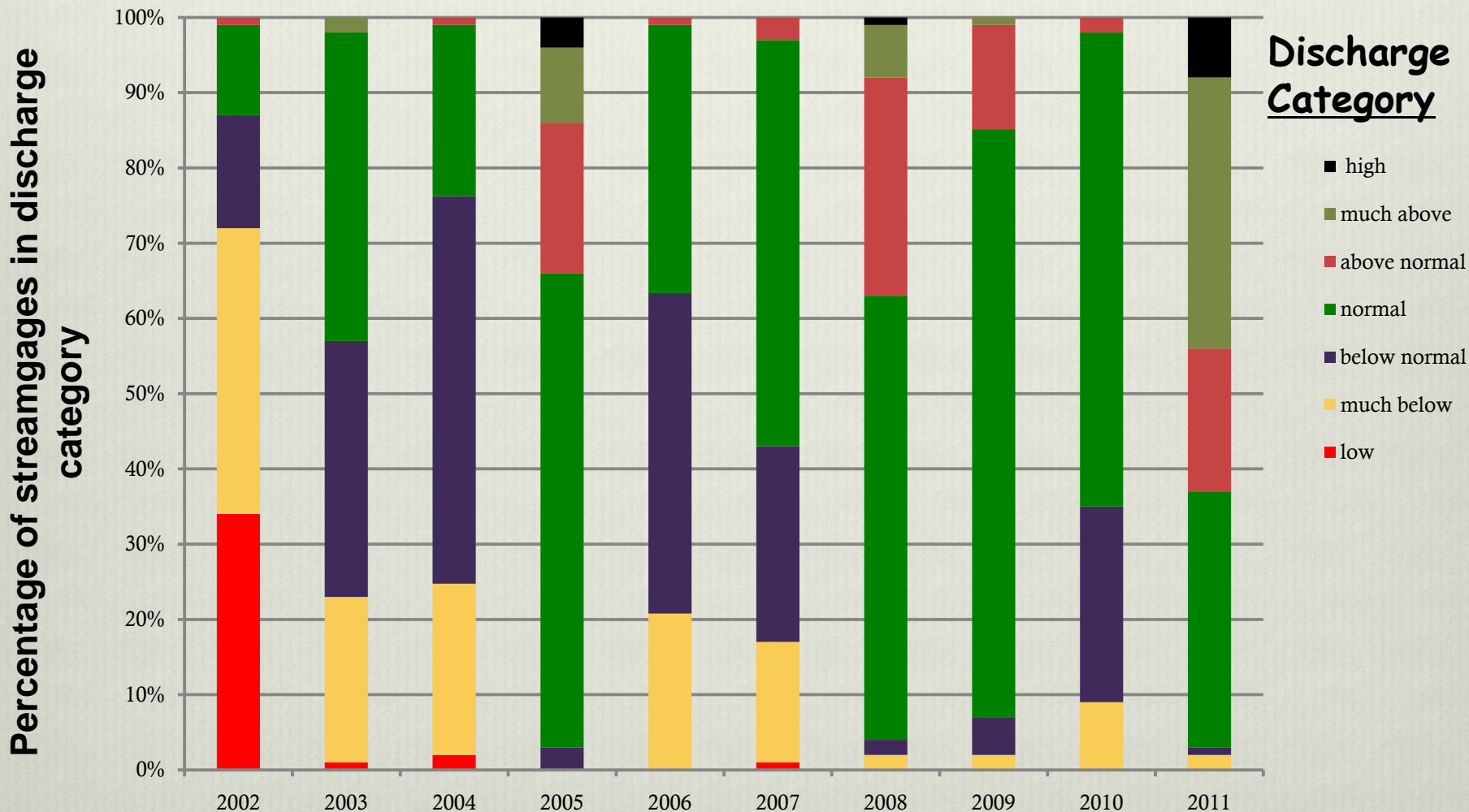
Sunday, June 26, 2011



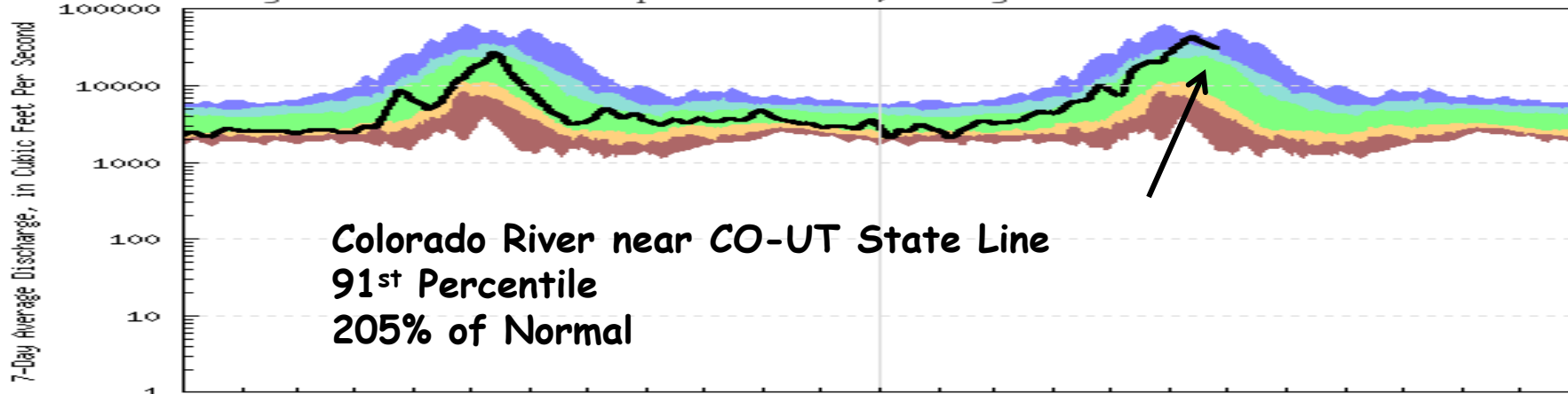
Explanation - Percentile classes

Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

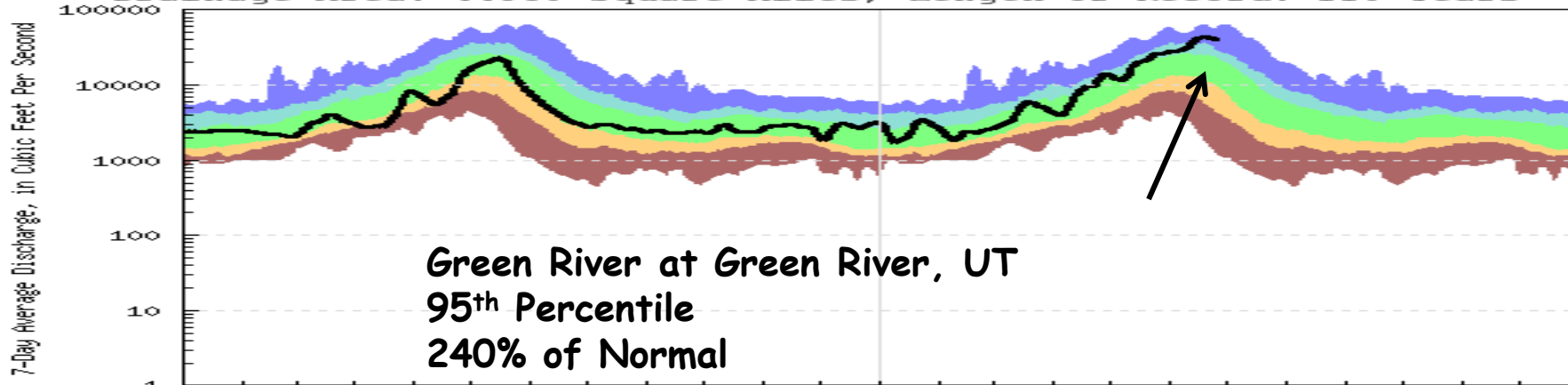
# -Upper Colorado River Basin- Comparison of 7-day Average Discharge For June 26th, 2002-2011



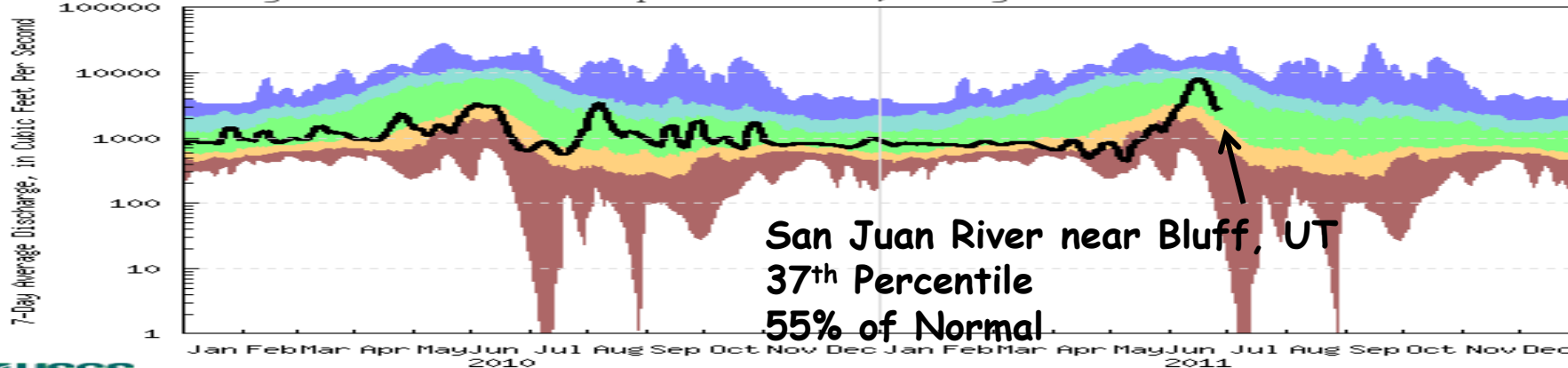
USGS 09163500 COLORADO RIVER NEAR COLORADO-UTAH STATE LINE  
Drainage Area: 17843 Square Miles, Length of Record: 59 Years



USGS 09315000 GREEN RIVER AT GREEN RIVER, UT  
Drainage Area: 44850 Square Miles, Length of Record: 110 Years

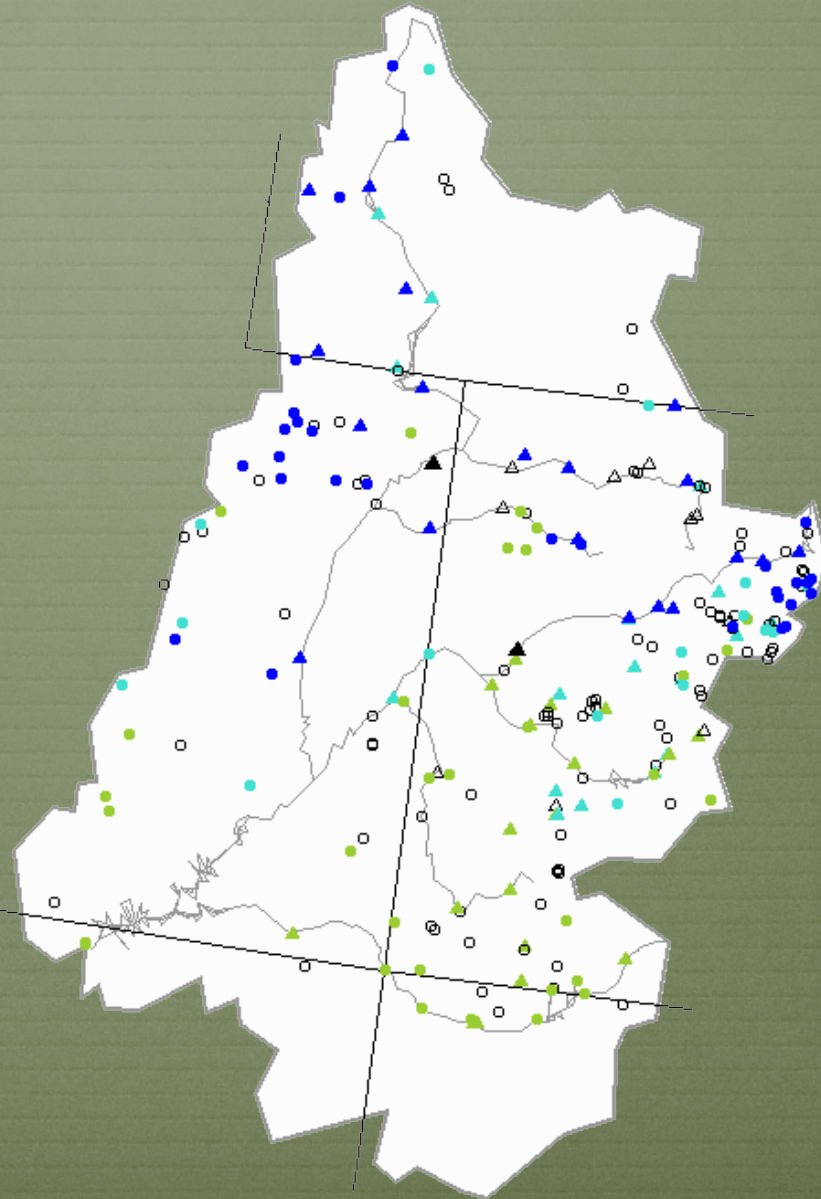


USGS 09379500 SAN JUAN RIVER NEAR BLUFF, UT  
Drainage Area: 23000 Square Miles, Length of Record: 85 Years



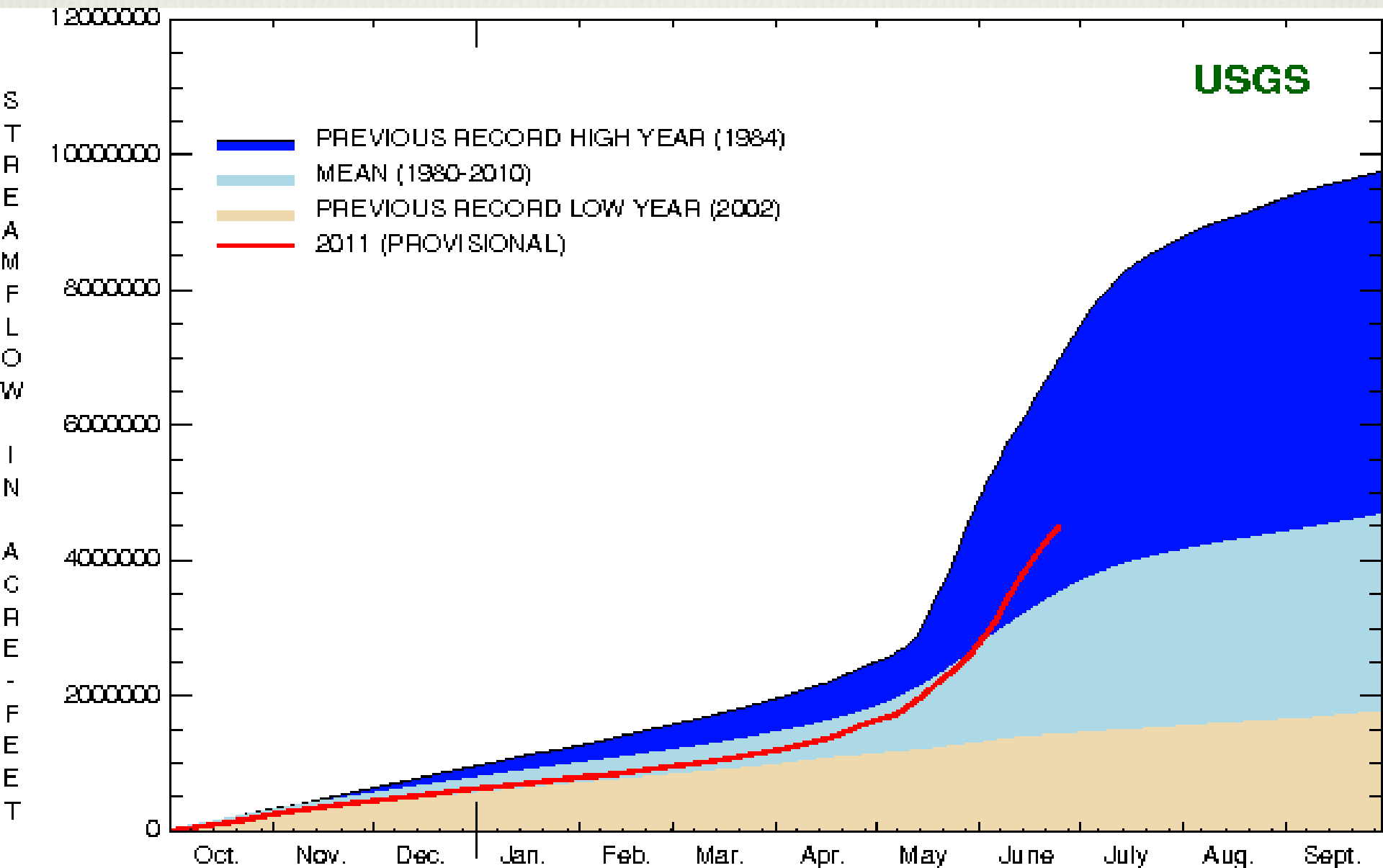
# Real-time discharge compared to historical discharge for the day of the year (June 27<sup>th</sup>)

Monday, June 27, 2011 16:46ET



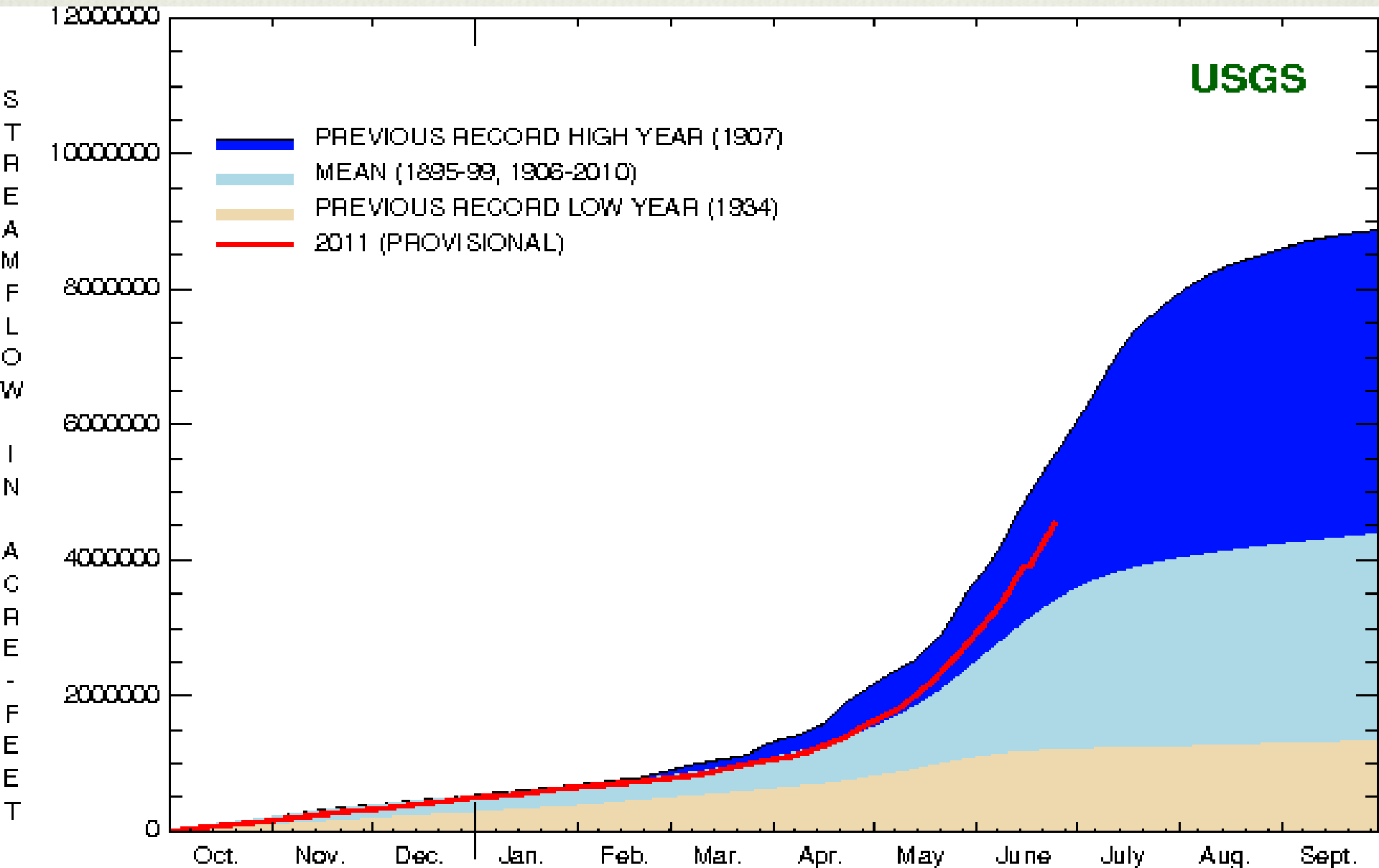
Explanation - Percentile classes				
<95	95-98	>= 99	River above flood stage	Not ranked
△ Streamgauge with flood stage	○ Streamgauge without flood stage			

# Colorado Near CO-UT Stateline



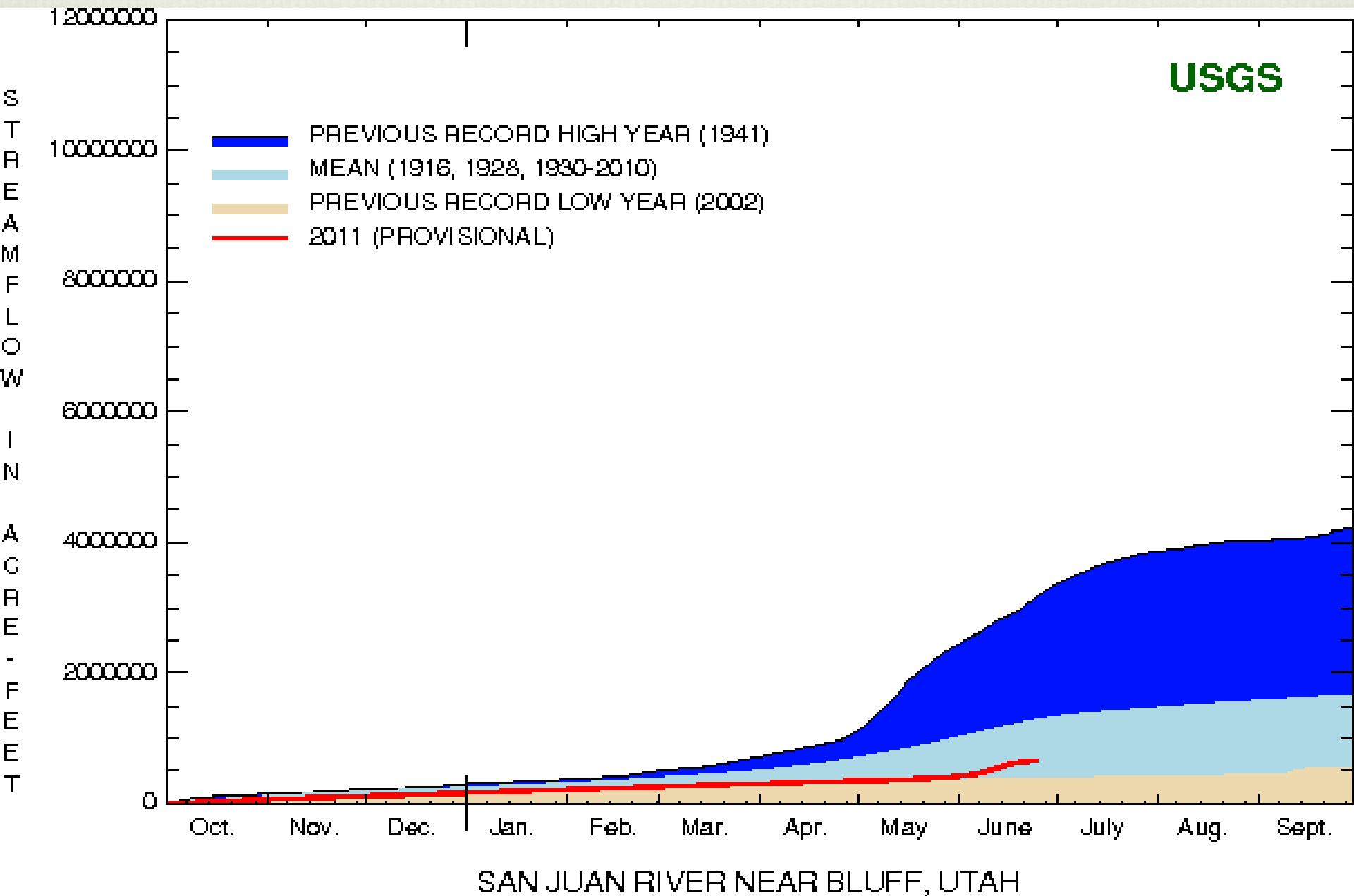
COLORADO RIVER NEAR COLORADO-UTAH STATELINE

# Green River at Green River, UT

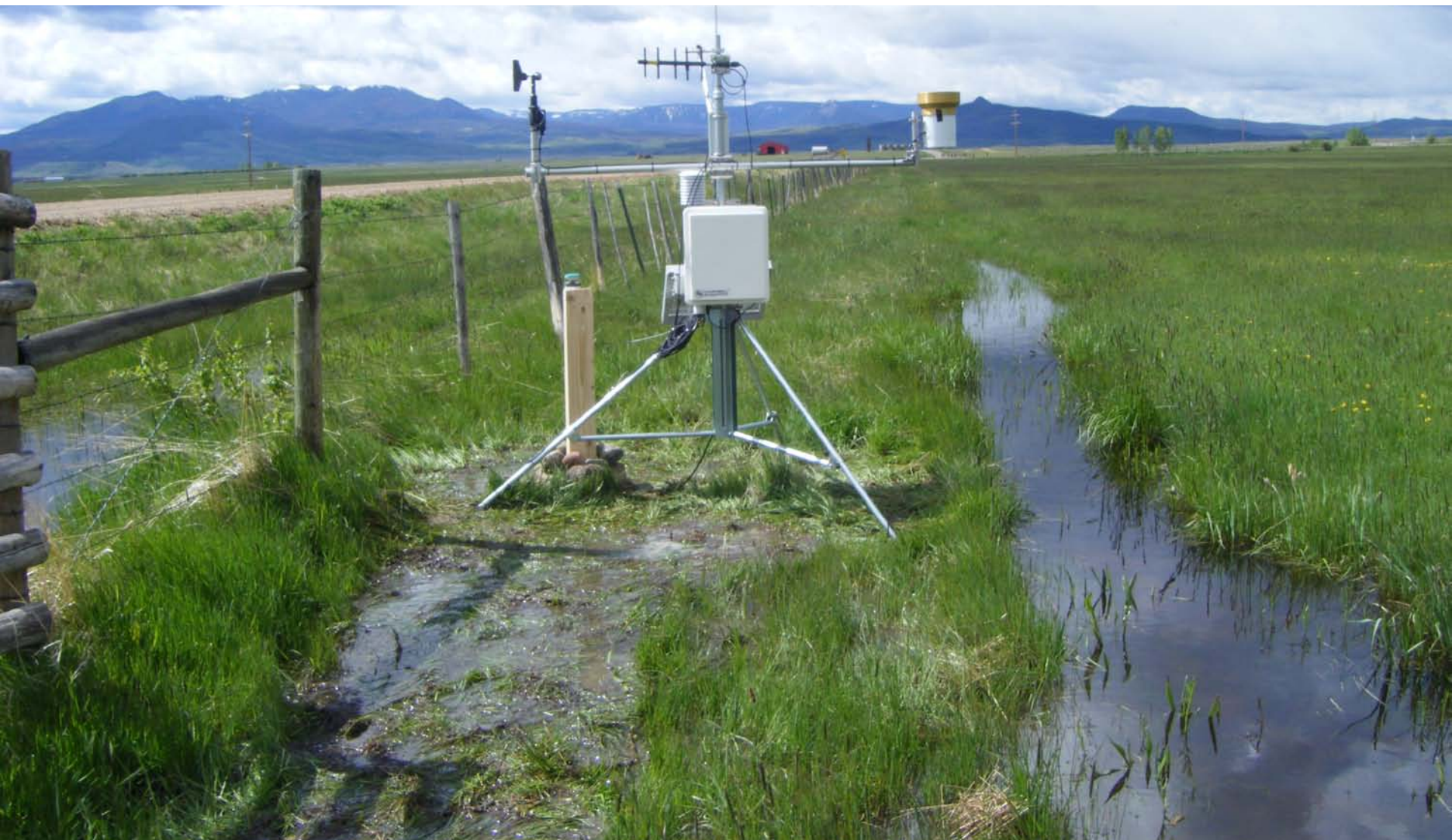


GREEN RIVER AT GREEN RIVER, UTAH

# San Juan near Bluff, UT

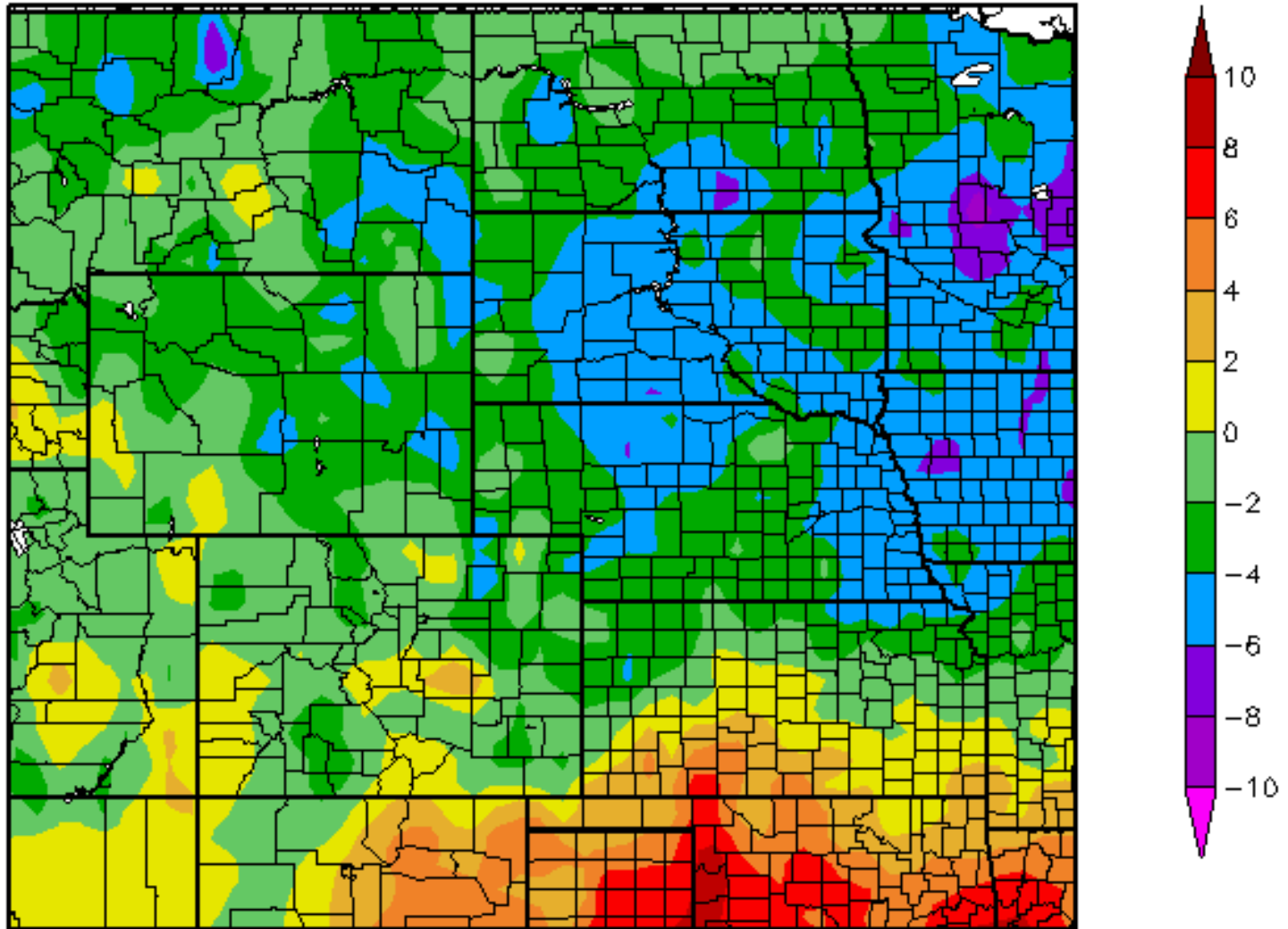


# Water Demand





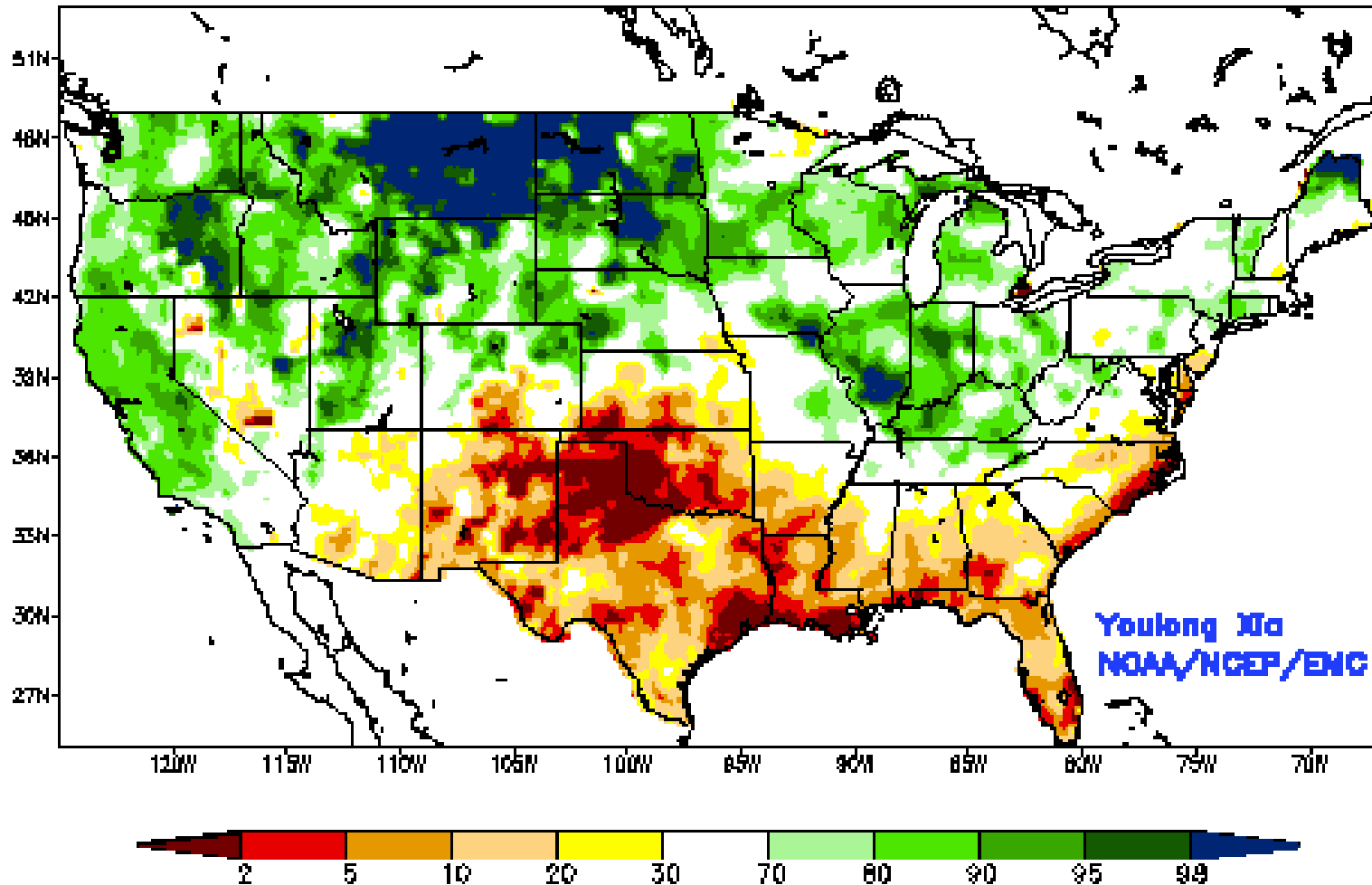
# Temperature Departure from Normal 06/20/2011 – 06/26/2011



# NLDAS Soil Moisture

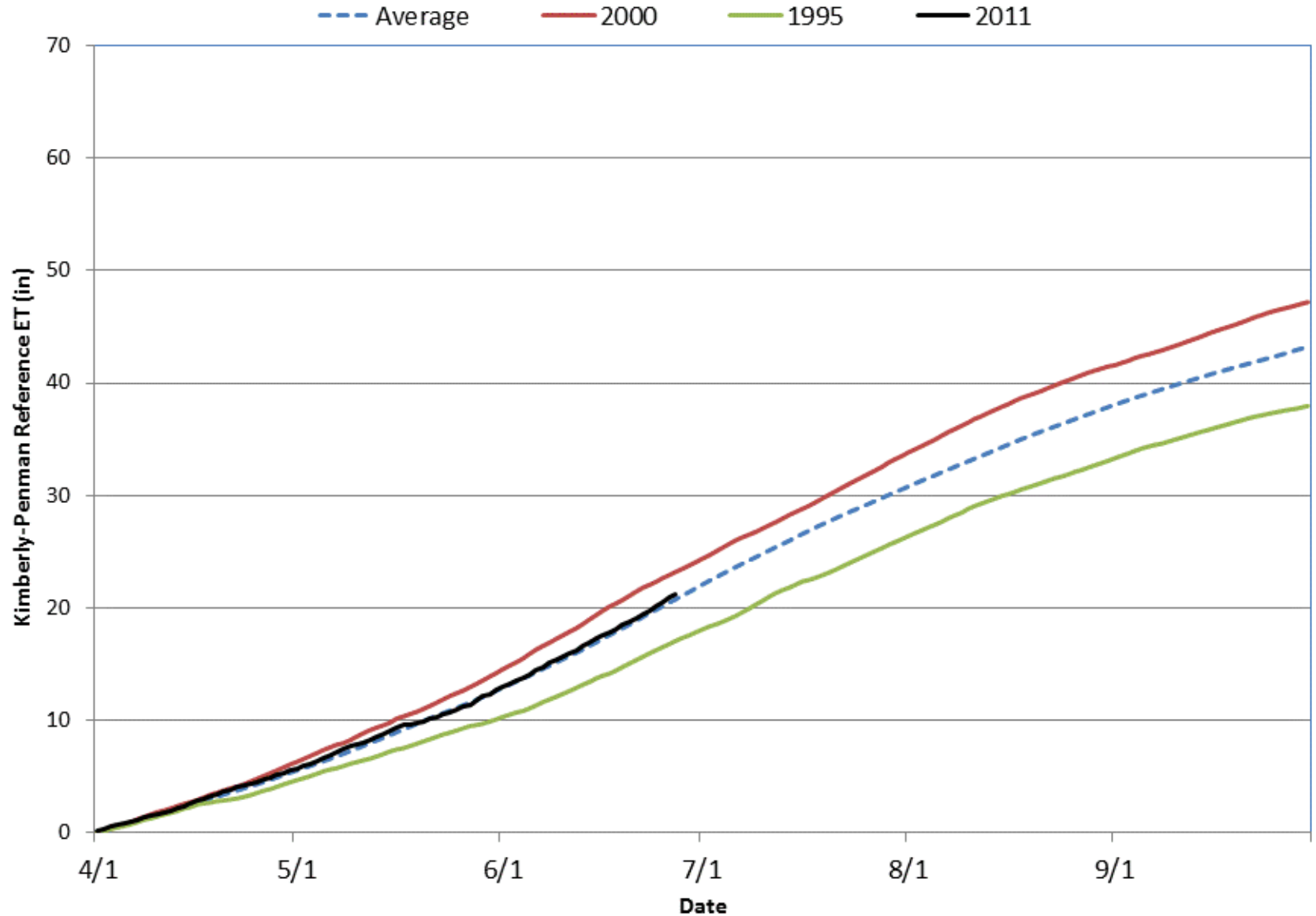
## 22 June 2011

Ensemble-Mean - Current Total Column Soil Moisture Percentile  
NCEP NLDAS Products Valid: JUN 22, 2011



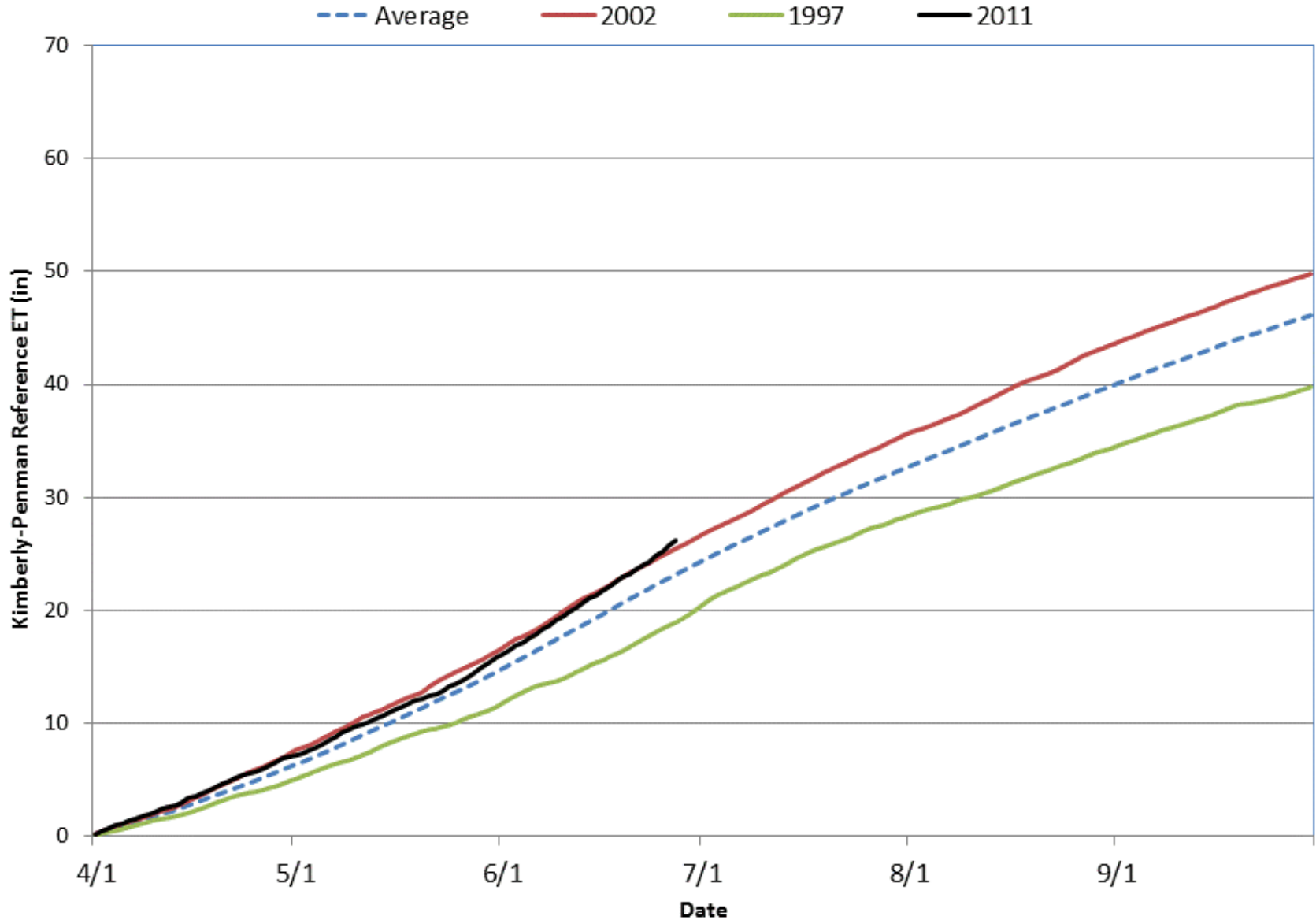
# Cortez Reference ET – SW CO

CTZ01 Kimberly-Penman Reference ET (1992 - 2011)



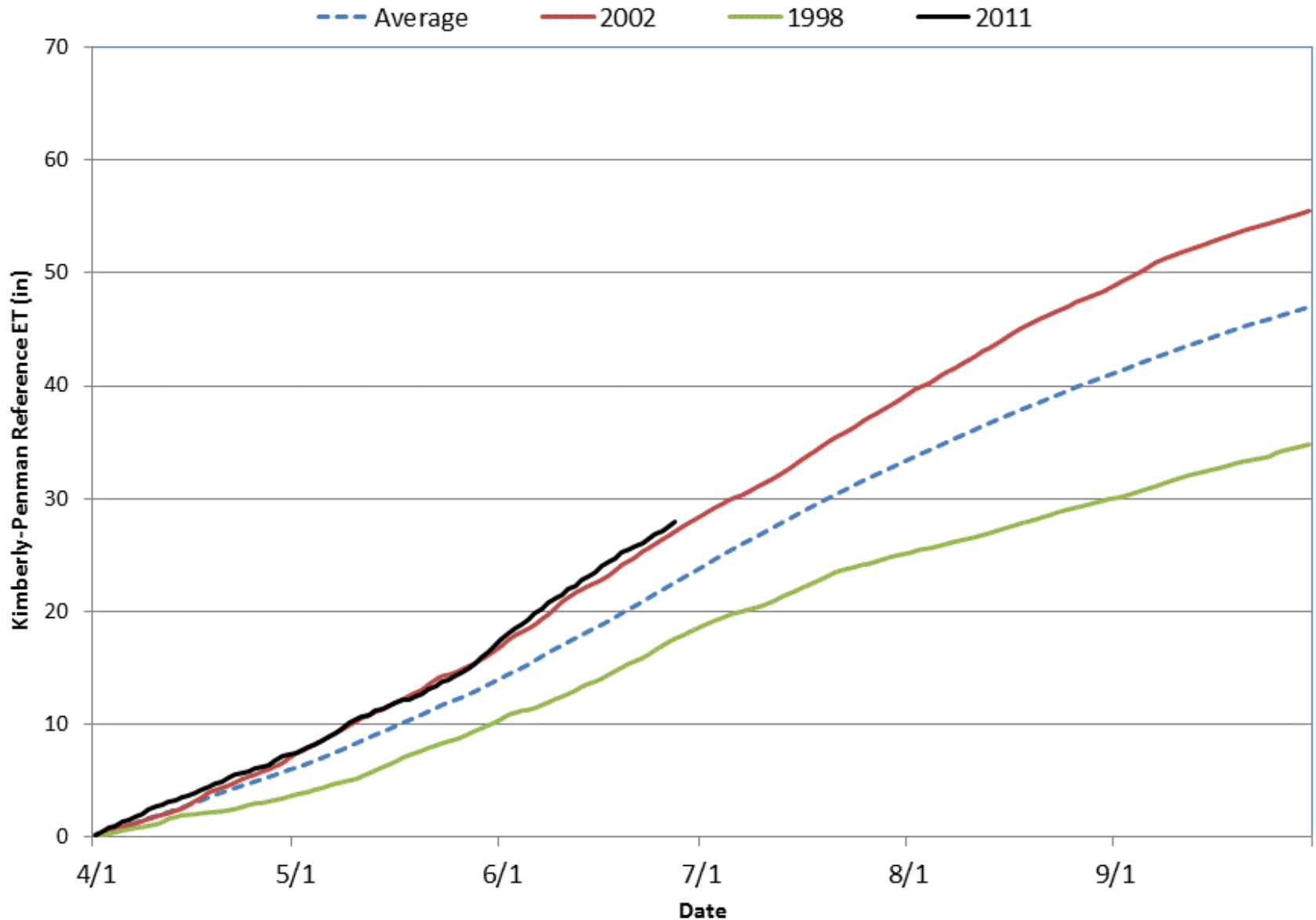
# Center Reference ET - SLV

CTR01 Kimberly-Penman Reference ET (1994 - 2011)



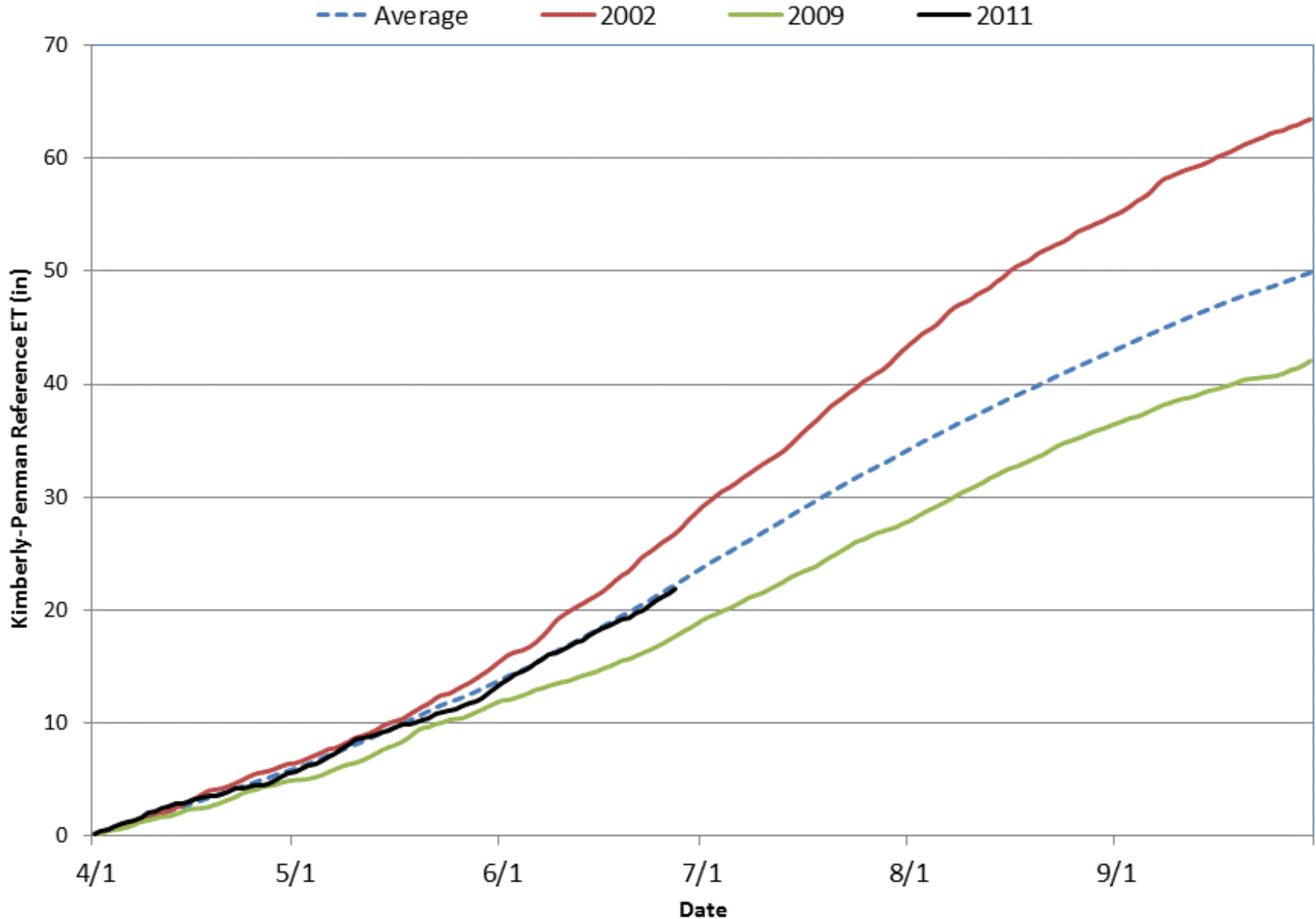
# Avondale Reference ET – AR Basin

AVN01 Kimberly-Penman Reference ET (1993 - 2011)



# Idalia Reference ET – Eastern CO

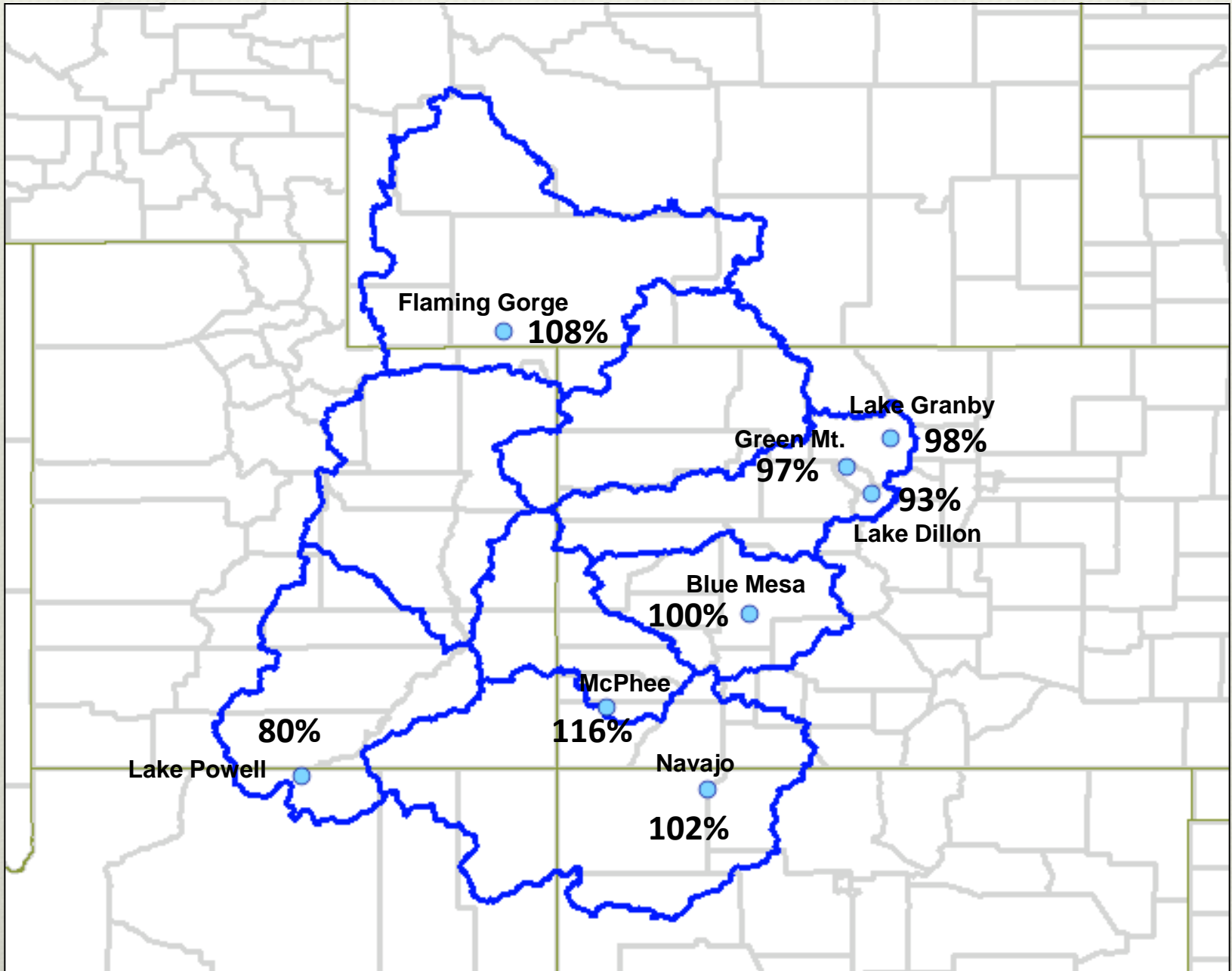
**IDL01 Kimberly-Penman Reference ET (1992 - 2011)**



# Reservoir Update

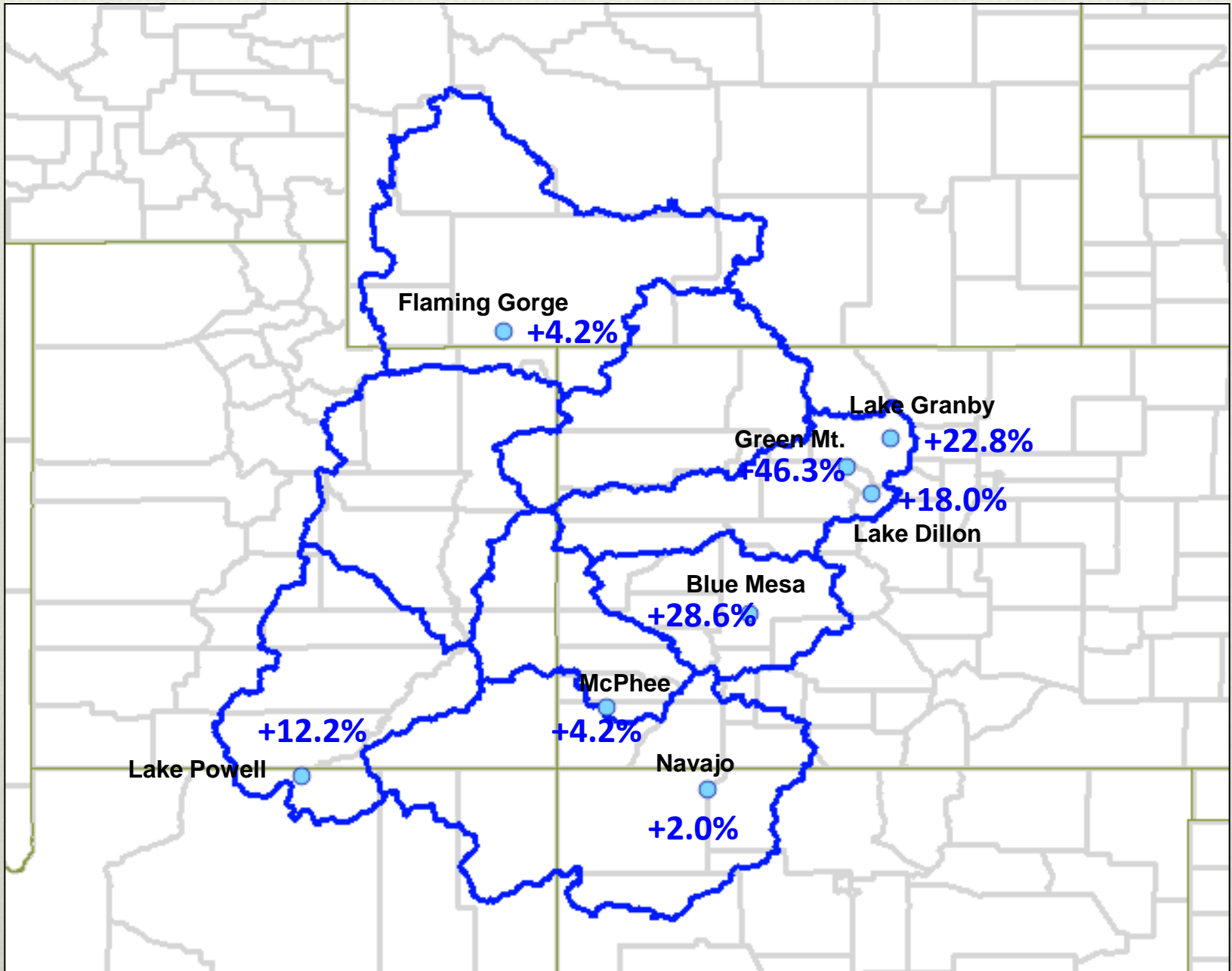


# Storage Volumes as a Percent of June Average – 6/26

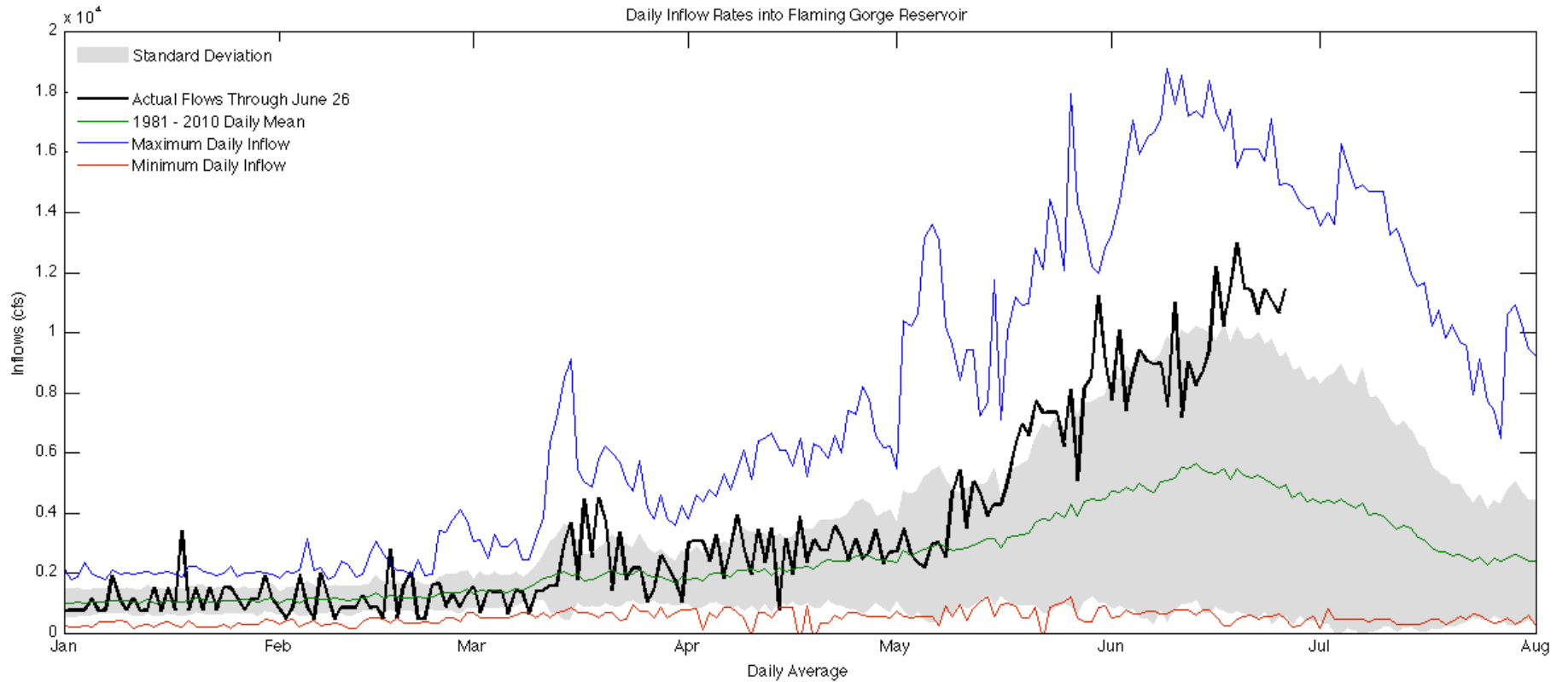




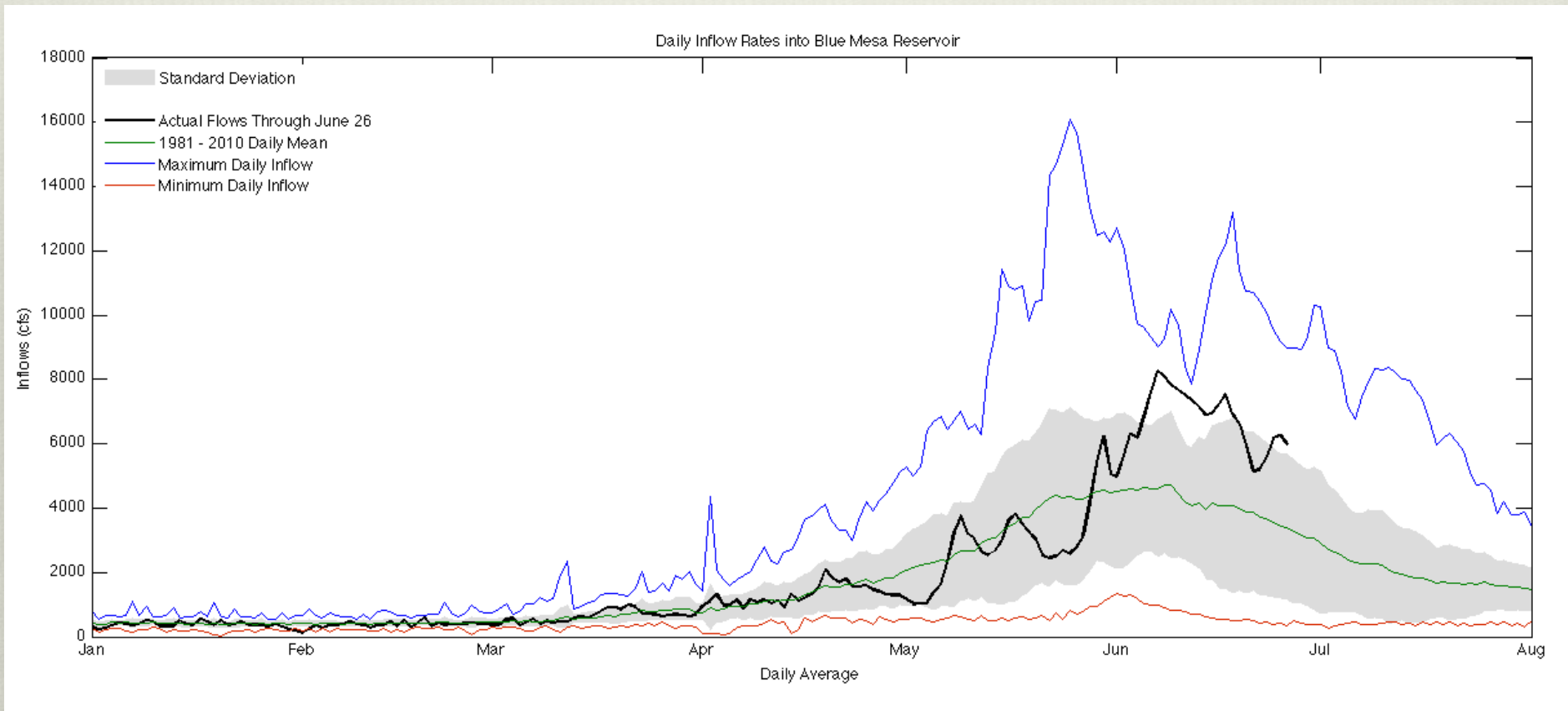
# Reservoir Level Month-to-Date Change



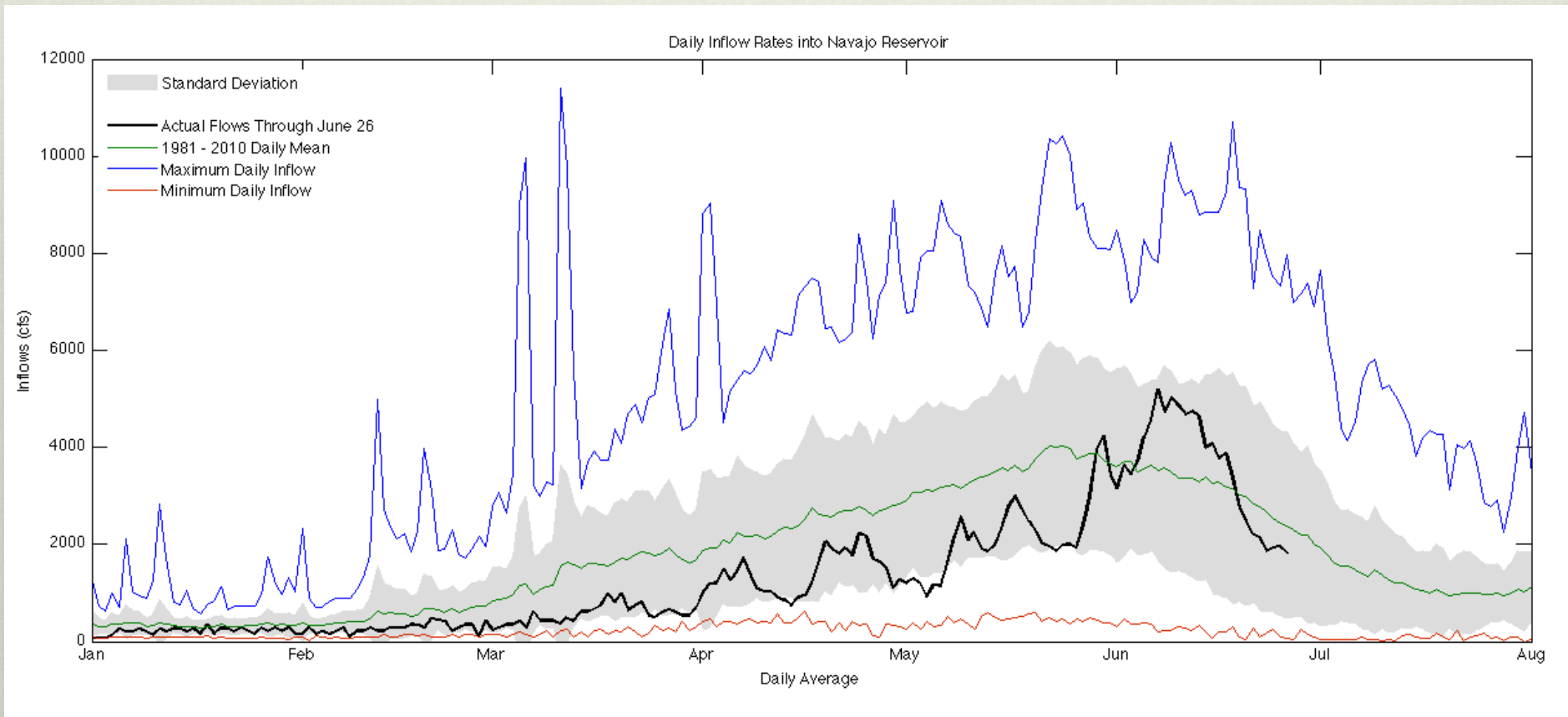
# Flaming Gorge Reservoir Inflows as of 6/26/2011



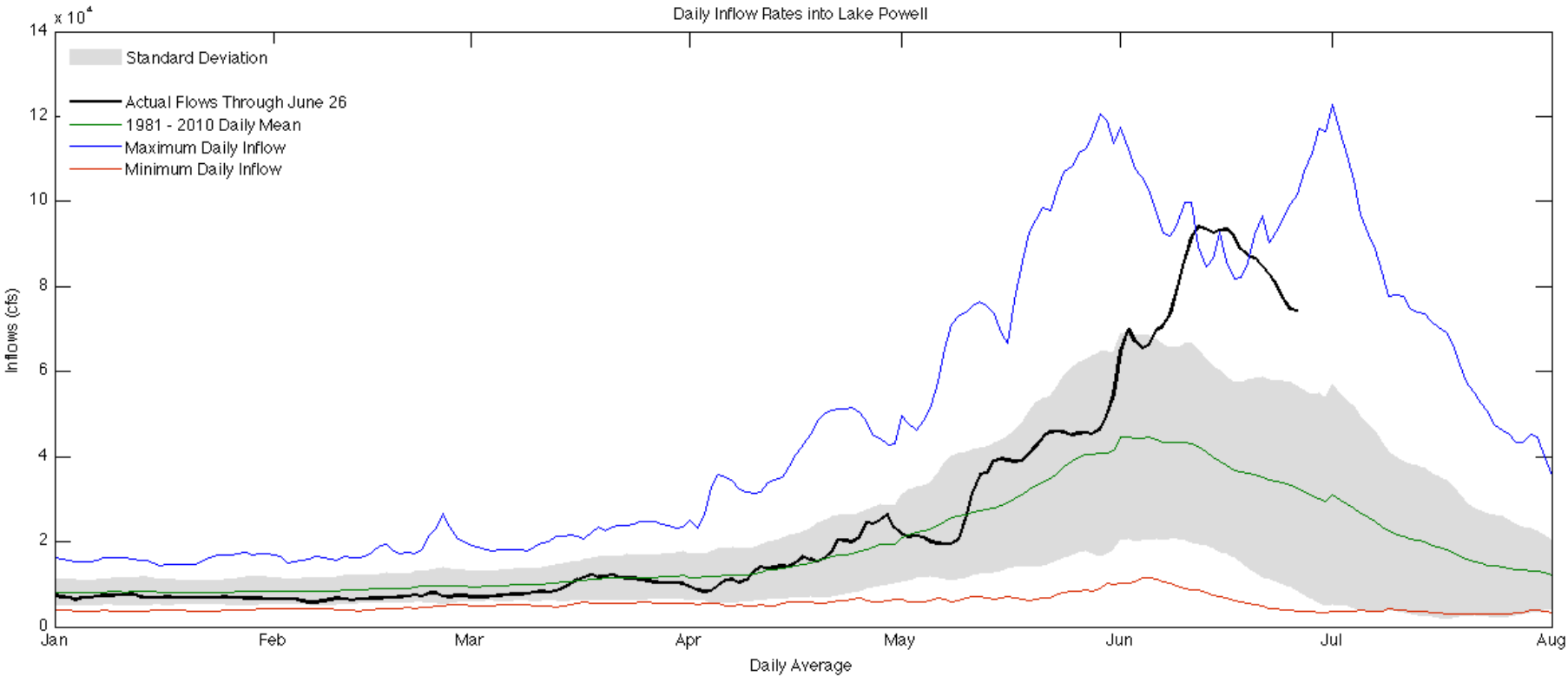
# Blue Mesa Reservoir Inflows as of 6/26/2011



# Navajo Reservoir Inflows as of 6/26/2011



# Lake Powell Inflows as of 6/26/2011

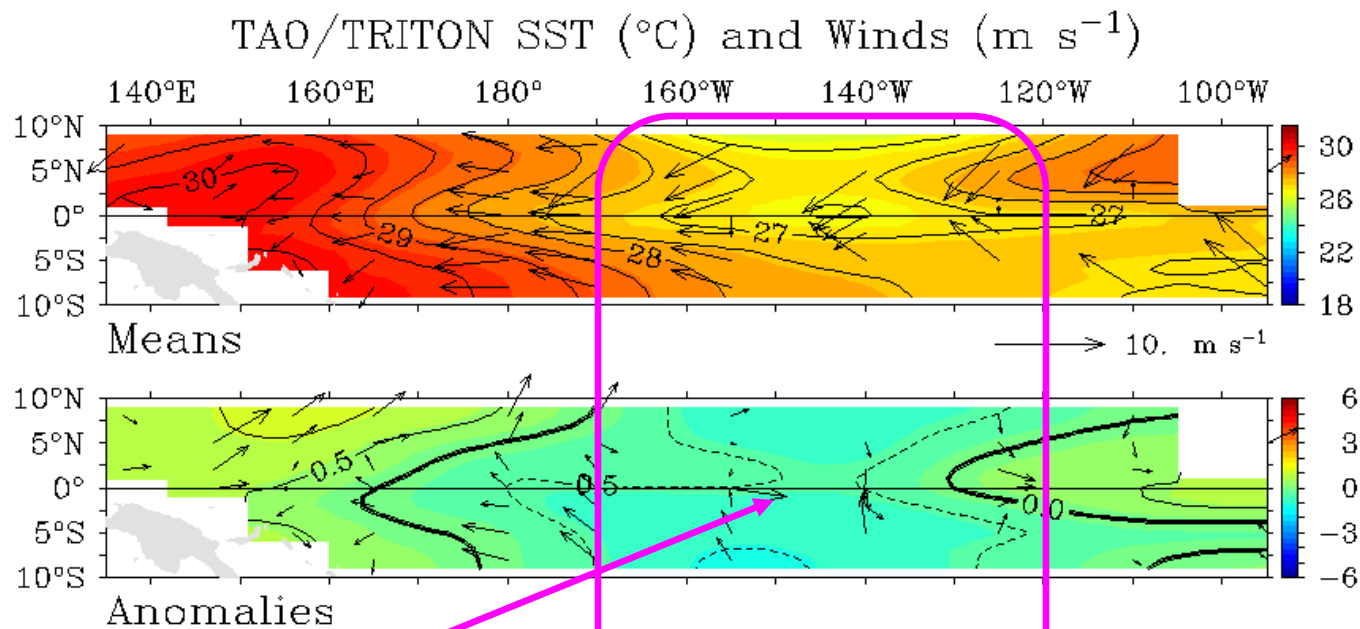


A wide river with rapids flowing through a lush green forest. The water is turbulent and white with foam, indicating rapids. The banks are lined with dense green trees and bushes. The sky is blue with some light clouds.

# Climate Forecast

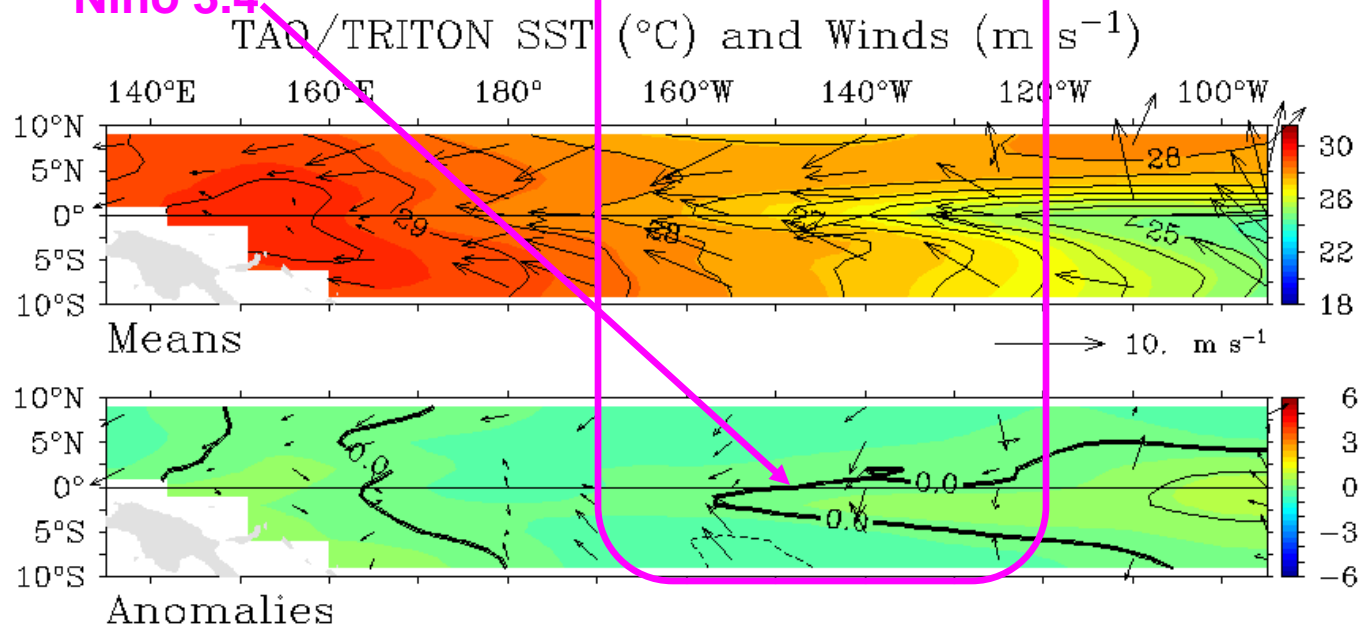
Klaus Wolter  
University of Colorado- CIRES Climate Diagnostics Center  
NOAA-ESRL Physical Science Division

**Current state of El Niño/Southern Oscillation (ENSO) phenomenon (bottom), compared to April '11(top): La Niña has clearly been replaced by more or less neutral ENSO conditions. This includes near-normal trade winds, and slightly positive SST anomalies in eastern tropical Pacific. In contrast (not shown), tropical thunderstorms are still shifted towards the Western Pacific, á la La Niña.**

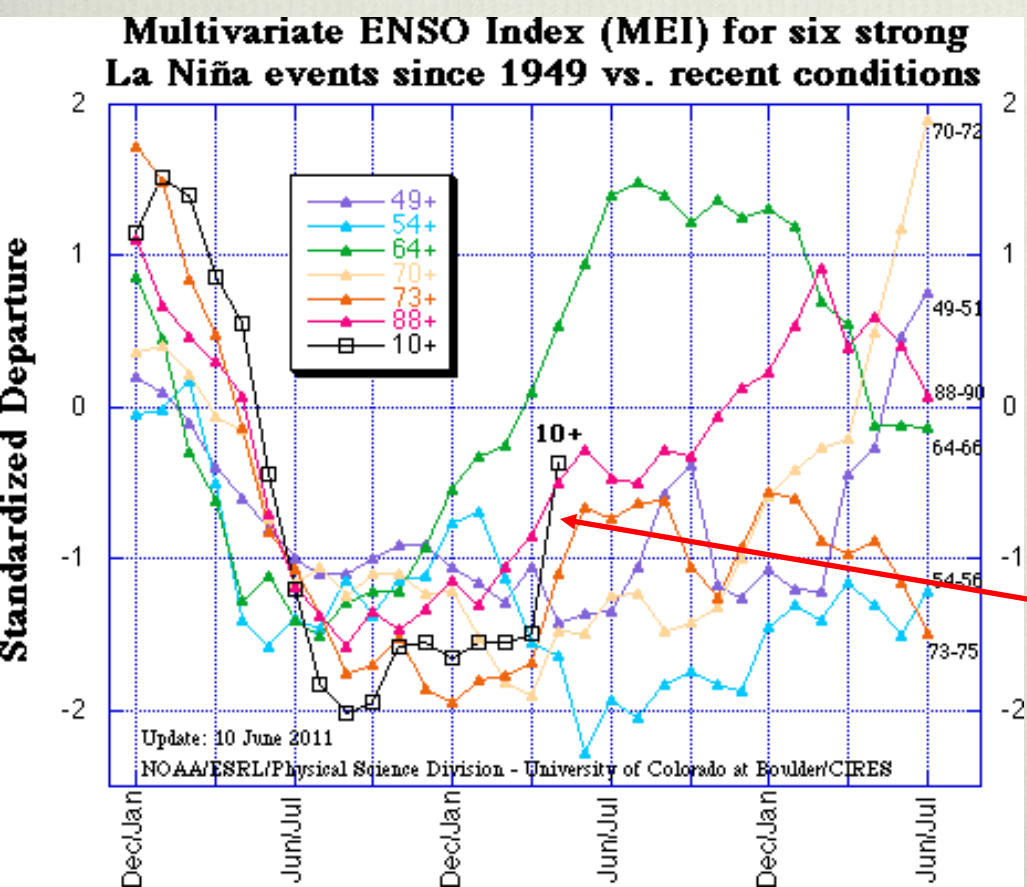
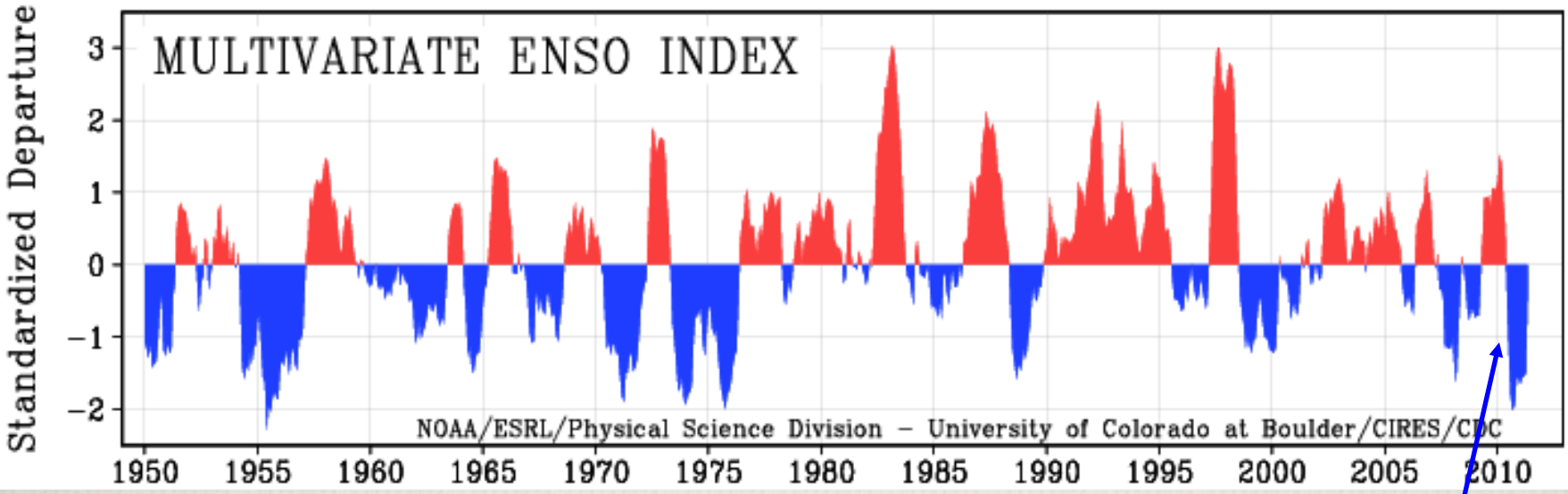


Five-Day Mean Ending on April 12 2011

Niño 3.4



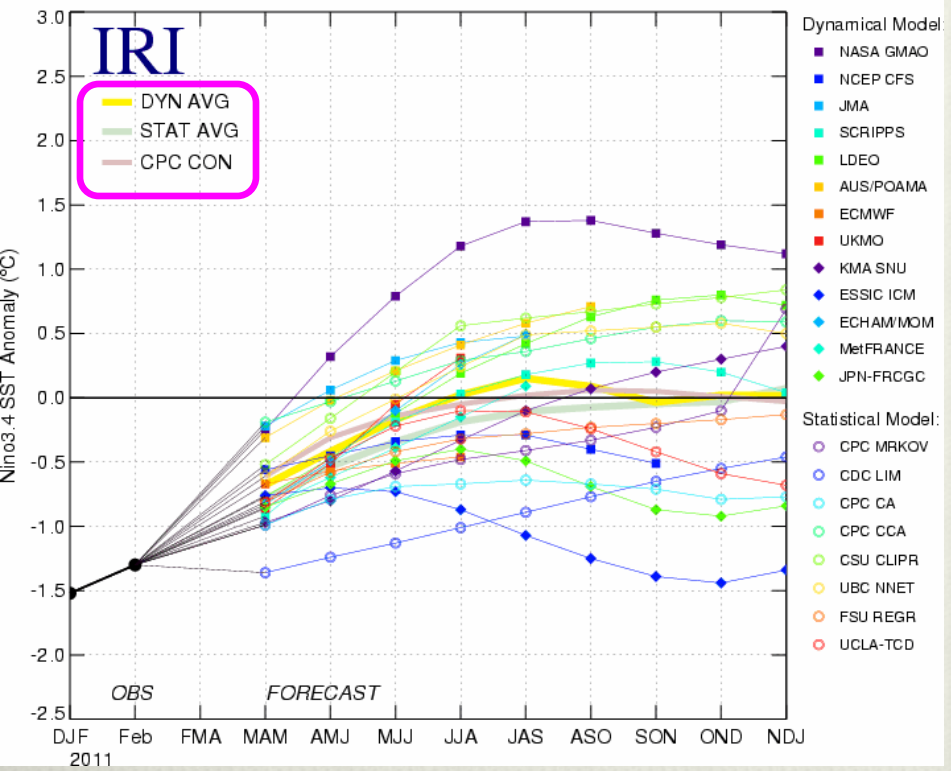
Five-Day Mean Ending on June 26 2011



Remarkable drop in 2010 from mid-sized El Niño to biggest La Niña event in 35 years in just half a year – are we seeing an opposite transition to El Niño in 2011? Not so fast...



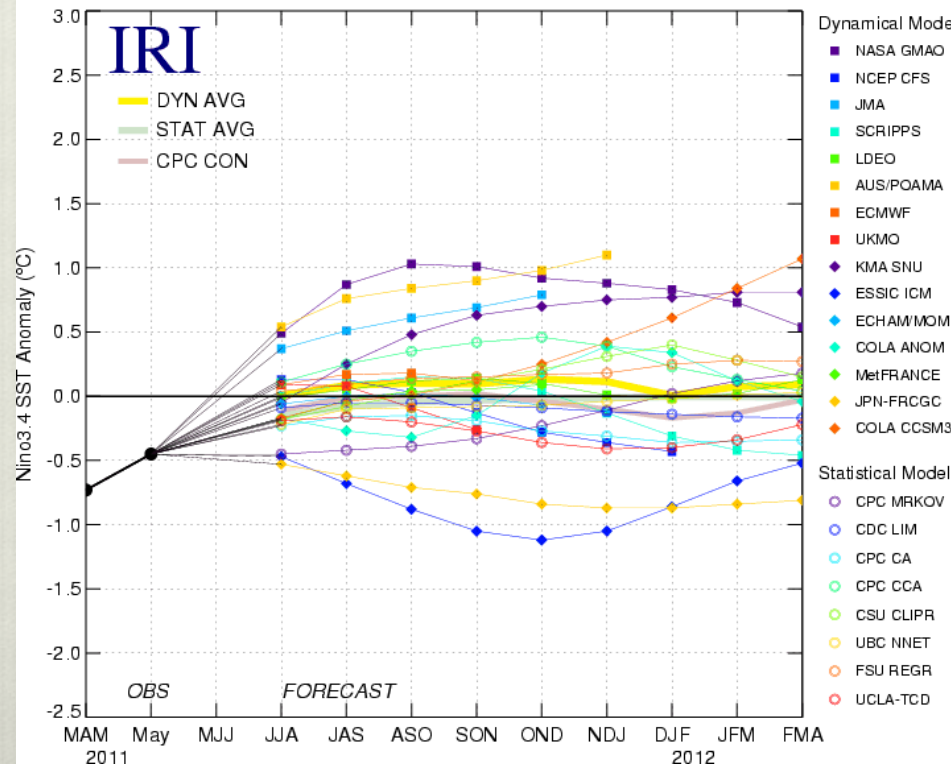
Model Predictions of ENSO from Mar 2011



**ENSO forecasts from 15 dynamical & 8 statistical forecast models in March 2011 (left):** Transition to ENSO-neutral by early summer ( $\surd$ ), then wide open outcome for rest of 2011;

**On average, dynamical models a bit warmer than statistical models, insignificant differences overall.**

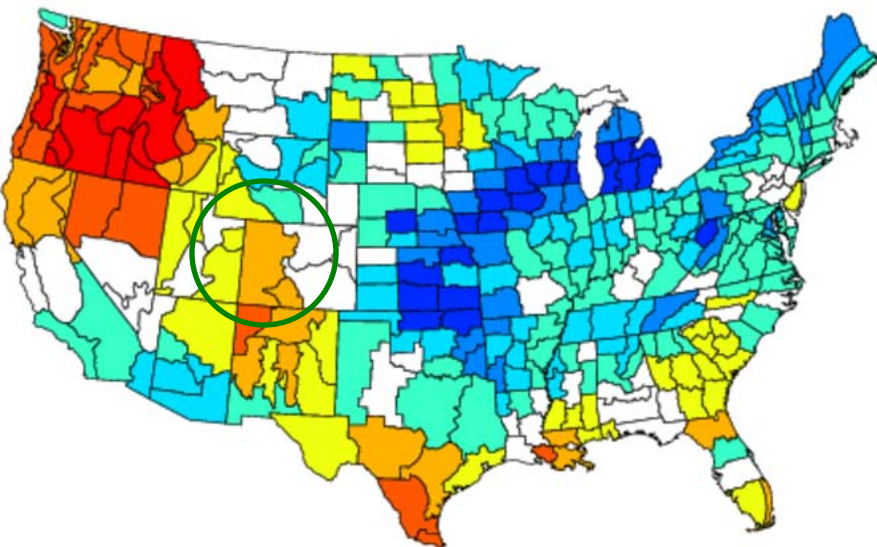
Model Predictions of ENSO from Jun 2011



**The most recent forecasts (right) remain near-neutral into next year, only a handful of models show transition to weak El Niño or a return to La Niña; meanwhile, the latest available PDO-value (May 2011) remains negative, leaving the door open for La Niña to return in a few months.**

# Weakening La Niña spring into summer (negative PDO)

Composite Standardized Precipitation Anomalies  
Apr to Jun 1951,1967,1974,1976,1989,1999,2000,2008  
Versus 1950–1995 Longterm Average

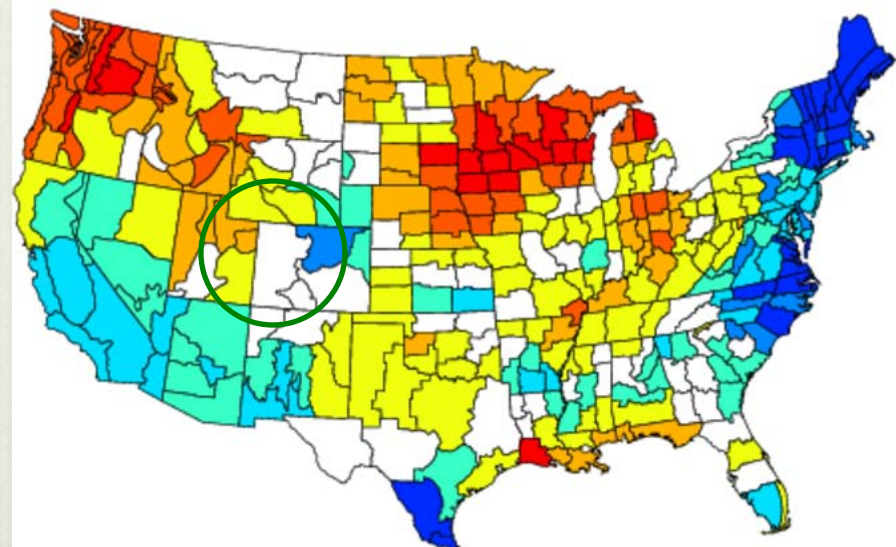


NOAA/ESRL PSD and CIRES-CDC

-0.70 -0.50 -0.30 -0.10 0.10 0.30 0.50 0.70

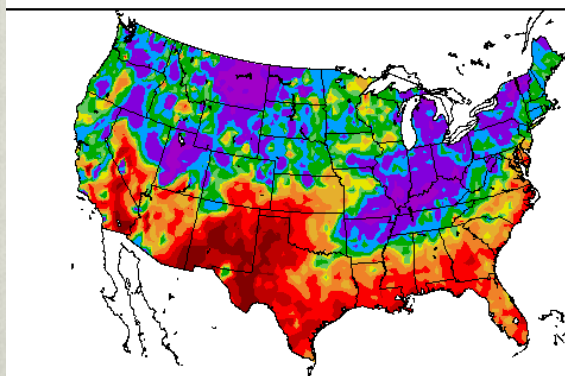
4/1/2011 - 6/26/2011

Composite Standardized Precipitation Anomalies  
Jul to Sep 1951,1967,1974,1976,1989,1999,2000,2008  
Versus 1950–1995 Longterm Average



NOAA/ESRL PSD and CIRES-CDC

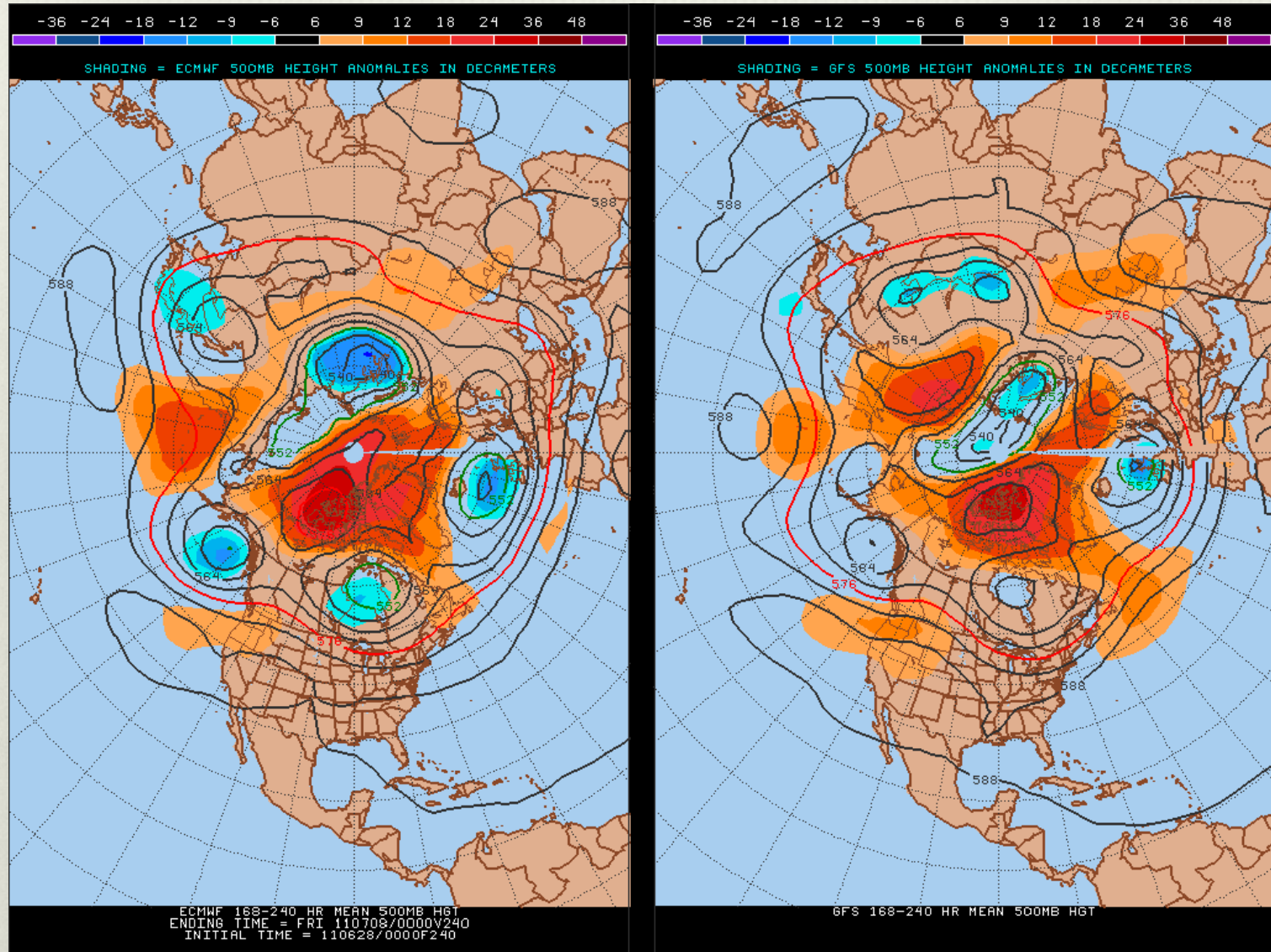
-0.70 -0.50 -0.30 -0.10 0.10 0.30 0.50 0.70



5 25 50 70 90 100 110 130 150 200

A composite look at spring (top left) and summer (top right) by requiring La Niña conditions to weaken into the summer, while also starting out with negative PDO conditions. Thus, the expectation was that western Colorado might end up drier than normal in spring (observe: left) & with climatological odds in the summer, while slightly favoring eastern Colorado, especially the South Platte basin.

# What can we expect next week and beyond?



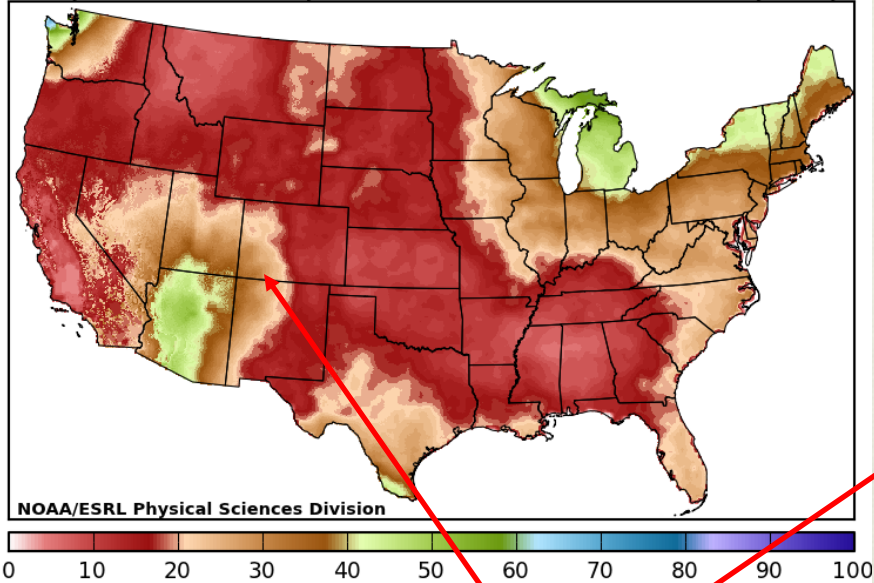
*European & U.S. models show above-normal heights just to our northwest in average circulation forecast for 8-10 days out from last **night** – a precursor pattern to summer?!*

# What can we expect in the next two weeks?

## Analog Prob Precip > 67th Percentile

4-6 day forecast, from 00Z 28 Jun 2011

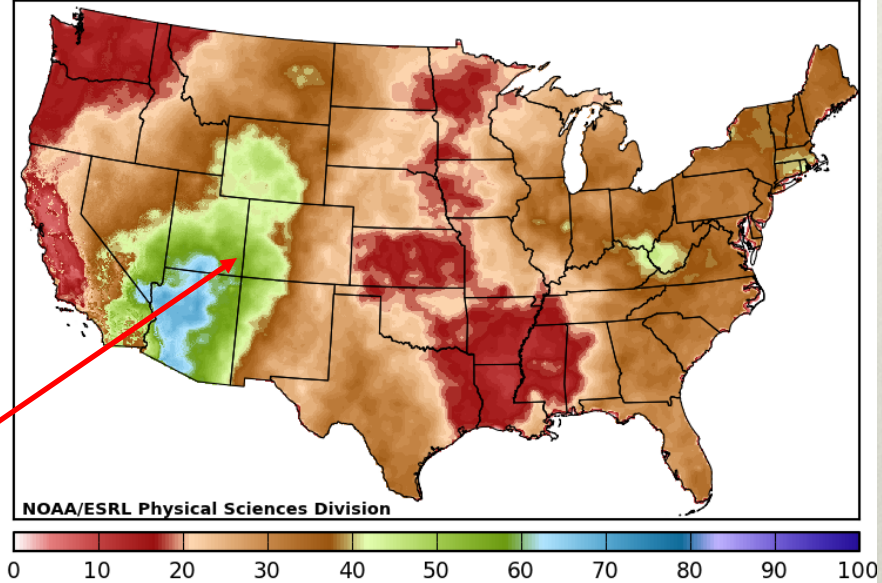
Valid 01 Jul - 03 Jul



## Analog Prob Precip > 67th Percentile

6-10 day forecast, from 00Z 28 Jun 2011

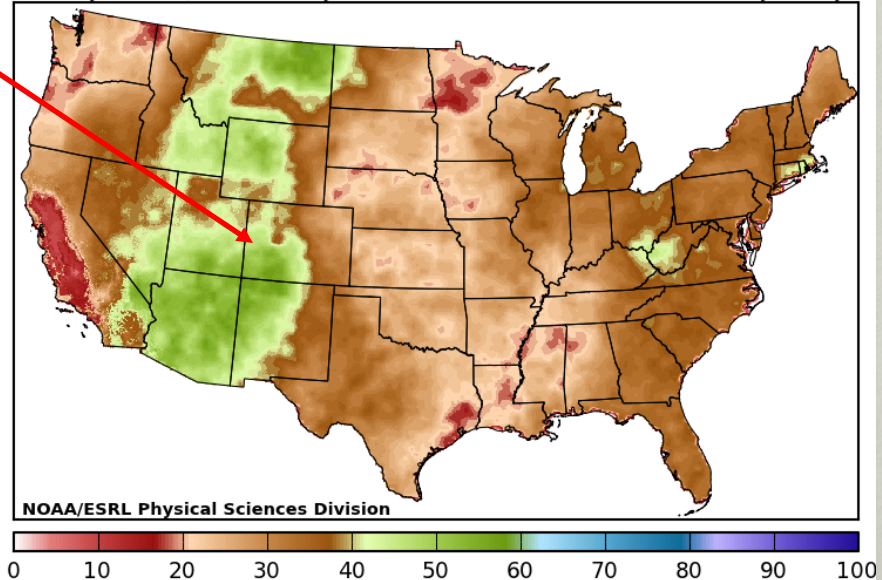
Valid 03 Jul - 07 Jul



## Analog Prob Precip > 67th Percentile

8-14 day forecast, from 00Z 28 Jun 2011

Valid 05 Jul - 11 Jul

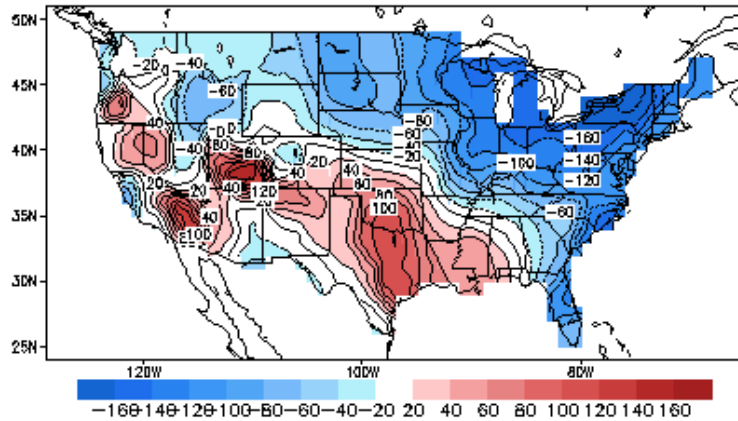


**Precipitation chances for 4-6, 6-10, and 8-14 days from today show the potential for a monsoon onset in AZ this weekend (top); expansion of this monsoon moisture into SW CO (top right), and continuing west of the Front Range in “Week 2” (right).**

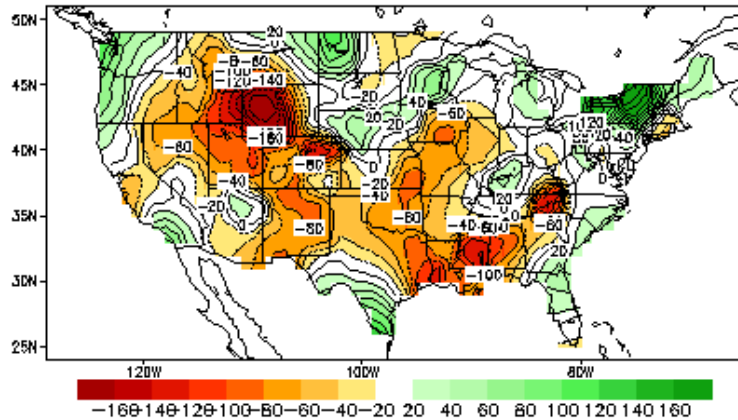
**Temperatures are expected to stay above average through the period which should help finish off the remaining snowpack.**

# Climate Prediction Center 'Analog' Forecasts

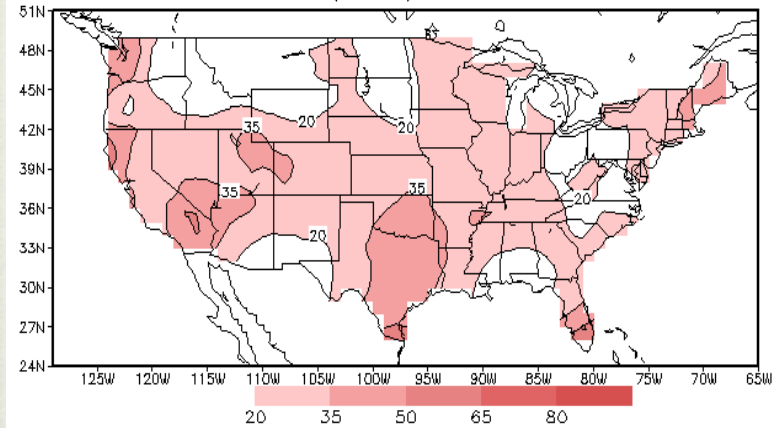
Lagged Averaged Temperature Outlook for JAS 2011  
units: anomaly (sdX100), SM data ending at 20110626



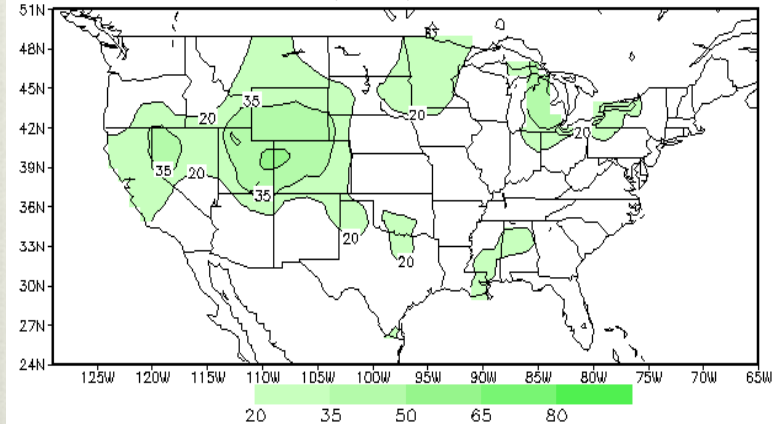
Lagged Averaged Precipitation Outlook for JAS 2011  
units: anomaly (sdX100), SM data ending at 20110626



lead 1 skill of temperature CAS forecast for JAS  
units: correlation (X100) based on 1981-2005



lead 1 skill of precipitation CAS forecast for JAS  
units: correlation (X100) based on 1981-2005



According to recent soil-moisture analog forecasts, most of the Upper Colorado basin can expect below-normal moisture in July-September 2011 (left), with above-normal temperatures in UT and SW CO. Typical skill at this lead-time (right) is about as high as it can get any time of year.

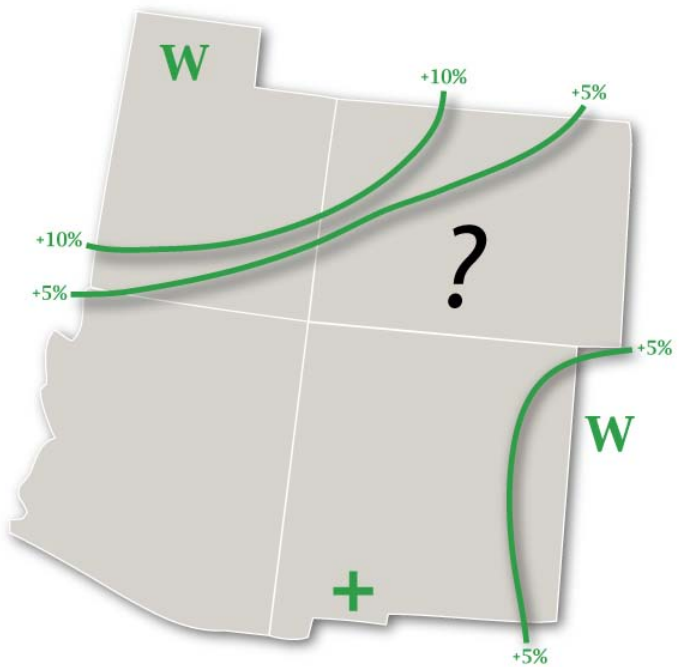
Source: <http://www.cpc.ncep.noaa.gov/soilmst/cas.shtml>

# Statistical Forecast for July-September 2011



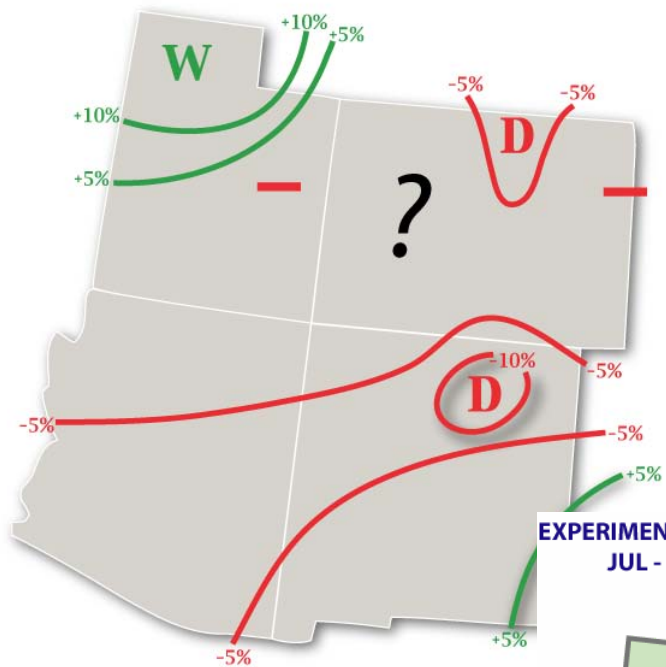
Experimental PSD Precipitation Forecast Guidance

JUL - SEP 2011 (Issued April 8, 2011)



Experimental PSD Precipitation Forecast Guidance

JUL - SEP 2011 (Issued June 16, 2011)



**Skill map (below) shows poor skill over SW CO, but better skill over E and NW CO.**

EXPERIMENTAL PSD PRECIPITATION FORECAST SKILL JUL - SEP 2000-2009 (Lead: +0.5 Months)



The April forecast for July-September 2011 (left) was optimistic for northwestern CO, and undecided for the rest of the state. *This month's update (top right) is significantly drier, including my first dry summer forecast for the eastern plains in more than one decade.*

- 'Wild cards' in 2011:*
1. Record-snowpack (might delay monsoon);
  2. Wildfires (could suppress monsoon a la 2002);
  3. Rapid (re-)development of El Niño (La Niña) could increase (decrease) odds for moisture in CO.

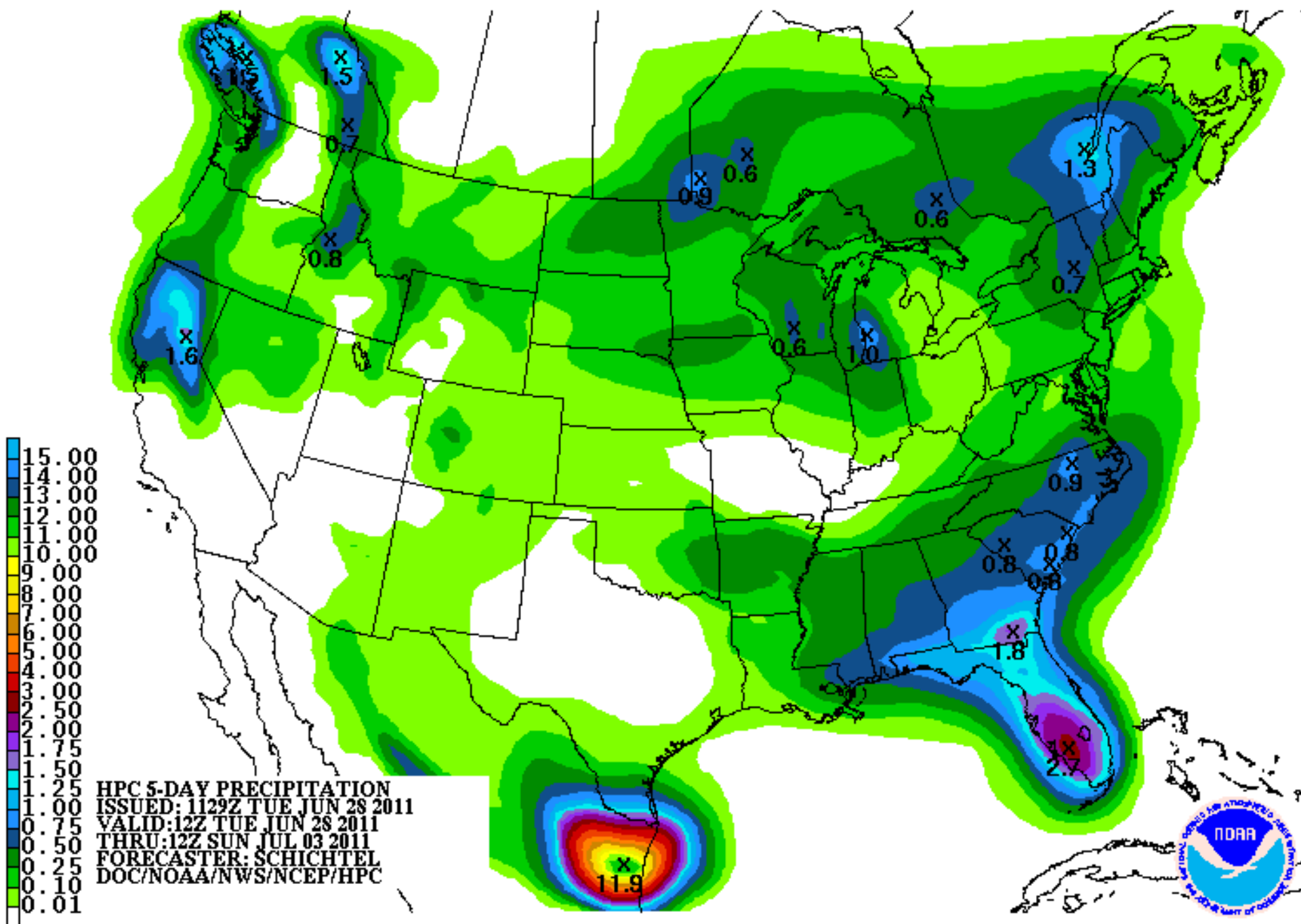
## **Executive Summary (28 June 2011) – *klaus.wolter@noaa.gov***

- 1. After reaching levels not seen in 35 years, La Niña is taking a ‘leave of absence’ this summer, but odds remain higher than 50/50 that it will return later this year (IMHO).**
- 2. In the Front Range, mid-April to mid-June has been wet for the northwestern half of the state and dry in the SE, worsening their drought status. I expect to see typical early July heat and dryness over eastern Colorado, with the potential for early monsoon moisture to sneak into the Upper Colorado basin next week.**
- 3. My latest forecast for late summer (July-September) is drier than my original forecast in April. While not explicitly included here, both near-record late season snowpack over northern Colorado and increased wildfire activity over southern Colorado could end up reinforcing this dry monsoon forecast for eastern Colorado.**
- 4. All in all, this year’s dust season appears to have been more benign than in last two years, which may have helped with slower snowmelt so far. Given the remaining snowpack in higher elevations of northern CO, we should see an extended runoff season with occasional ‘nuisance’ flooding, but most of the snow-melt has occurred under relatively cool and dry conditions, with no major flooding damage.**
- 5. Bottomline: Count your blessings, this La Niña season has delivered higher-than-expected amounts of snow in our mountains which is giving us a good runoff season (*and flooding north and east of here*). I remain much less optimistic for local conditions over the eastern plains, nor do I expect a repeat performance for our mountains next year.**

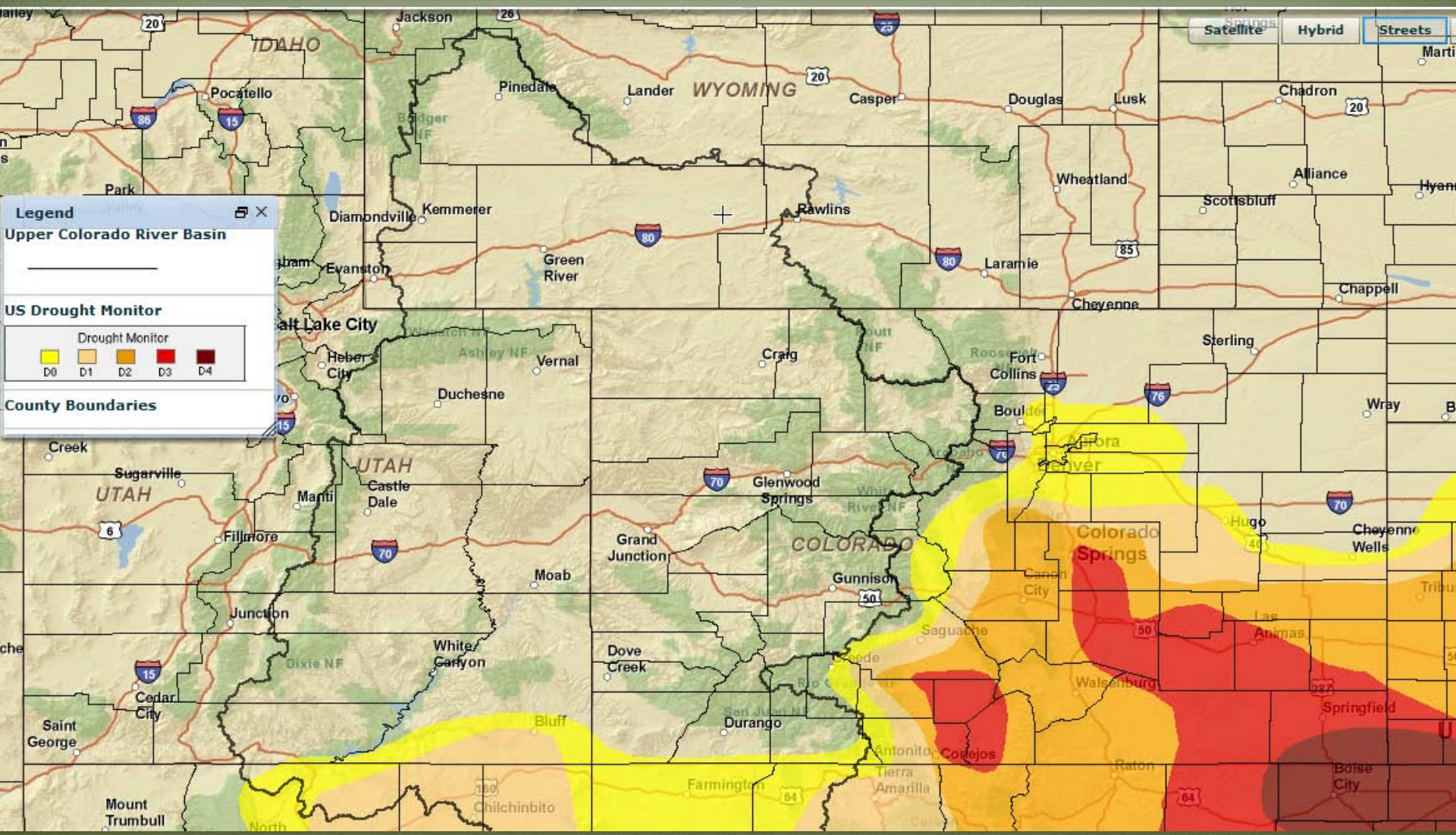
# Precipitation Forecast







# Recommendations



**O  
F  
N  
I**



**CONTACT:**

**COLORADO CLIMATE CENTER**

**COLORADO STATE UNIVERSITY**

**FORT COLLINS, CO 80523**

**970 - 491 - 8545**

**NIDIS - UPPER COLORADO BASIN PILOT PROJECT**

**F o r m o r e i n f o r m a t i o n**

# NIDIS Weekly Climate, Water and Drought Assessment Summary

Upper Colorado River Basin

June 28, 2011

# Precipitation and Snowpack

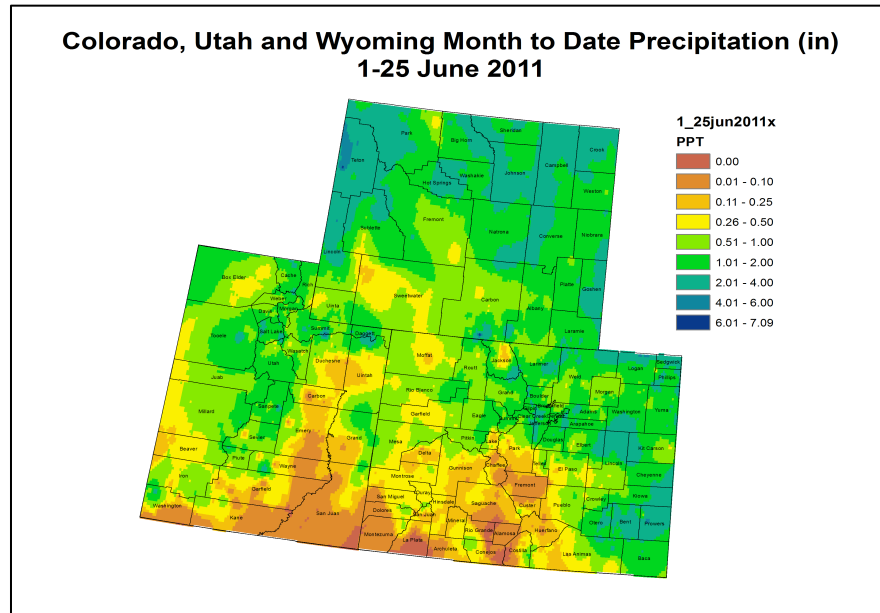


Fig. 1: June month-to-date precipitation in inches.

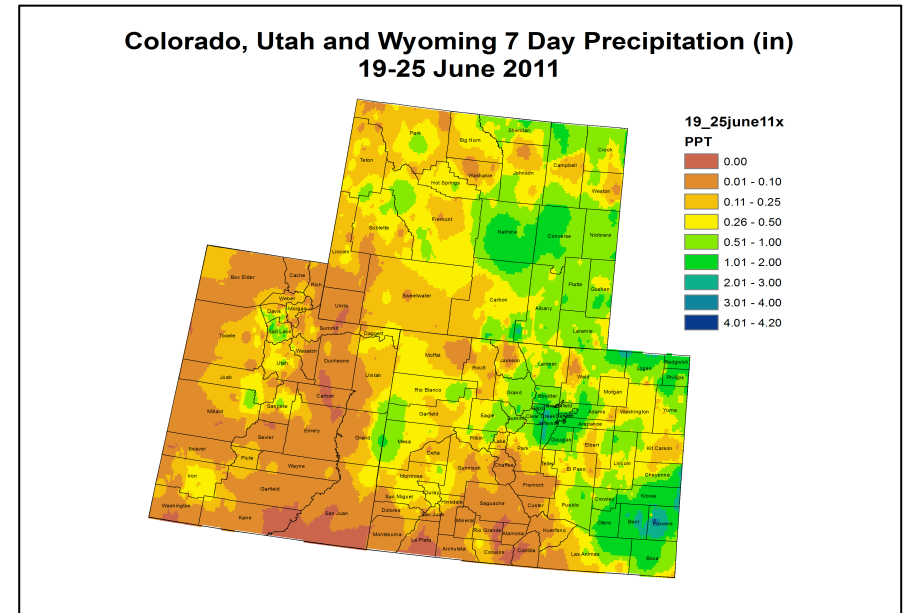


Fig. 2: June 19 – 25 precipitation in inches.

For the month of June, to date, much of the northern portions of the Upper Colorado River Basin (UCRB) has received over half an inch to over 2 inches of precipitation (Fig. 1). The Four Corners remains the driest region of the basin, receiving less than a tenth of an inch of moisture for the month so far. Northeastern and southeastern Colorado have seen 1 to 4 inches of accumulation since the first of the month. The San Luis Valley has remained dry for the month, receiving less than a tenth of an inch of precipitation.

Last week, the heaviest amounts of precipitation were concentrated over the northern Front Range of CO and in southeastern CO (Fig. 2). The accumulations of 1 to 3 inches were mostly the result of one storm that moved through the region early last week. Aside from a few isolated events resulting in half an inch of moisture in western CO, the majority of the UCRB was relatively dry for the week. The San Luis Valley in southern CO also remained fairly dry for the week.

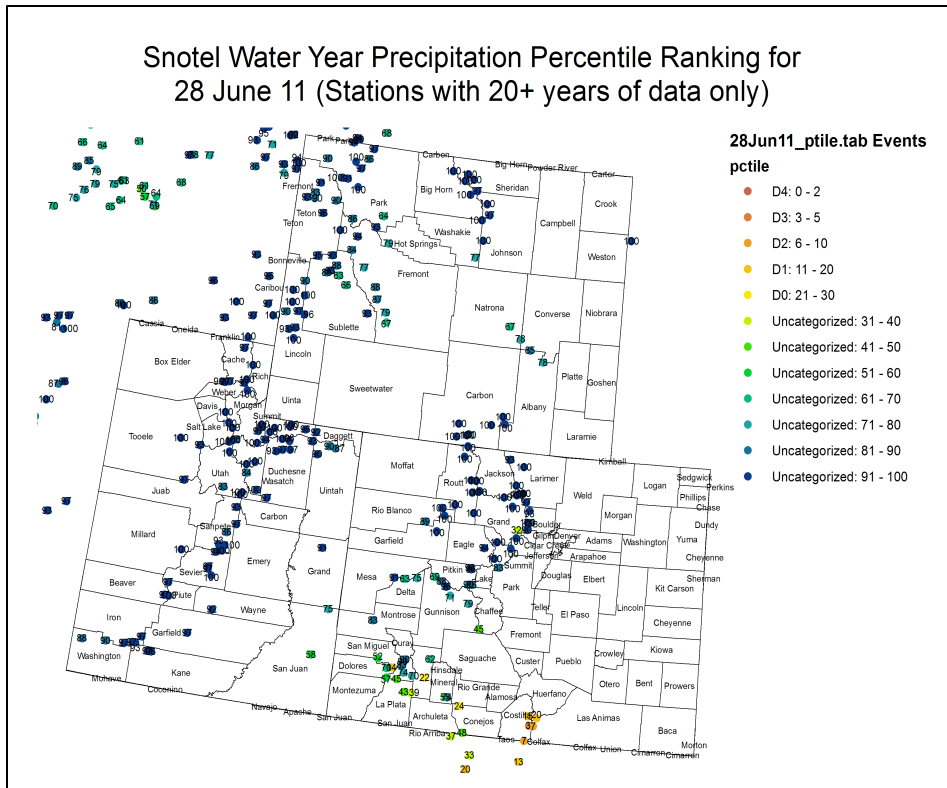


Fig. 3: SNOTEL WYTD precipitation percentiles (50% is median, 21-30% is Drought Monitor's D0 category).

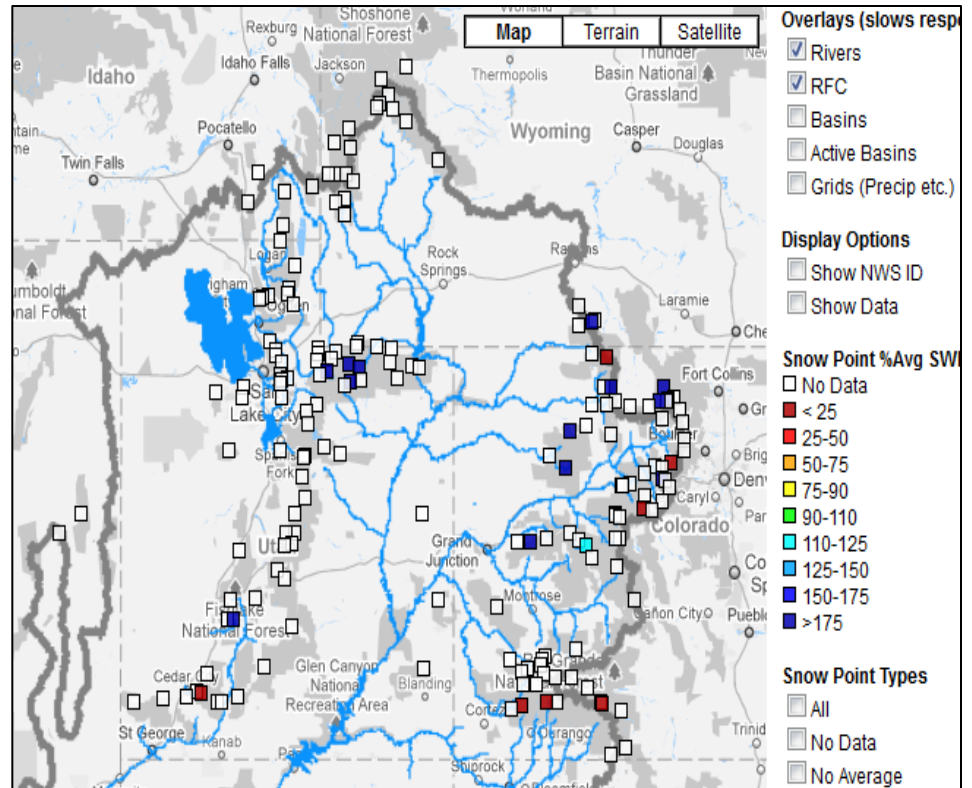


Fig. 4: SNOTEL WYTD accumulated snow water equivalent as a percent of average.

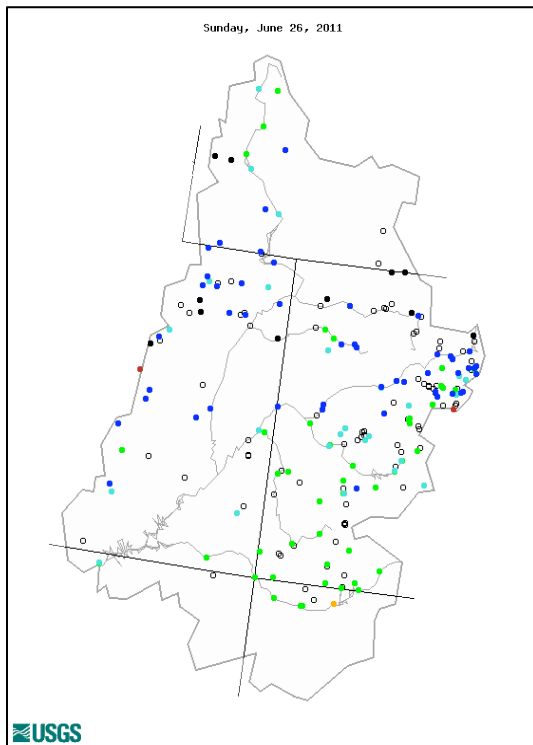
The majority of the SNOTEL sites in the UCRB are showing very high (and in many cases, record high) percentile rankings for water-year-to-date (WYTD) precipitation (Fig. 3). The Rio Grande and San Juan basins in southern CO are the driest, though the higher elevations of the San Juan basin have improved somewhat from the earlier part of the water year. Several sites in the Sangre de Cristos show percentiles worthy of D1 – D2.

After a near record season high for snowpack in the UCRB, the majority of the SNOTEL sites have now completely melted their accumulated snowpack for the season (Fig. 4 – white squares indicate sites that have completely melted out). Most of the sites with significant remaining snowpack are located in the higher elevations of the Duchesne River basin (Lakefork Basin still has 25 inches of snow water equivalent) and near the upper reaches of the Colorado and Yampa Rivers (the Tower site still has about 40 inches of snow water equivalent).

# Streamflow

As of June 26<sup>th</sup>, about 97% of the USGS streamgages in the UCRB recorded normal (25<sup>th</sup> – 75<sup>th</sup> percentile) or above normal 7-day average streamflows with 63% of the gages recording flows above the 75<sup>th</sup> percentile (Fig. 5). As of June 21<sup>st</sup>, 2 gages were still exceeding the National Weather Service flood stage—one on the Colorado River and one on the Green River. Many of the gages in the northern part of the UCRB are still recording real-time flows at or above the 99<sup>th</sup> percentile, while flows in the southern part of the basin have receded.

Key gages on the Colorado River near the CO-UT state line and the Green River at Green River, UT have above normal 7-day average streamflow at the 91<sup>st</sup> and 95<sup>th</sup> percentiles, respectively (Fig. 6). Streamflow on the San Juan River near Bluff, UT is at the 37<sup>th</sup> percentile, down from the 66<sup>th</sup> percentile last week. Flows on the San Juan have decreased as a response to the decreased releases from Navajo combined with the lower snowpack now being completely melted out.



Explanation - Percentile classes							
<span style="color: red;">●</span>	<span style="color: red;">●</span>	<span style="color: orange;">●</span>	<span style="color: green;">●</span>	<span style="color: cyan;">●</span>	<span style="color: blue;">●</span>	<span style="color: black;">●</span>	<span style="color: gray;">○</span>
Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

Fig. 5: 7-day average discharge compared to historical discharge for June 26<sup>th</sup>.

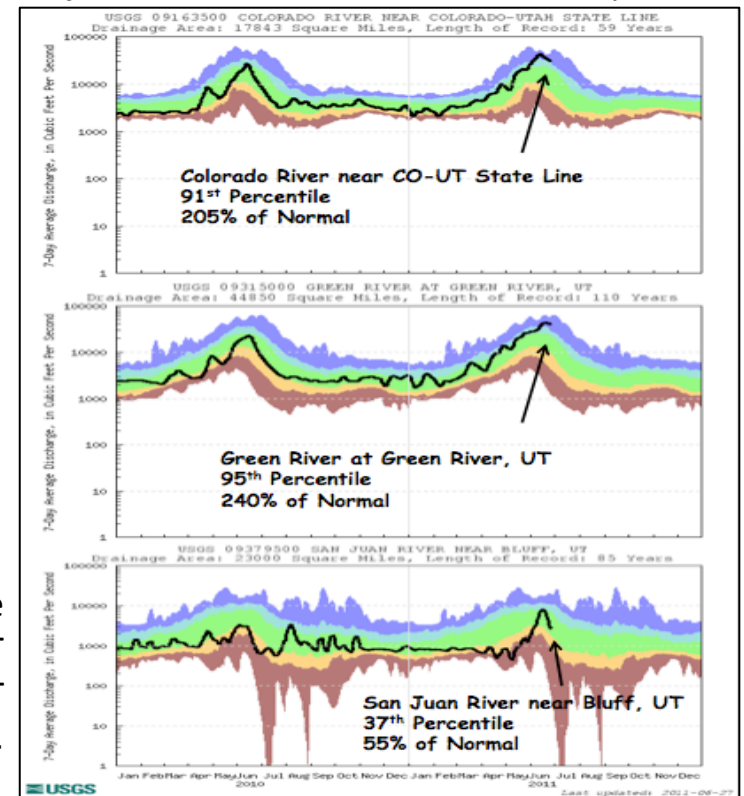


Fig. 6: USGS 7-day average discharge over time at the CO-UT stateline (top), Green River, UT (middle) and Bluff, UT (bottom).

## Water Supply and Demand

Last week, near average temperatures were prevalent over the UCRB, with slightly warmer than average temperatures over the Four Corners and San Luis Valley. Soil moisture conditions remain poor for the San Luis Valley. Soil moisture is above average along the Wasatch range in UT, in the northern CO mountains, and in northeast CO (Fig. 7). Soil moisture models also indicate improved conditions over southeast CO as a response to the recent large storm, though the models could be erroneously overestimating moisture that is not actually being observed in the region.

All of the major reservoirs in the UCRB have experienced rapid storage increases in June. Daily inflows into Flaming Gorge, Blue Mesa, and Lake Powell are all well above their averages for this time of year. Inflows into Navajo have dipped below their average for this time of year. Lake Powell has seen large increases in volume and is now at 80% of average. It is projected that Lake Powell's elevation will continue to rise through late July—projected elevation levels would be the highest they've been since October 2001.

## Summer Forecast

The La Niña that dominated over the winter has now been replaced by neutral conditions though the atmosphere continues to show lingering La Niña-like features. Models are predicting neutral conditions to continue through the summer, but are divided on what conditions will be later in the year—some trending back to La Niña while some shift to an El Niño pattern. Over the next week, a minor disturbance will move through the area, bringing the possibility for thunderstorms over the Four Corners area and mainly west of the Continental Divide. Temperatures in the UCRB are expected to remain near or above average. The introduction of monsoon flow into Arizona is expected over the next two weeks and could soon extend into the UCRB. For the summer, drier conditions are expected over parts of the UCRB and into eastern CO (Fig. 8). It is possible that the recent record snowpack and current wildfire season could delay and suppress this year's monsoon. Klaus Wolter's full forecast can be found at:

<http://www.esrl.noaa.gov/psd/people/klaus.wolter/SWcasts/>



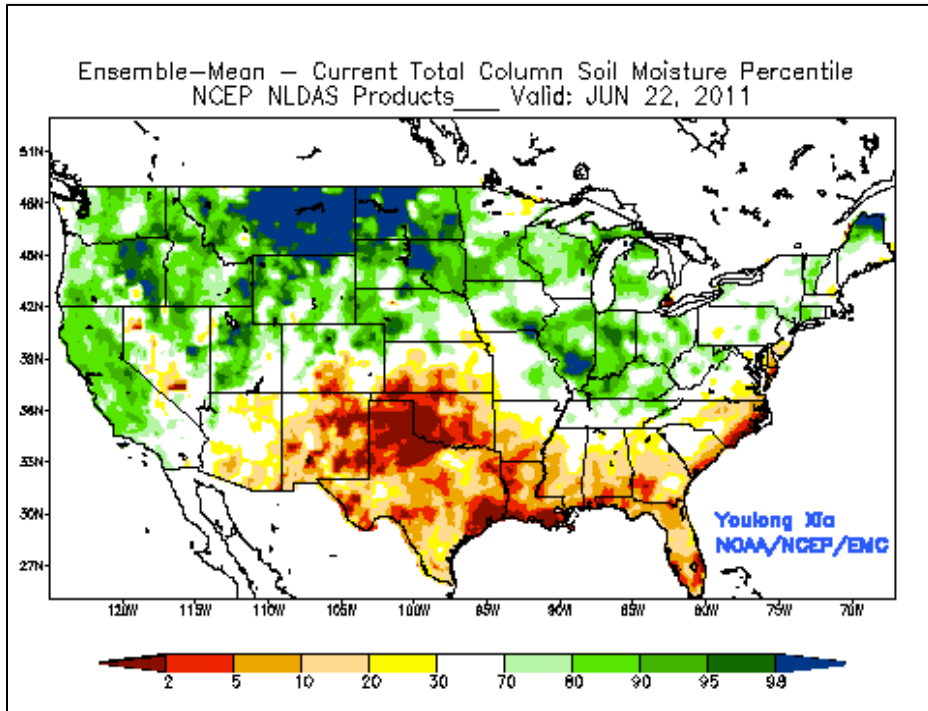


Fig. 7: NLDAS total column soil moisture percentiles for June 22<sup>nd</sup>.

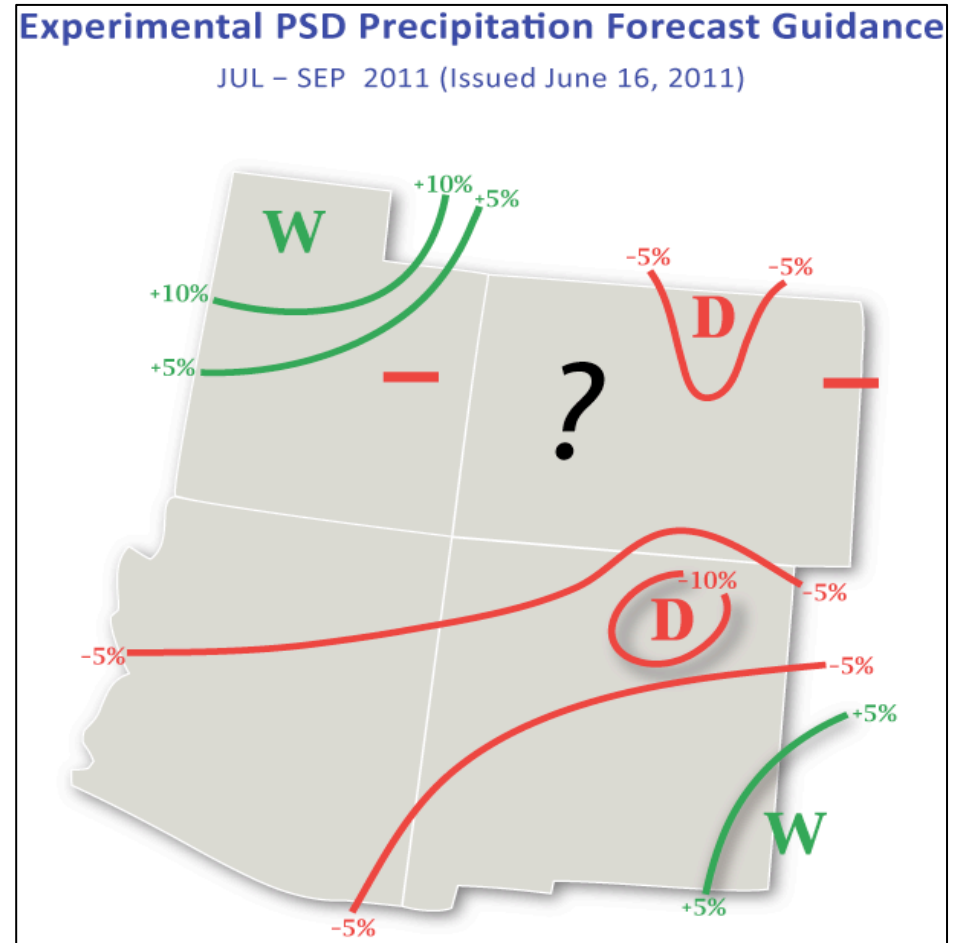
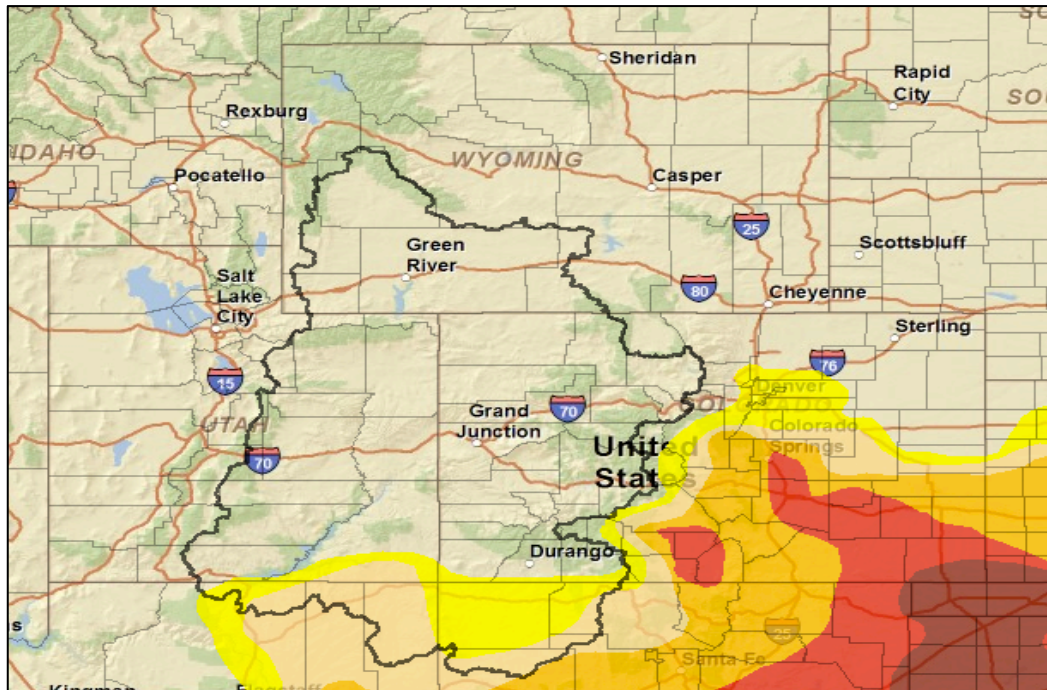


Fig. 8: July – September probabilistic precipitation forecast issued by Klaus Wolter on June 16<sup>th</sup>.

# Drought and Water Discussion



Drought – Exceptional	0 to 2 (D4)
Drought – Extreme	2 to 5 (D3)
Drought – Severe	5 to 10 (D2)
Drought – Moderate	10 to 20 (D1)
Abnormally Dry	20 to 30 (D0)

Drought categories and their associated percentiles

Fig. 9: June 21<sup>st</sup> release of U.S. Drought Monitor for the UCRB

In the UCRB, the current U.S. Drought Monitor (USDM) author expanded the D0 and D1 that is currently in the Four Corners region (Fig. 9). The D0 extends through Montezuma, La Plata, Hinsdale and Mineral counties, while D1 now extends eastward to the UT-CO border. Status quo is recommended for the rest of the UCRB.

More degradations are proposed for the San Luis Valley. D1 – D3 expansion would be justified westward through Rio Grande and Conejos counties. Eastward, the D3 could be expanded to cover more of the Sangre de Cristo mountains and into Huerfano County.

# Drought and Water Discussion

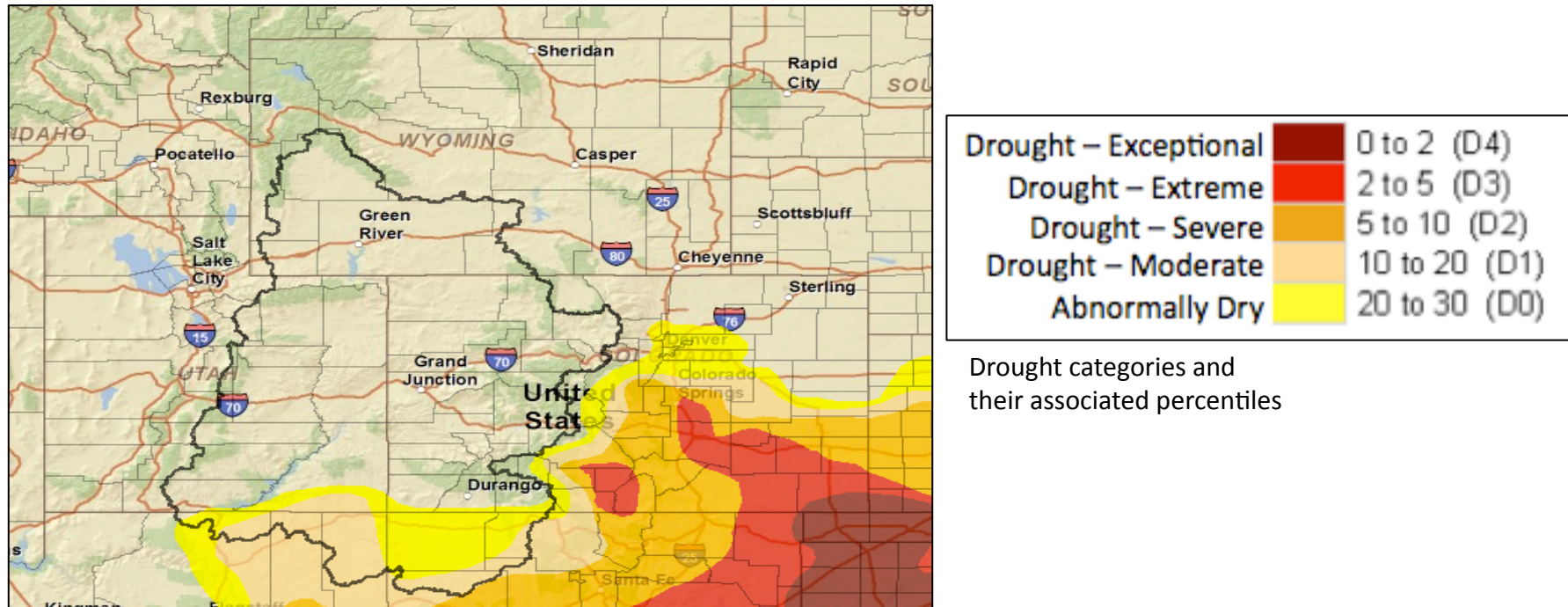


Fig. 9: June 21<sup>st</sup> release of U.S. Drought Monitor for the UCRB

Short term SPIs and impacts in the region suggest a westward expansion of the D3 from El Paso and Pueblo counties into Fremont and Custer counties—this could likely be connected to the D3 in the San Luis Valley and Huerfano County. Major drought impacts and low SPIs in Chaffee and Park counties point to an expansion of the D0 to the Continental Divide and a westward expansion of D1.

Though recent precipitation events seemed to warrant improvements in southeast CO last week (Fig. 9), impacts from the area still suggest that the situation is not improved. It has been recommended by local experts that D3 be expanded to cover southern Lincoln County and more of western Kiowa County.