Autumn 2010

Weekly Climate, Water & Drought Assessment

Today's Agenda

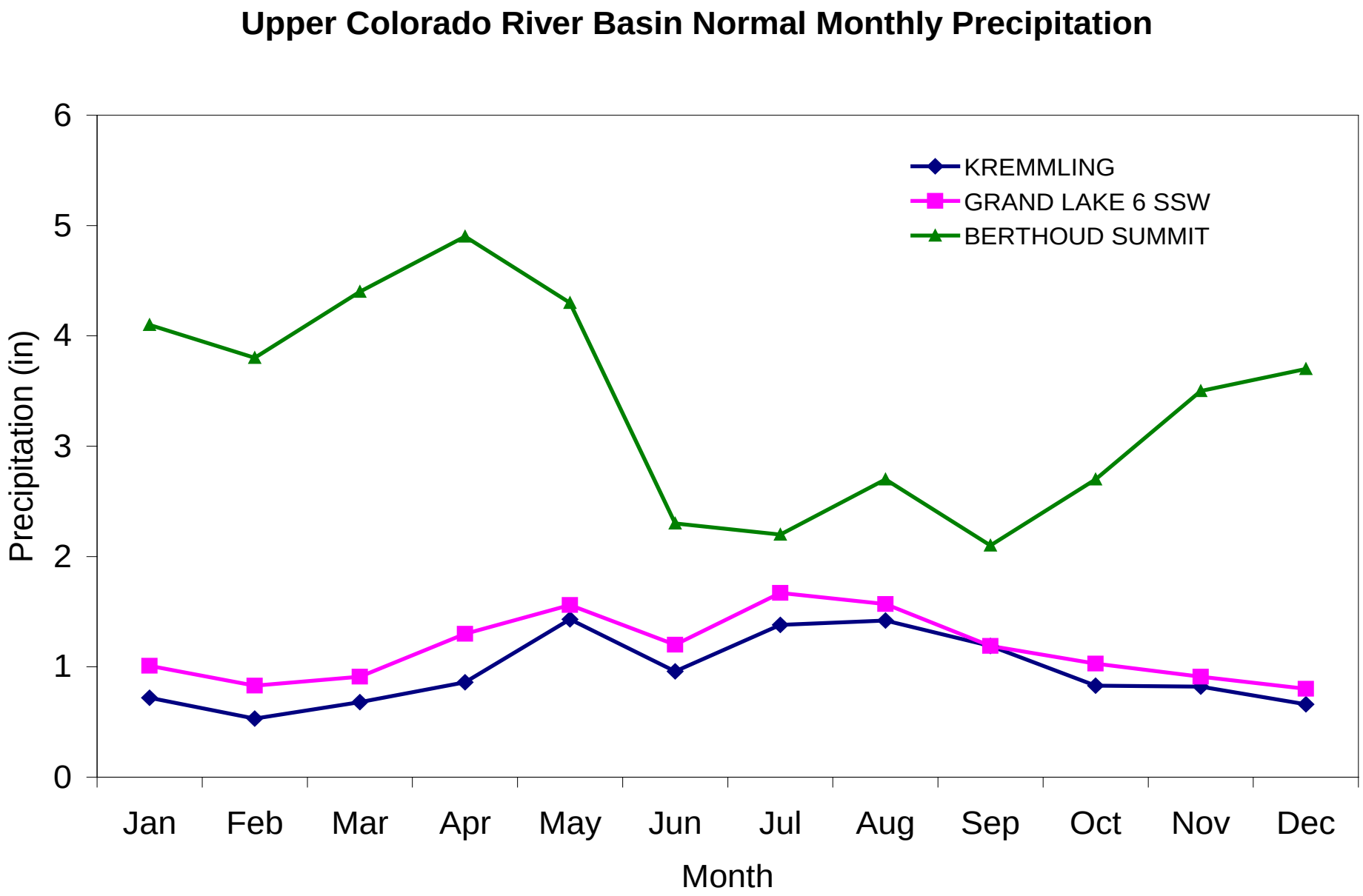
-Assessment of current water conditions

- Precipitation Forecast

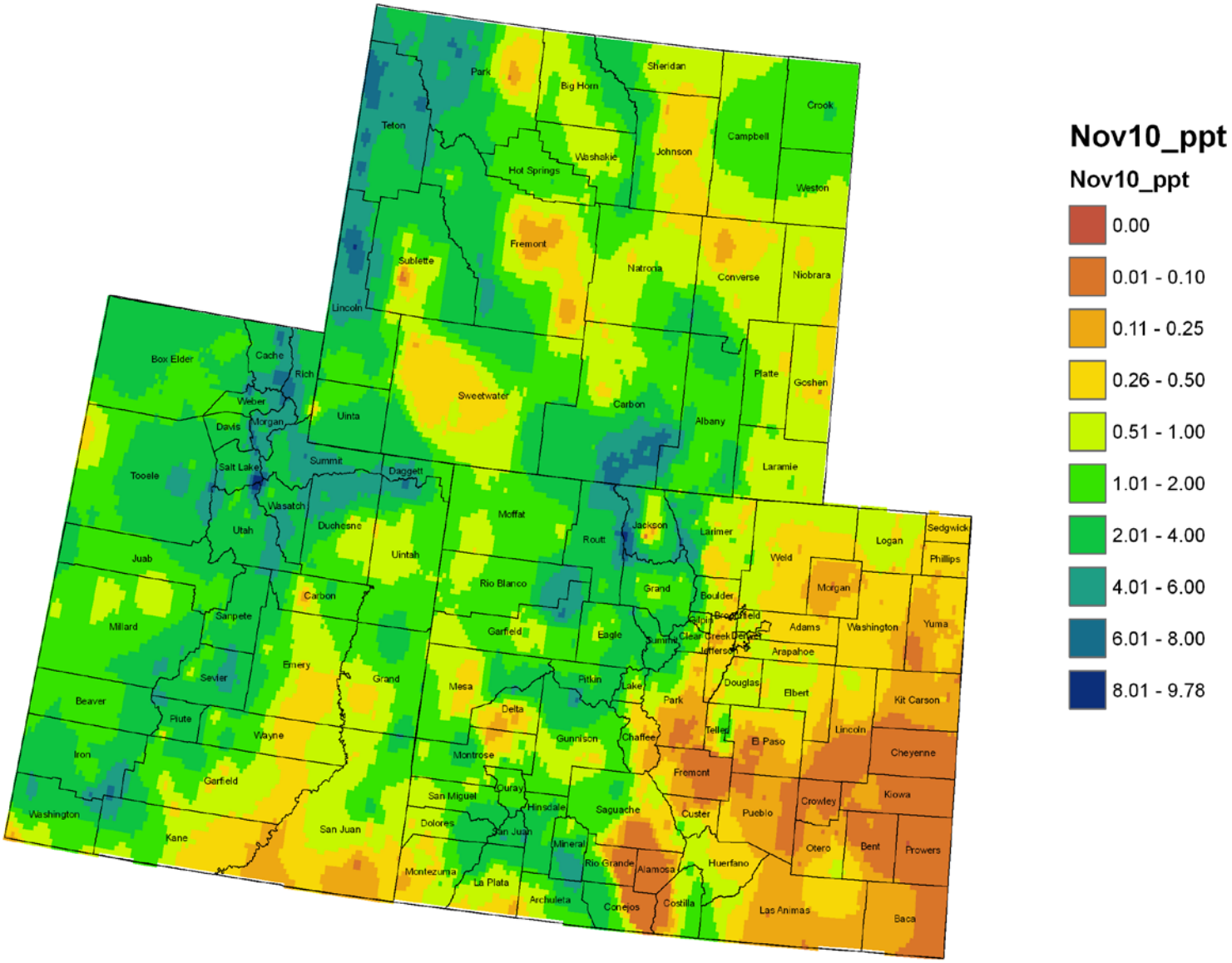
- Recommendations for Drought Monitor

Precipitation/Snowpack Update

Upper Colorado Normal Precipitation



Colorado, Utah and Wyoming Precipitation (in)
November 2010

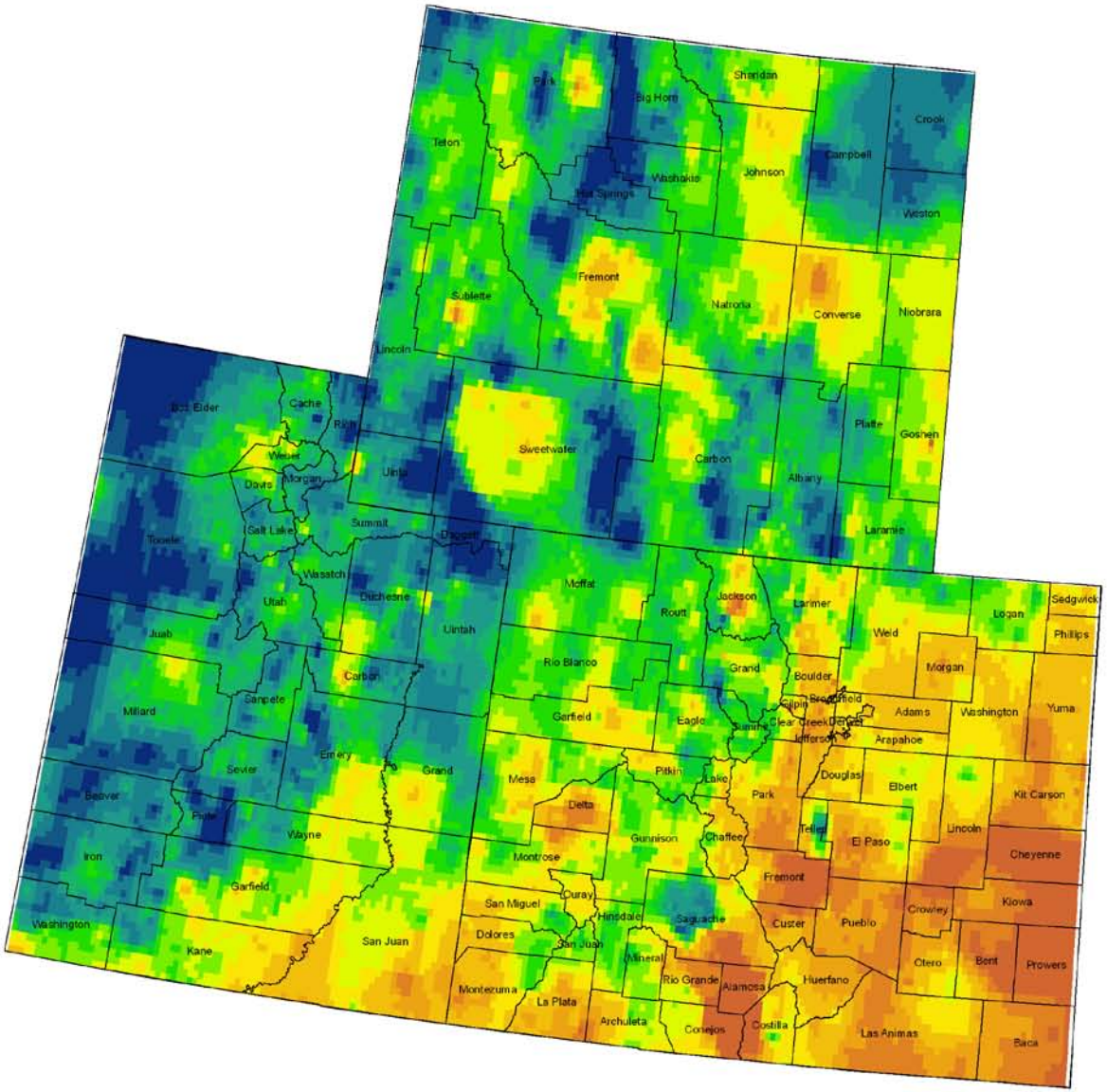


Nov10_ppt

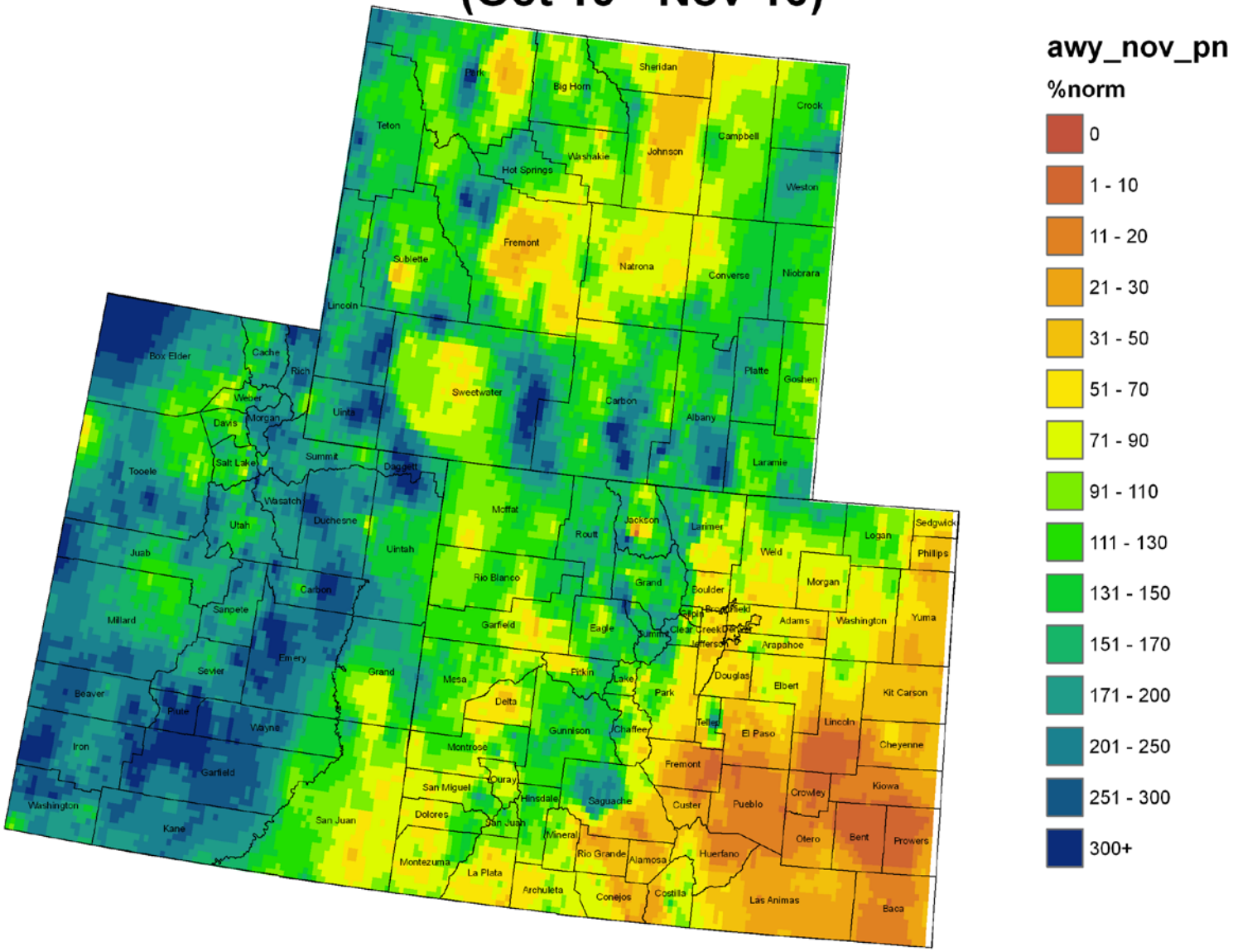
Nov10_ppt

- 0.00
- 0.01 - 0.10
- 0.11 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- 8.01 - 9.78

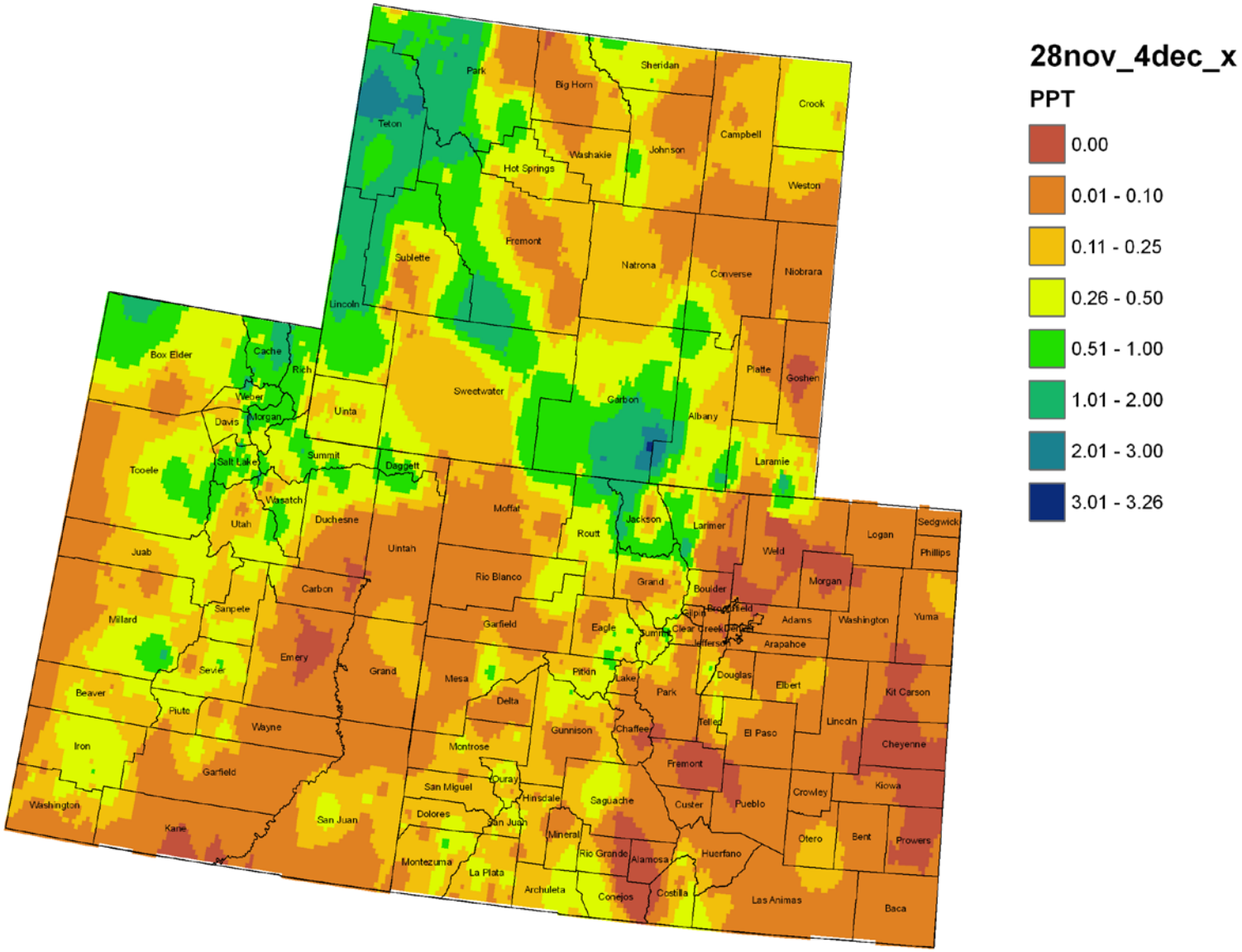
Colorado, Utah and Wyoming November 2010 Precipitation as Percentage of Normal



Colorado, Utah and Wyoming Water Year 2011 Precipitation as Percentage of Normal (Oct 10 - Nov 10)

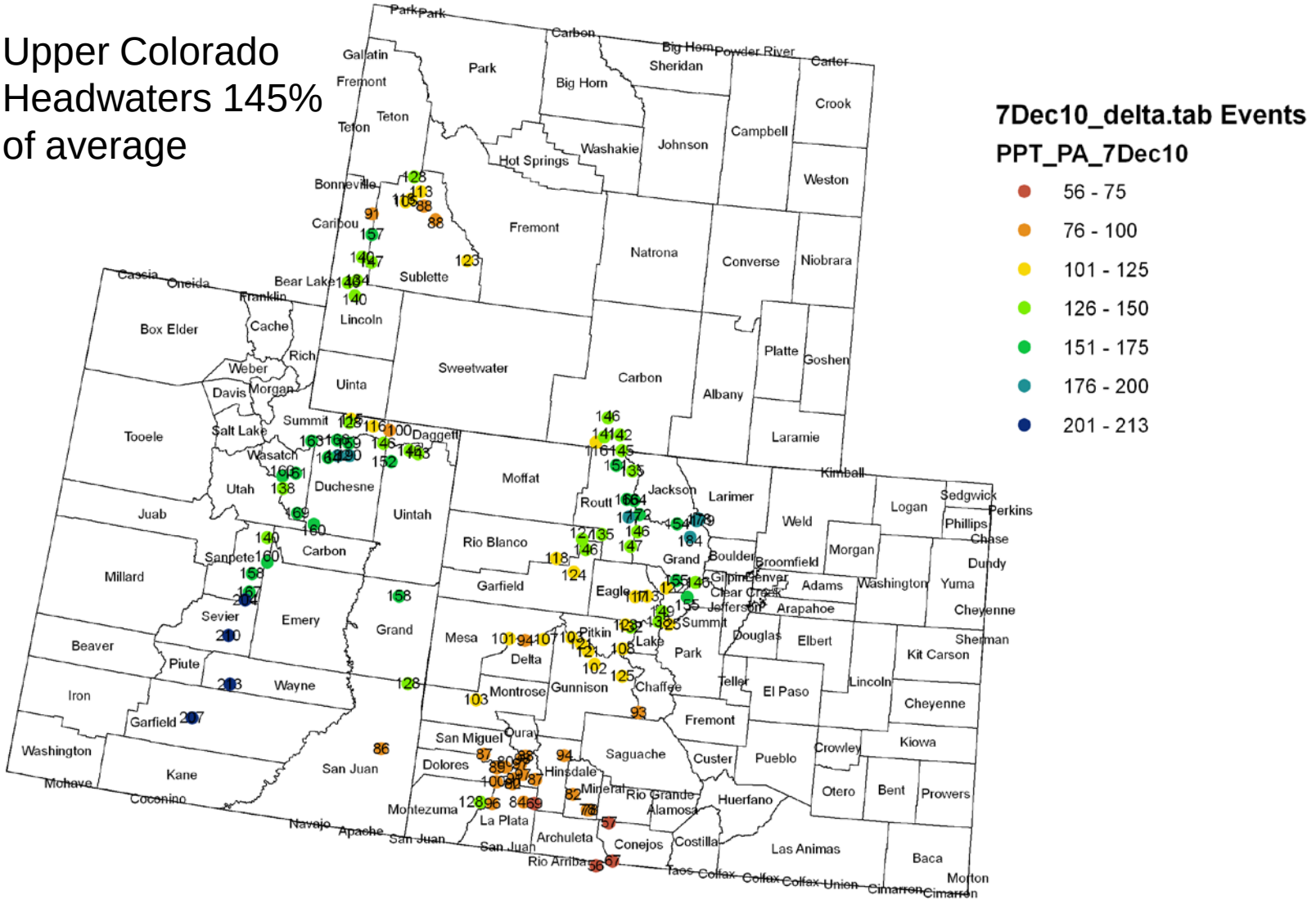


Colorado, Utah and Wyoming 7 Day Precipitation
28 November - 4 December 2010

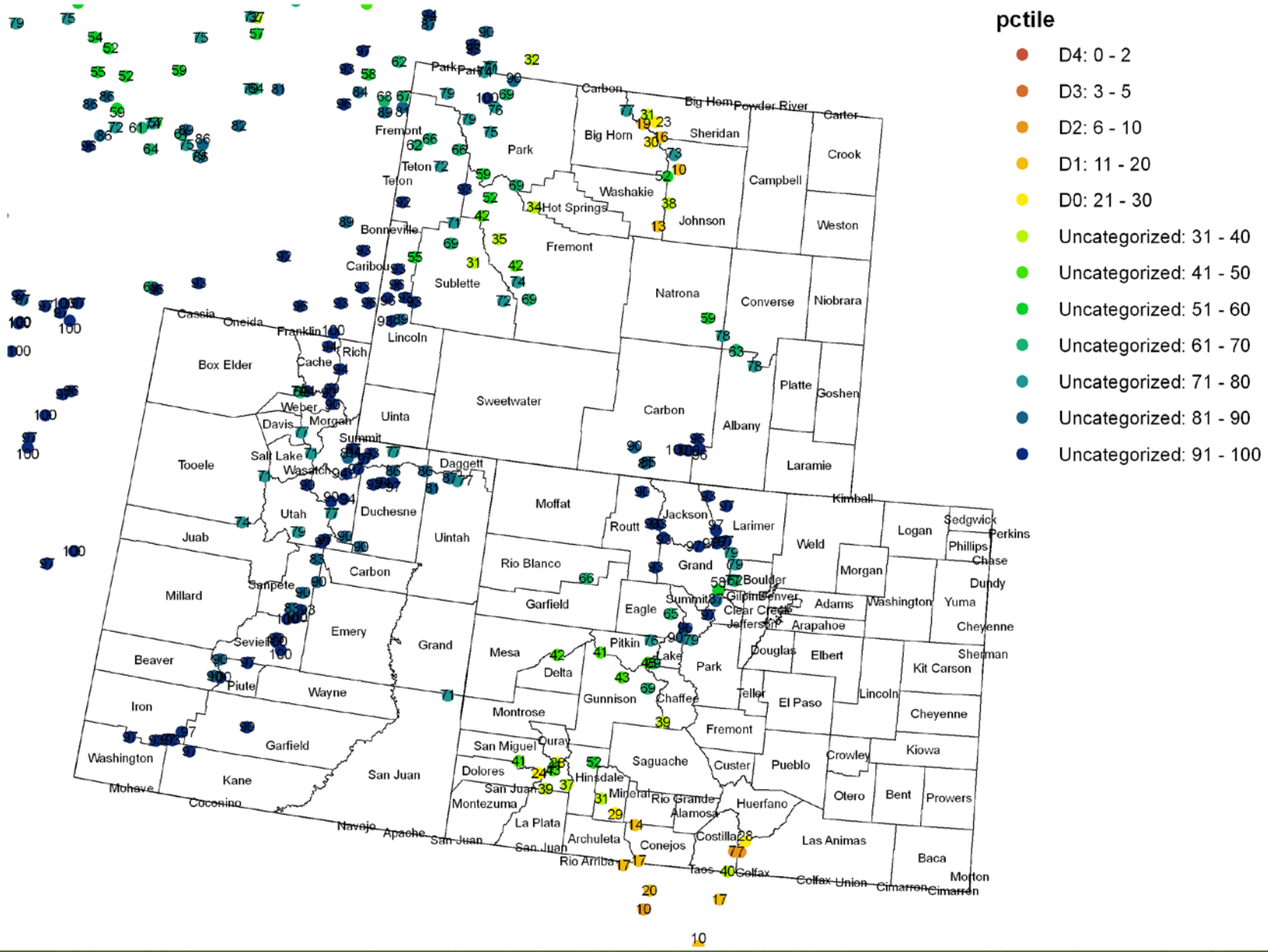


Snotel WY Precipitation as Percentage of Average
7 December 2010

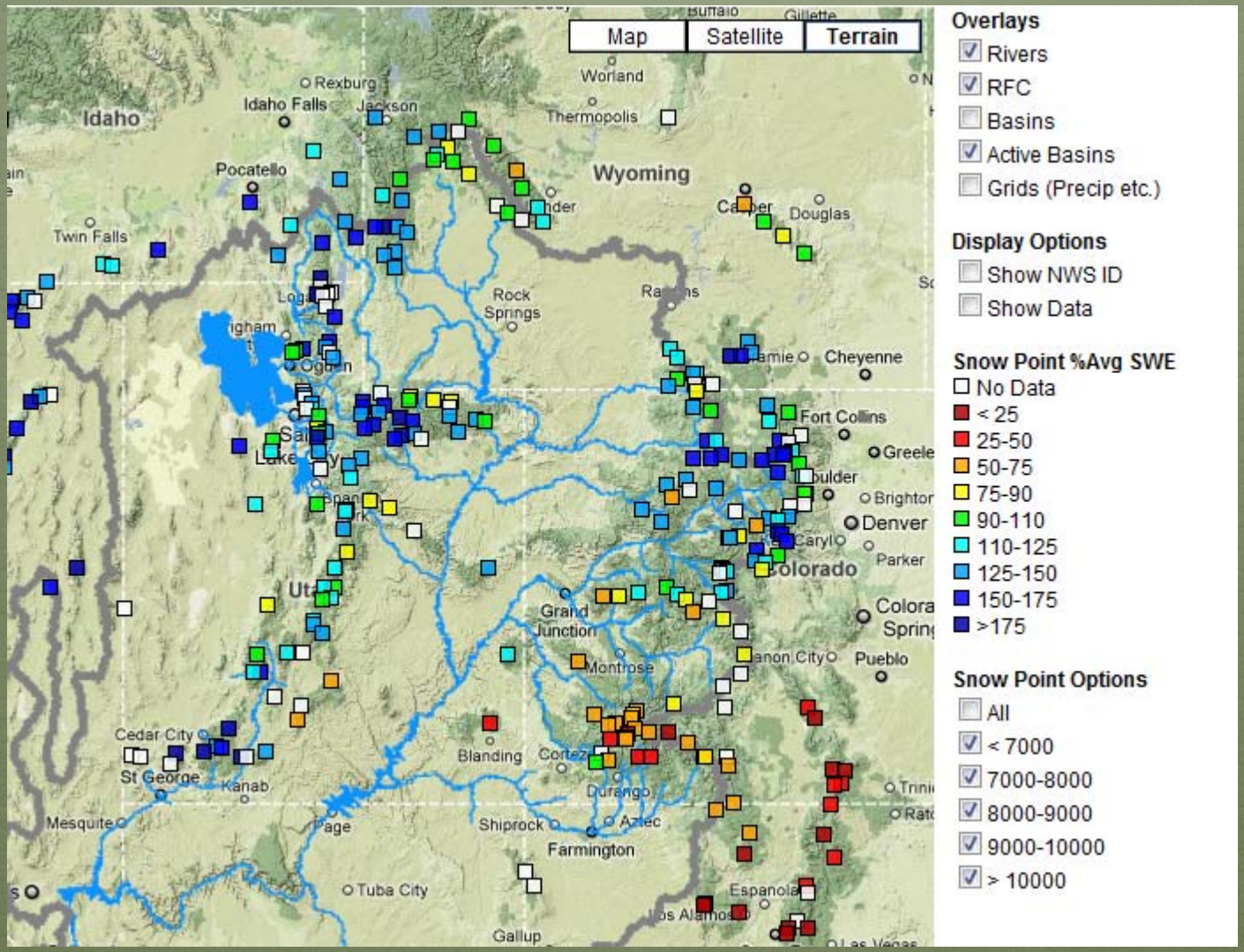
Upper Colorado Headwaters 145% of average



Snotel WY Precipitation Percentile Ranking
7 December 2010

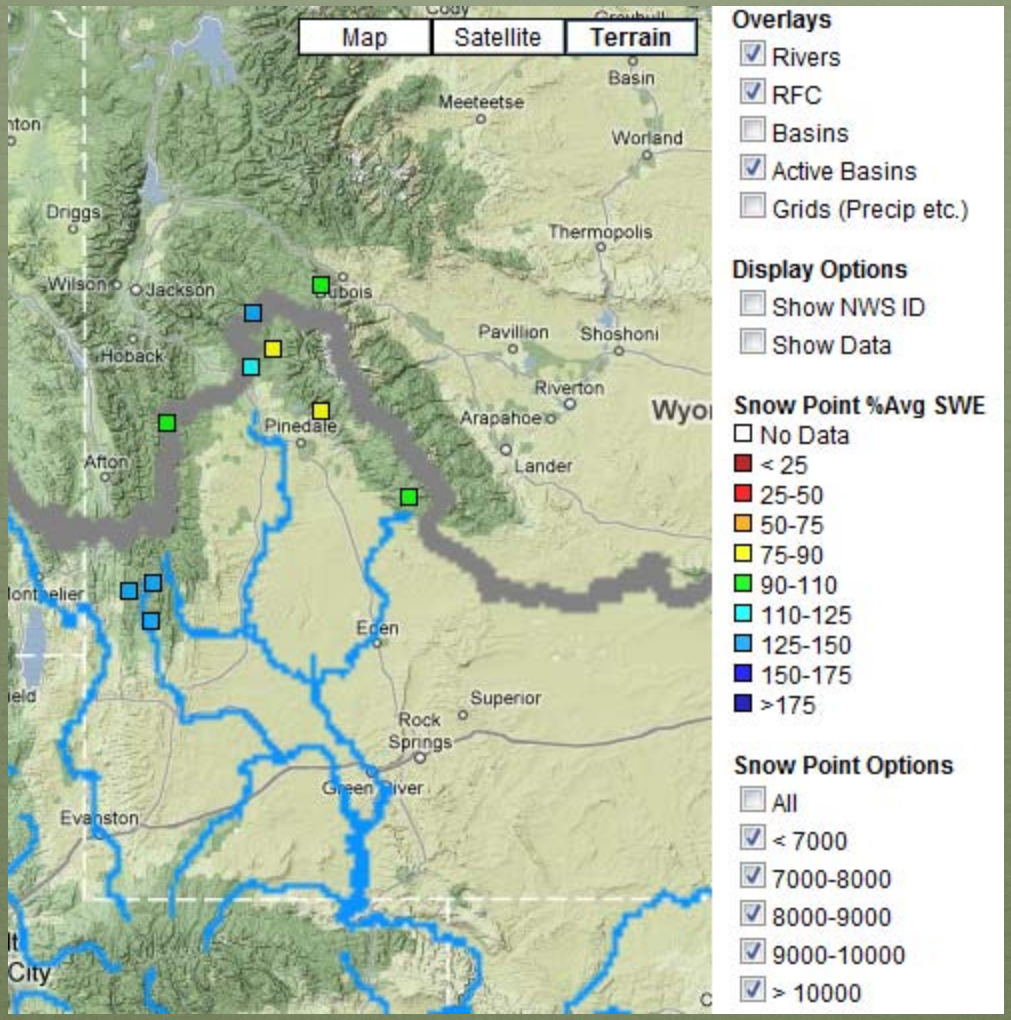


Upper Colorado River Basin

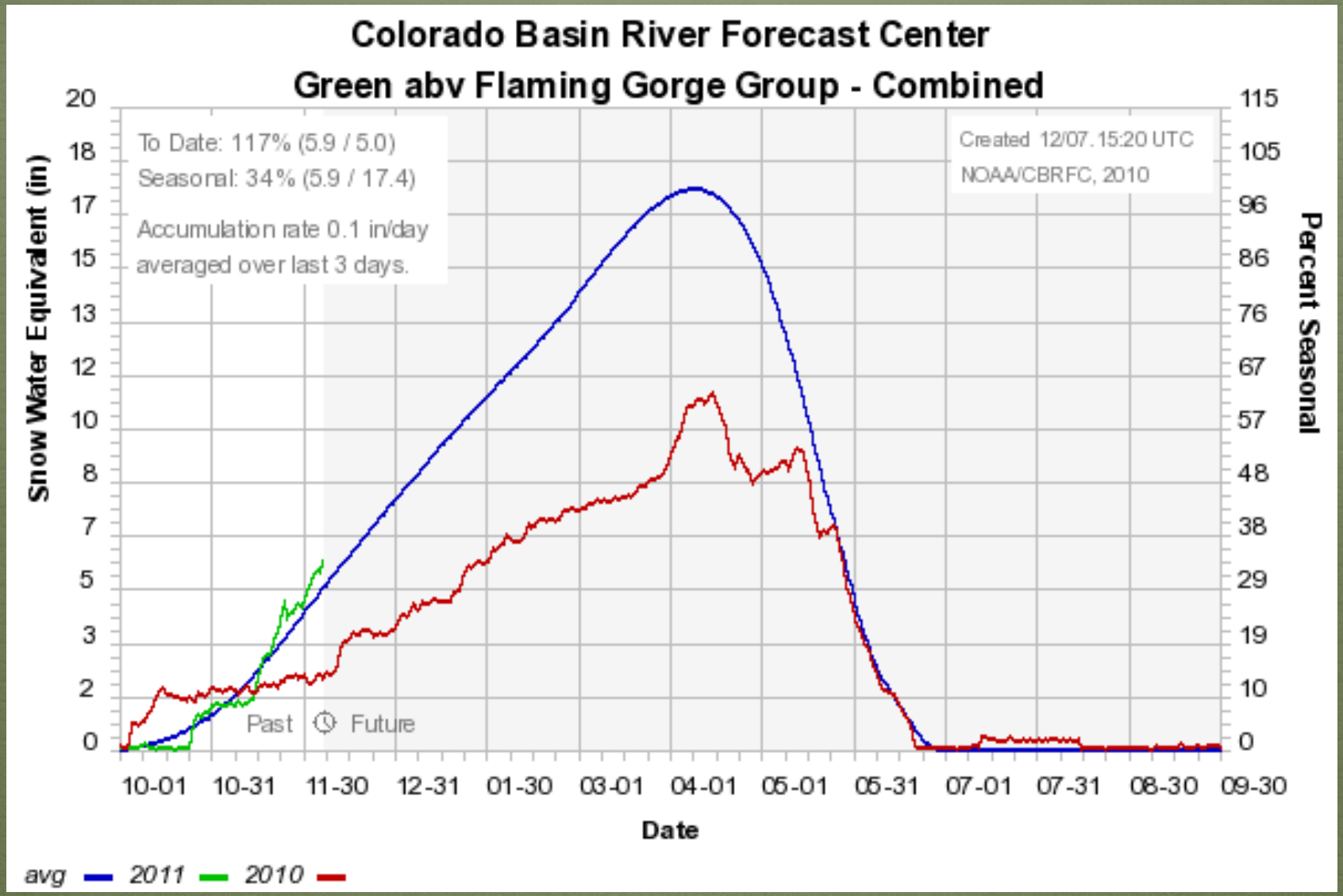


NATIONAL WEATHER SERVICE
Colorado Basin River Forecast Center

Green River Basin above Flaming Gorge

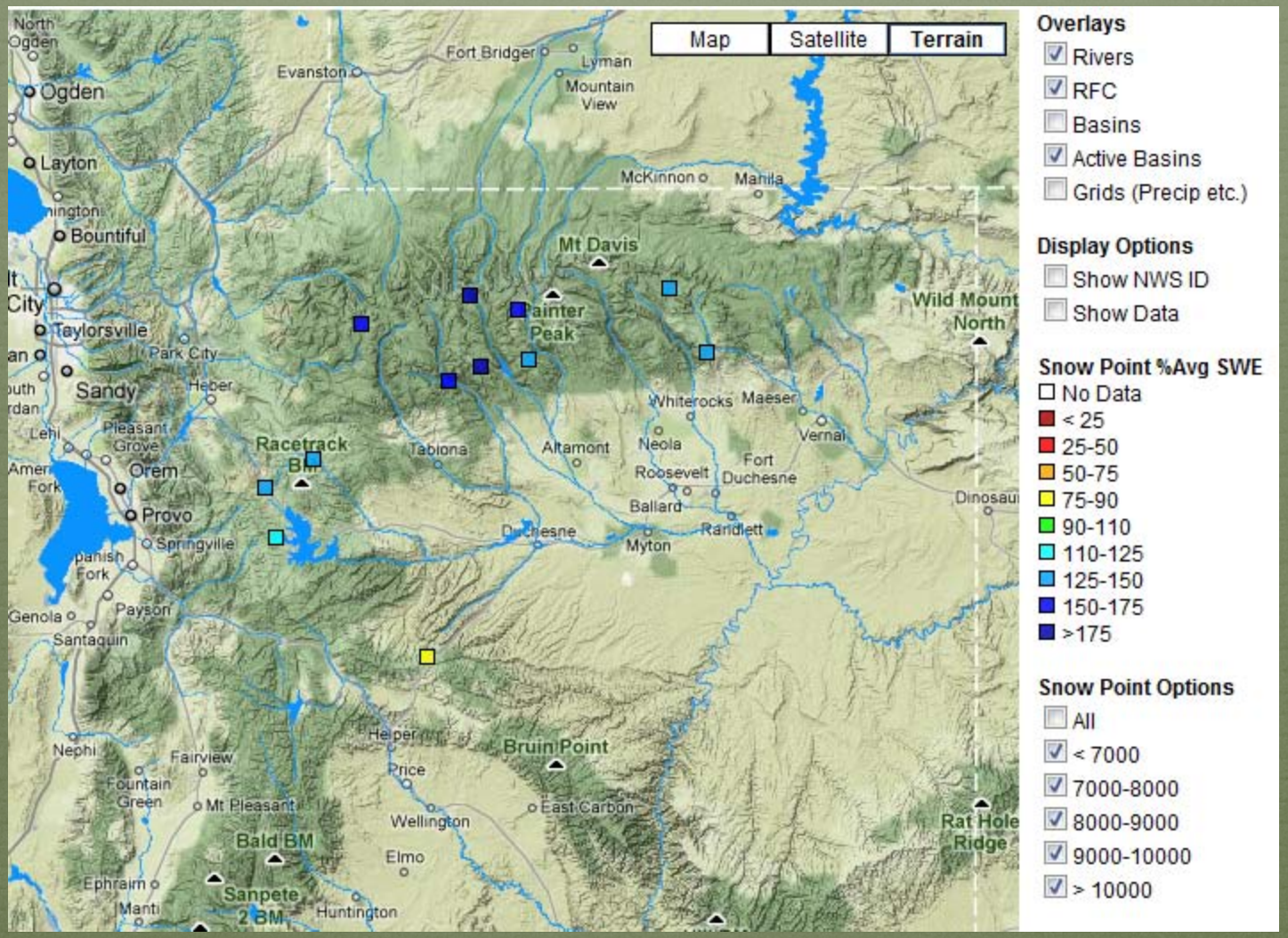


NATIONAL WEATHER SERVICE
Colorado Basin River Forecast Center

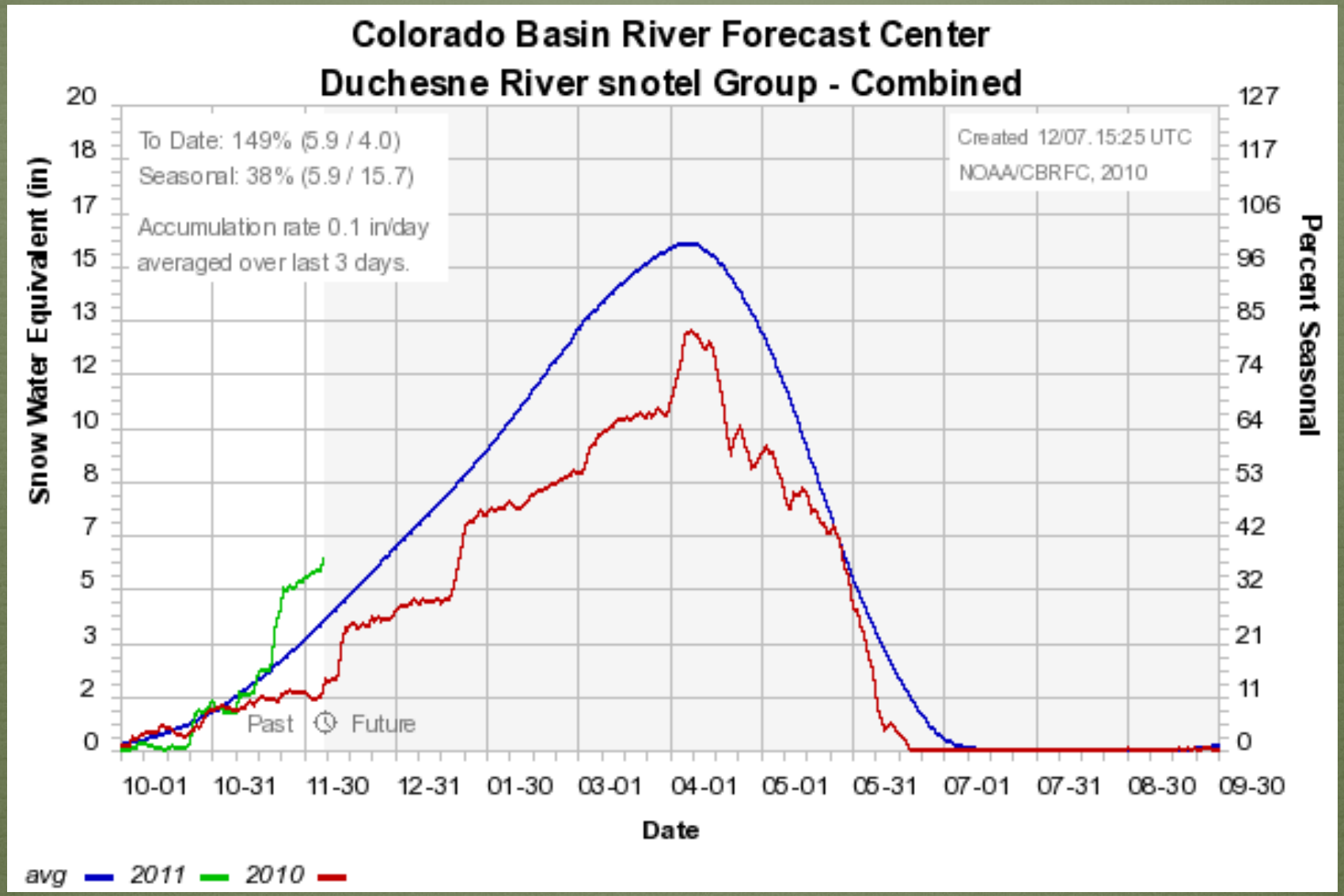


Snowpack % of average to date: 117%
Seasonal average: 34%

Duchesne River Basin

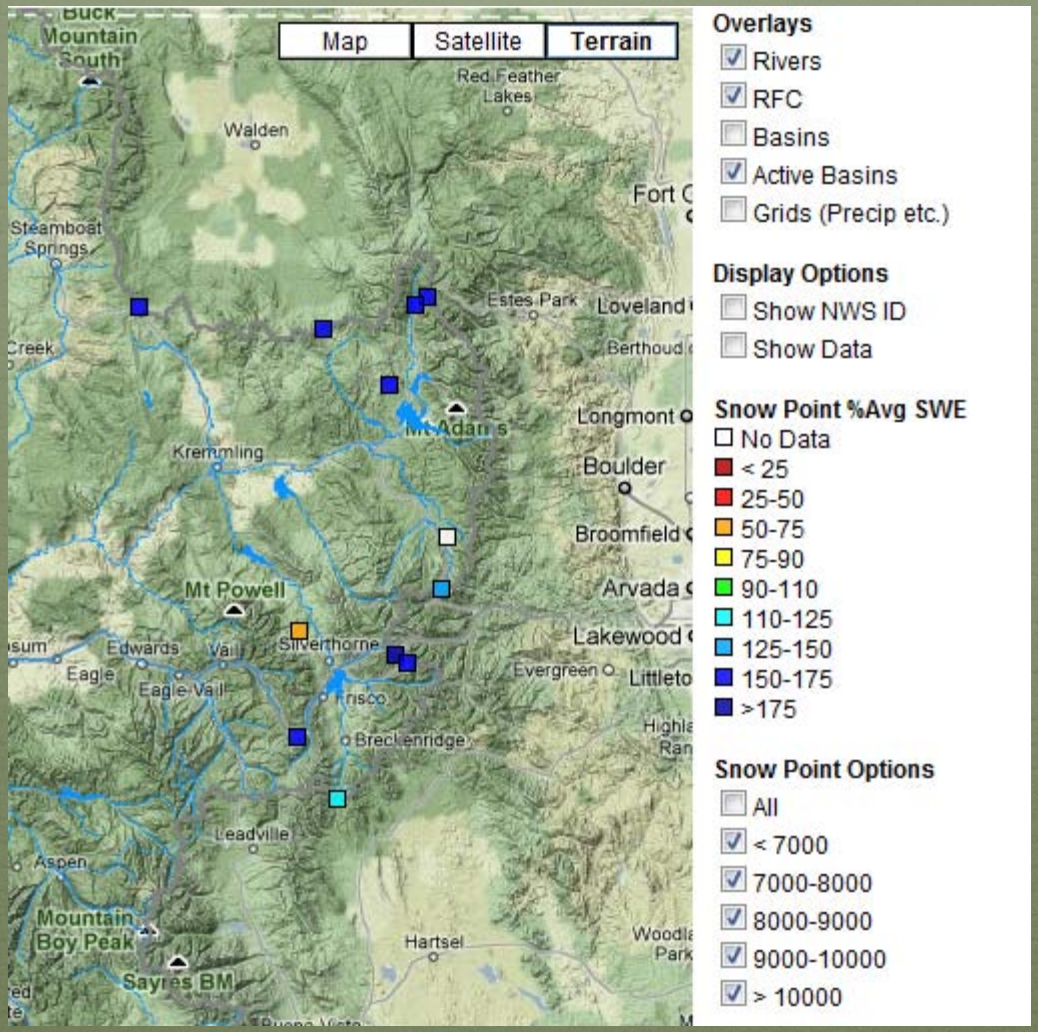


NATIONAL WEATHER SERVICE
Colorado Basin River Forecast Center

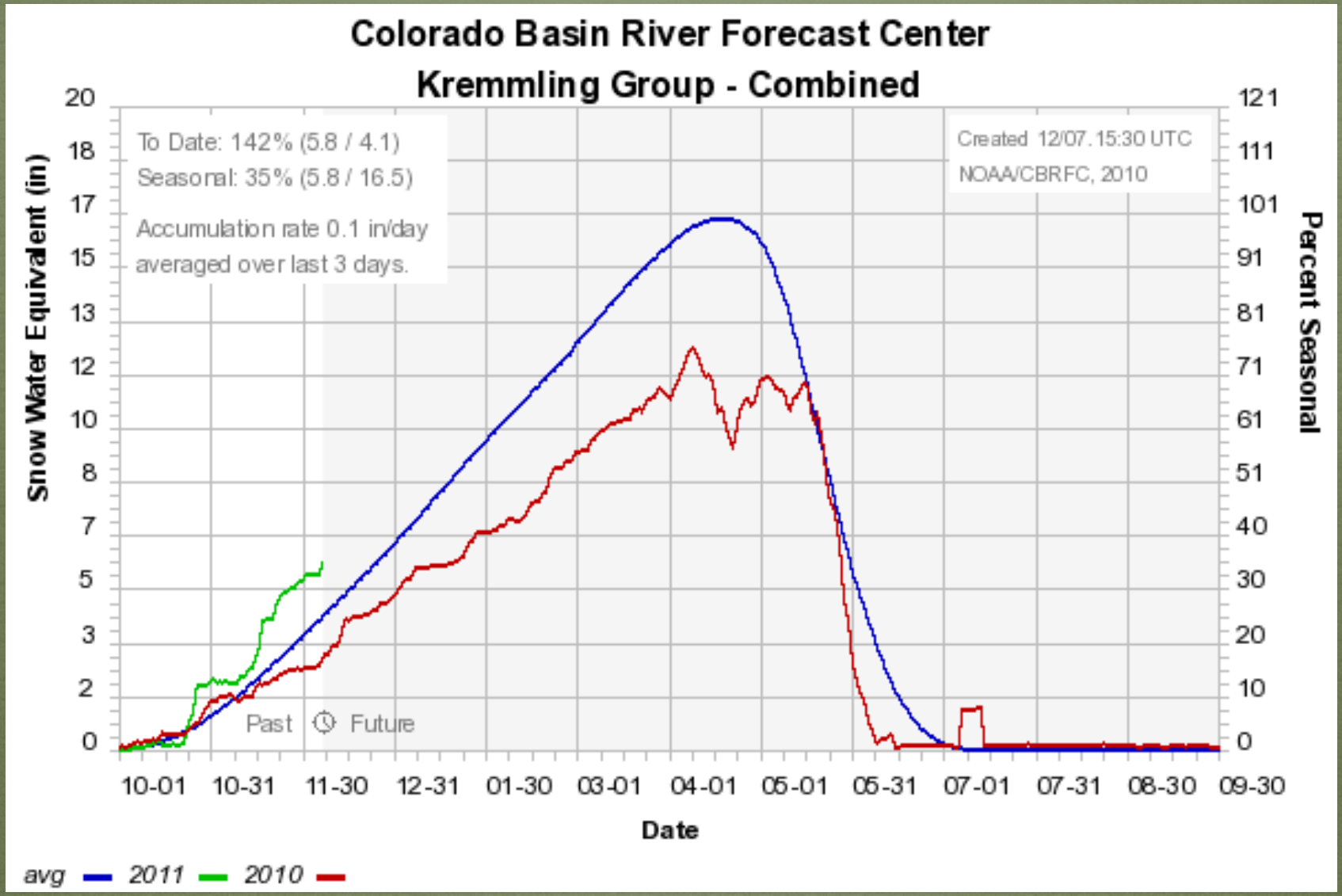


Snowpack % of average to date: 149%
Seasonal average: 38%

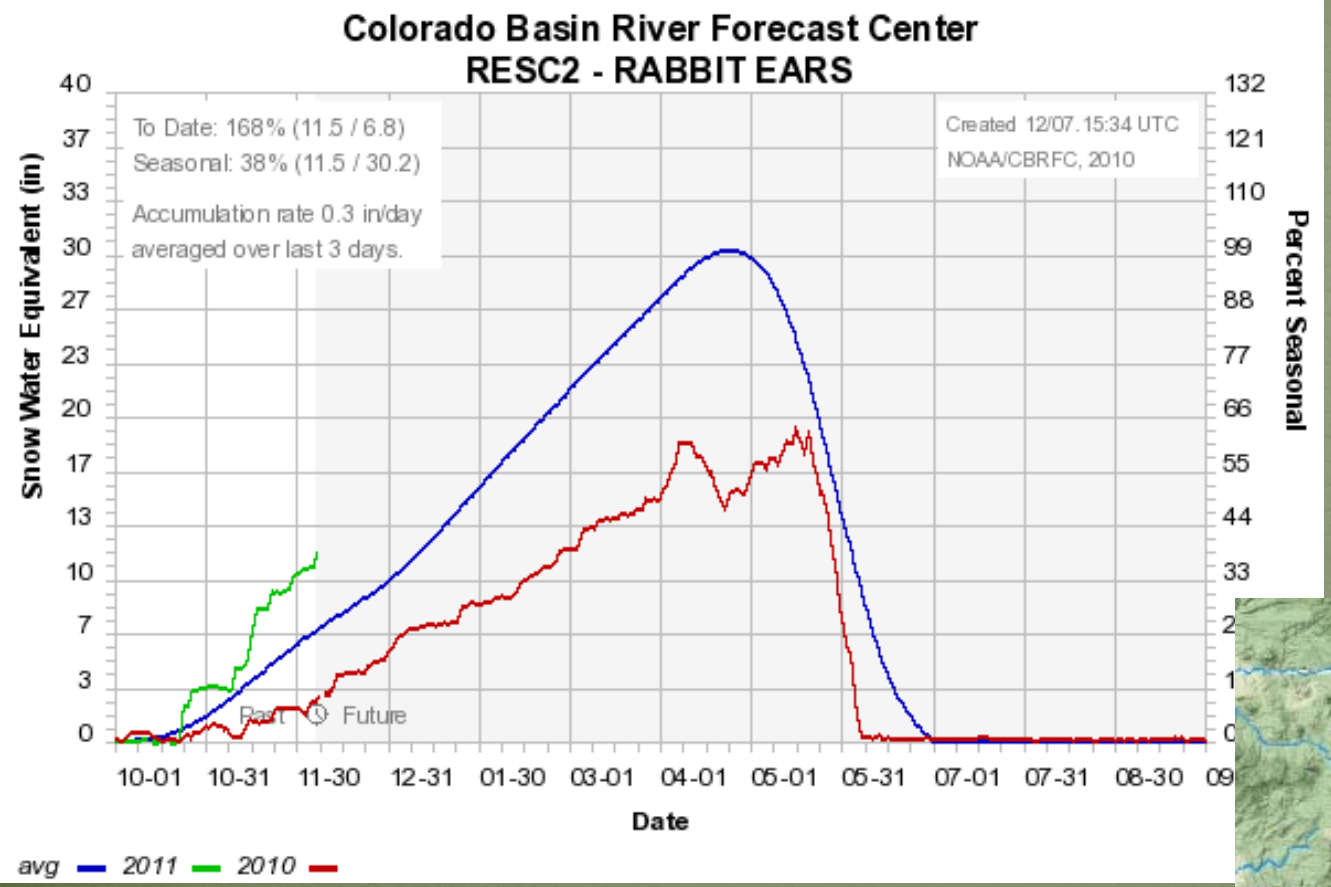
Upper Colorado above Kremmling

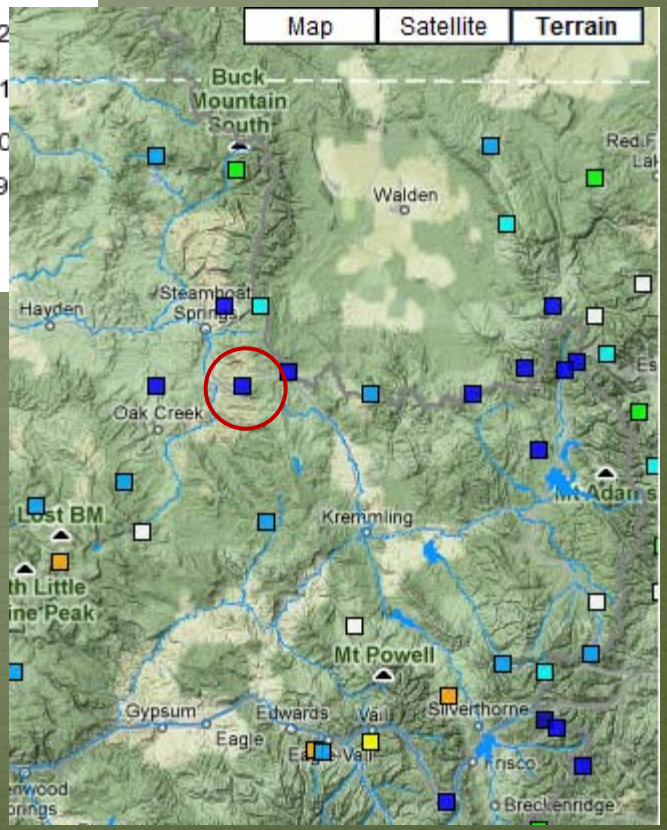


NATIONAL WEATHER SERVICE
Colorado Basin River Forecast Center

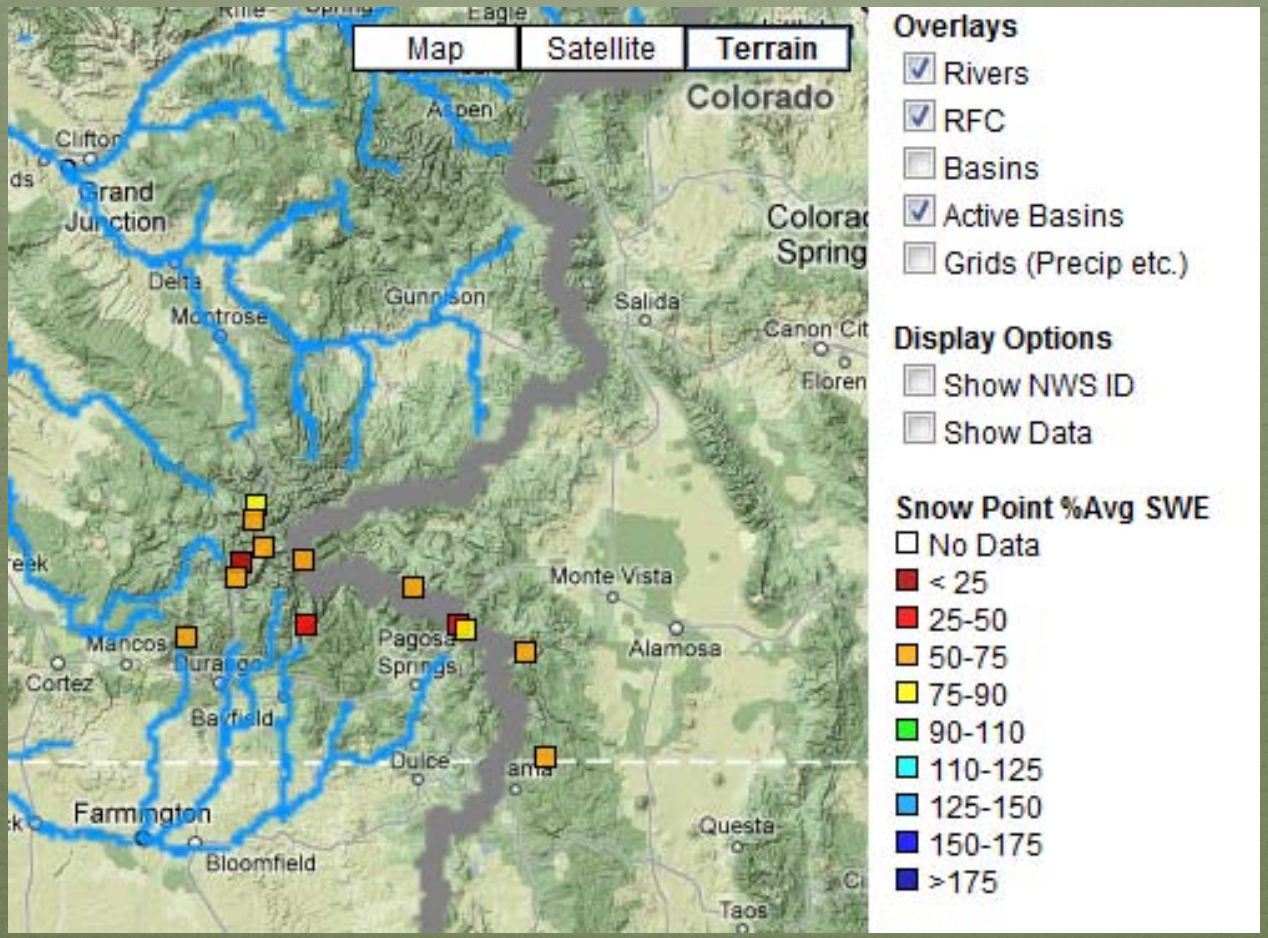


Snowpack % of average to date: 142%
Seasonal average: 35%

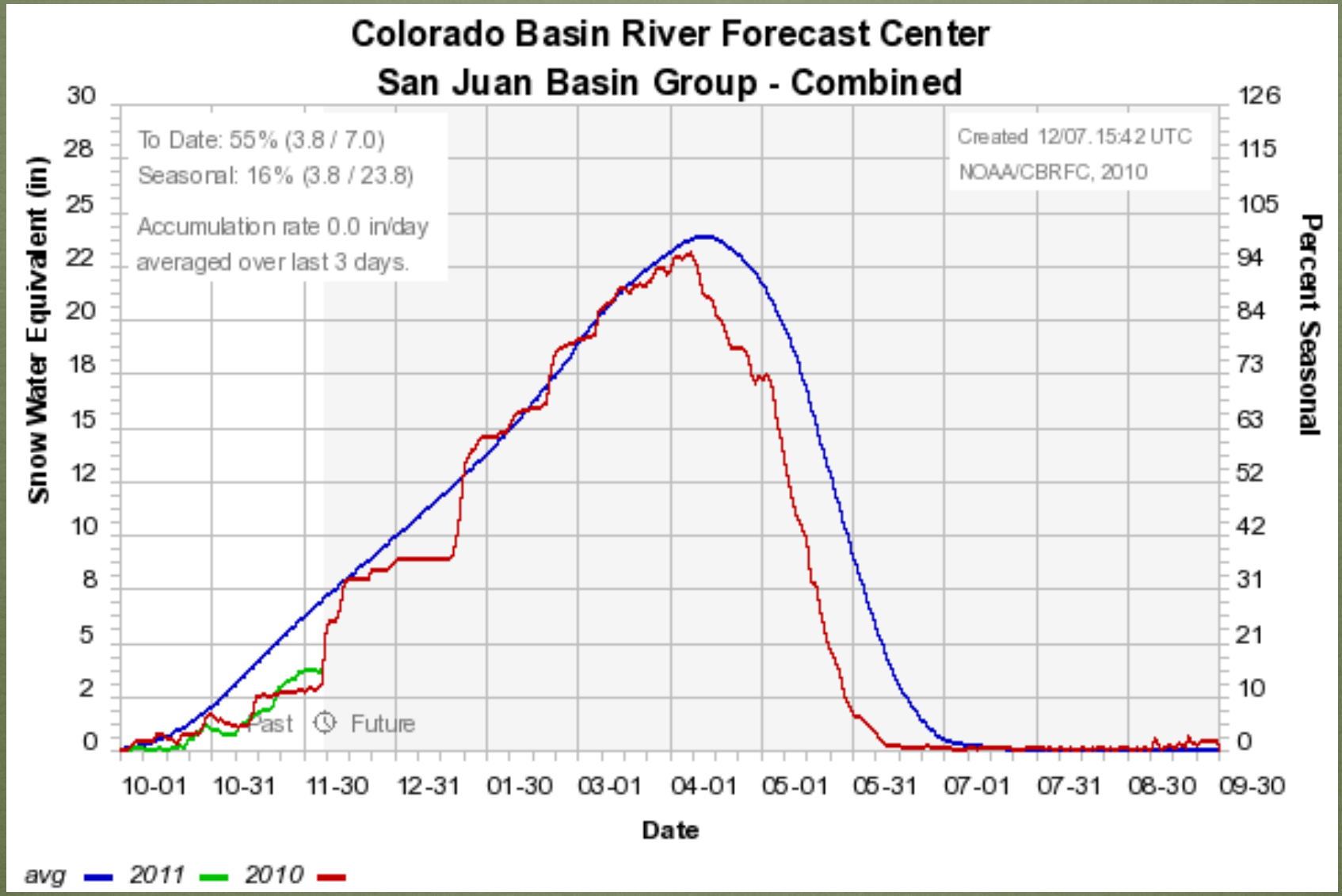

Colorado Basin River Forecast Center
RESC2 - RABBIT EARS
To Date: 168% (11.5 / 6.8)
Seasonal: 38% (11.5 / 30.2)
Accumulation rate 0.3 in/day
averaged over last 3 days.
Created 12/07.15:34 UTC
NOAA/CBRFC, 2010
Snow Water Equivalent (in)
Percent Seasonal
40
37
33
30
27
23
20
17
13
10
7
3
0
132
121
110
99
88
77
66
55
44
33
Past
Future
10-01
10-31
11-30
12-31
01-30
03-01
04-01
05-01
05-31
07-01
07-31
08-30
Date
avg
2011
2010


Map
Satellite
Terrain
Buck Mountain South
Walden
Hayden
Steamboat Springs
Oak Creek
Lost BM
Kremmling
Mt Powell
Gypsum
Edwards
Eagle
Silverthorne
Breckenridge

San Juan Basin



NATIONAL WEATHER SERVICE
Colorado Basin River Forecast Center

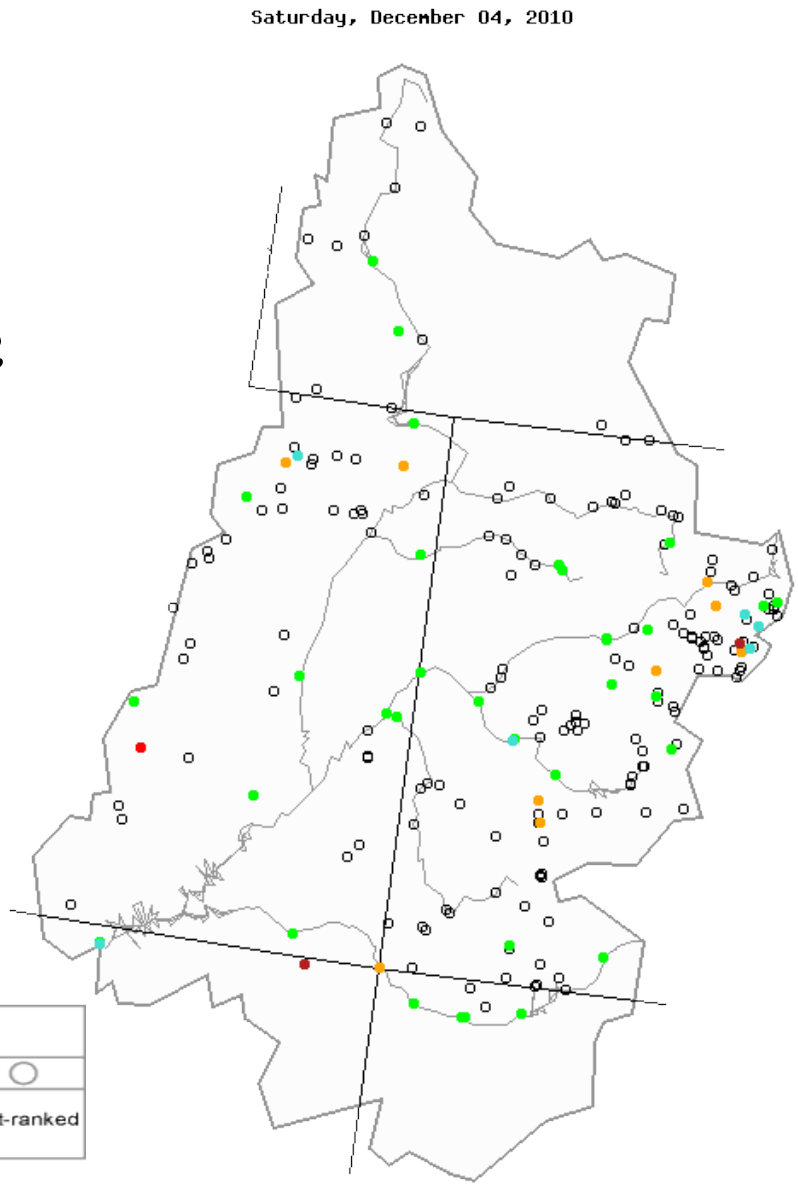


Snowpack % of average to date: 55%
Seasonal average: 16%

Streamflow Update

Michael Lewis USGS

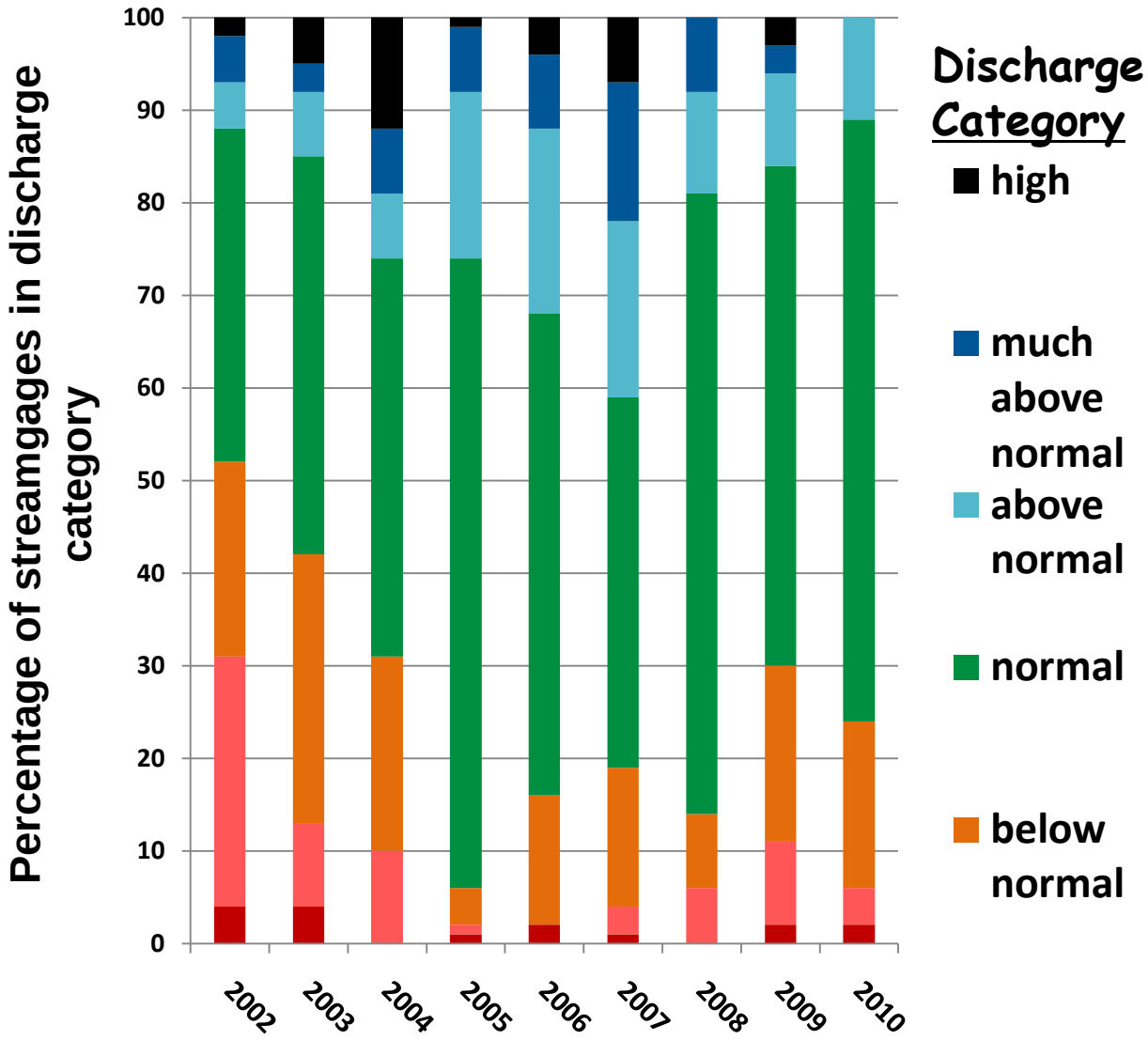
7-day average discharge compared to historical discharge for the day of the year (December 4)

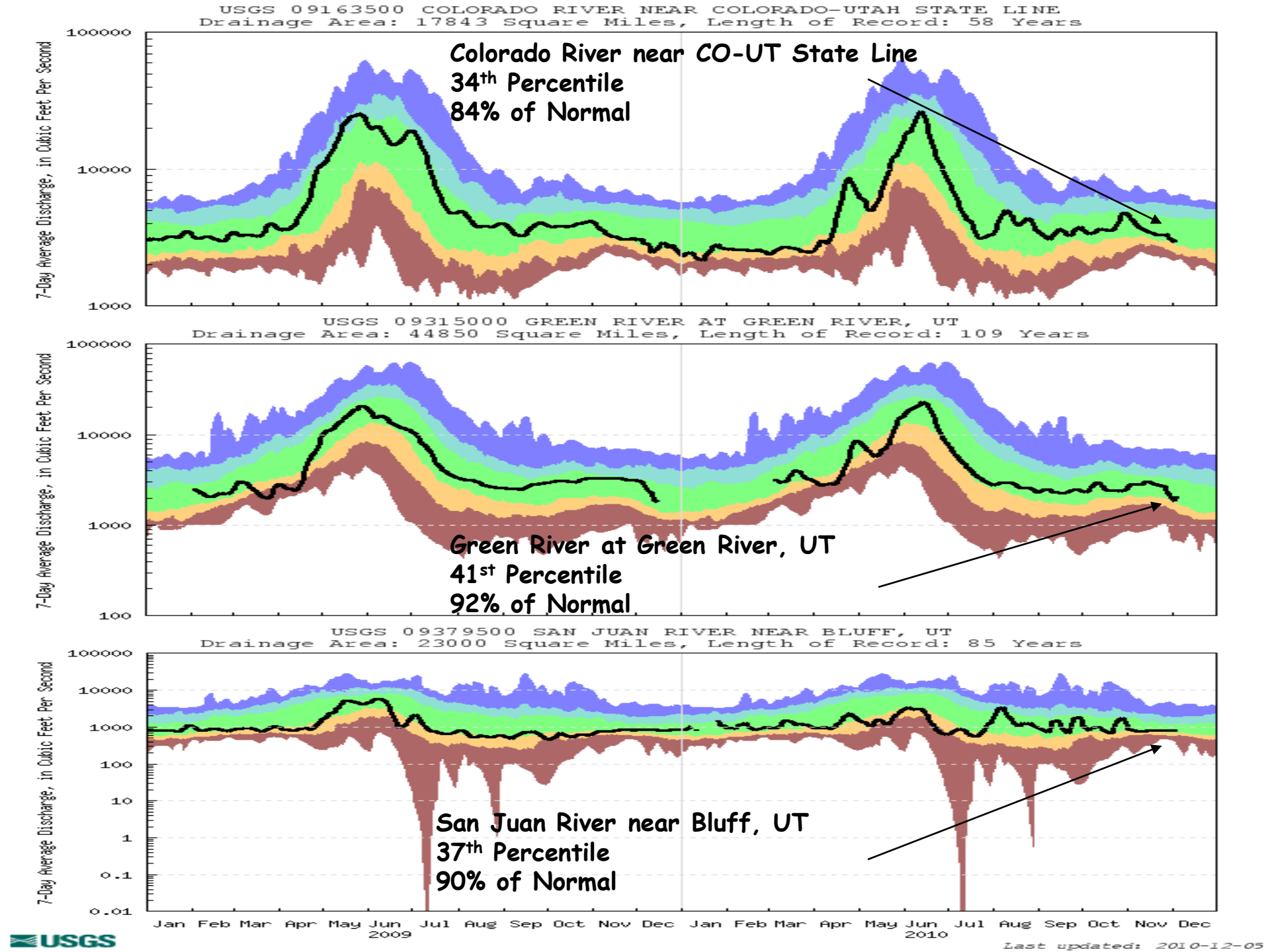


Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

USGS

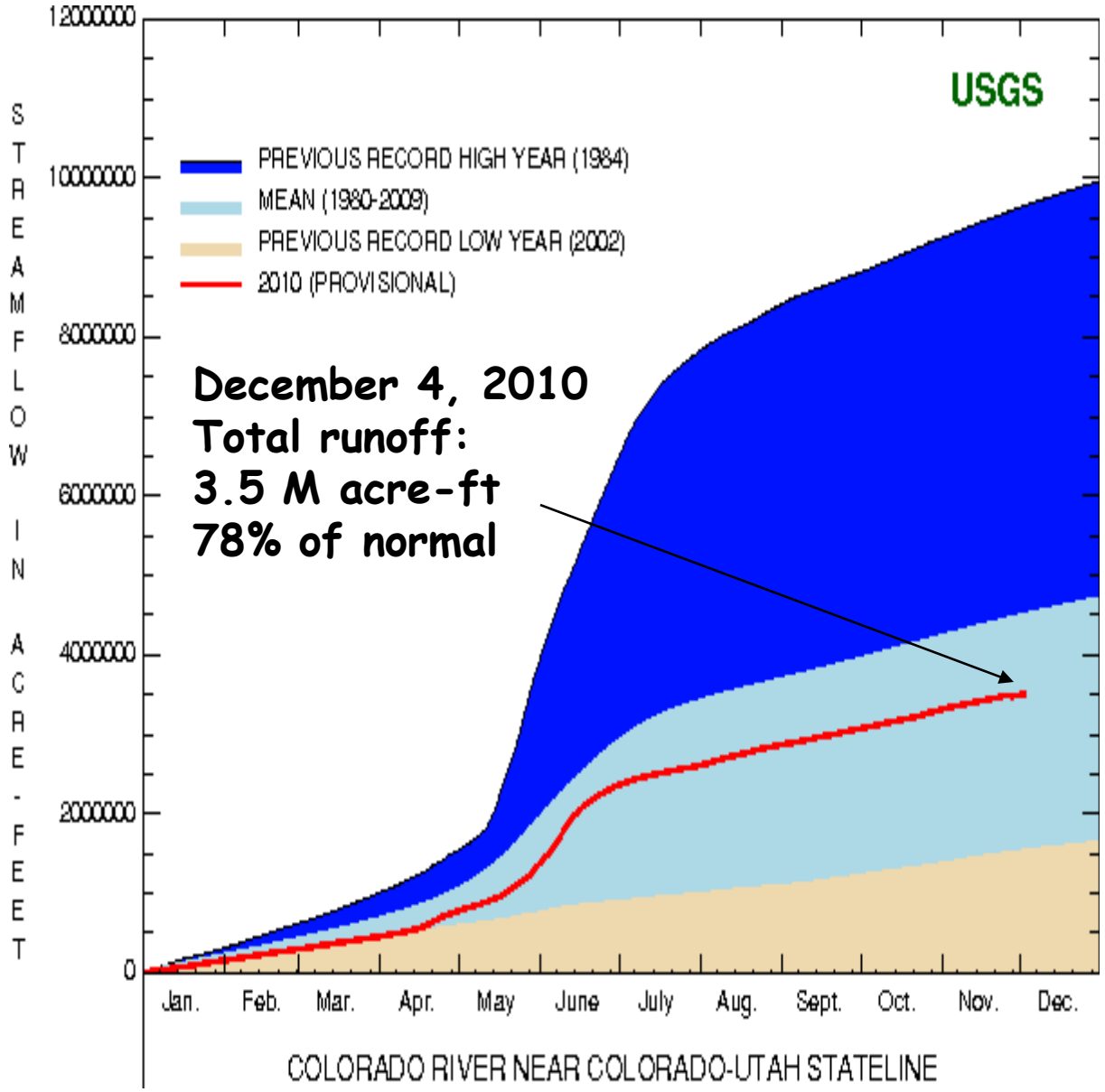
Upper Colorado River Basin- Comparison of 7-day Average Discharge For December 4, 2002-2010




USGS 09163500 COLORADO RIVER NEAR COLORADO-UTAH STATE LINE
Drainage Area: 17843 Square Miles, Length of Record: 58 Years
Colorado River near CO-UT State Line
34th Percentile
84% of Normal
USGS 09315000 GREEN RIVER AT GREEN RIVER, UT
Drainage Area: 44850 Square Miles, Length of Record: 109 Years
Green River at Green River, UT
41st Percentile
92% of Normal
USGS 09379500 SAN JUAN RIVER NEAR BLUFF, UT
Drainage Area: 23000 Square Miles, Length of Record: 85 Years
San Juan River near Bluff, UT
37th Percentile
90% of Normal
7-Day Average Discharge, in Cubic Feet Per Second
100000
10000
1000
100
10
1
0.1
0.01
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2009
2010
USGS
Last updated: 2010-12-05

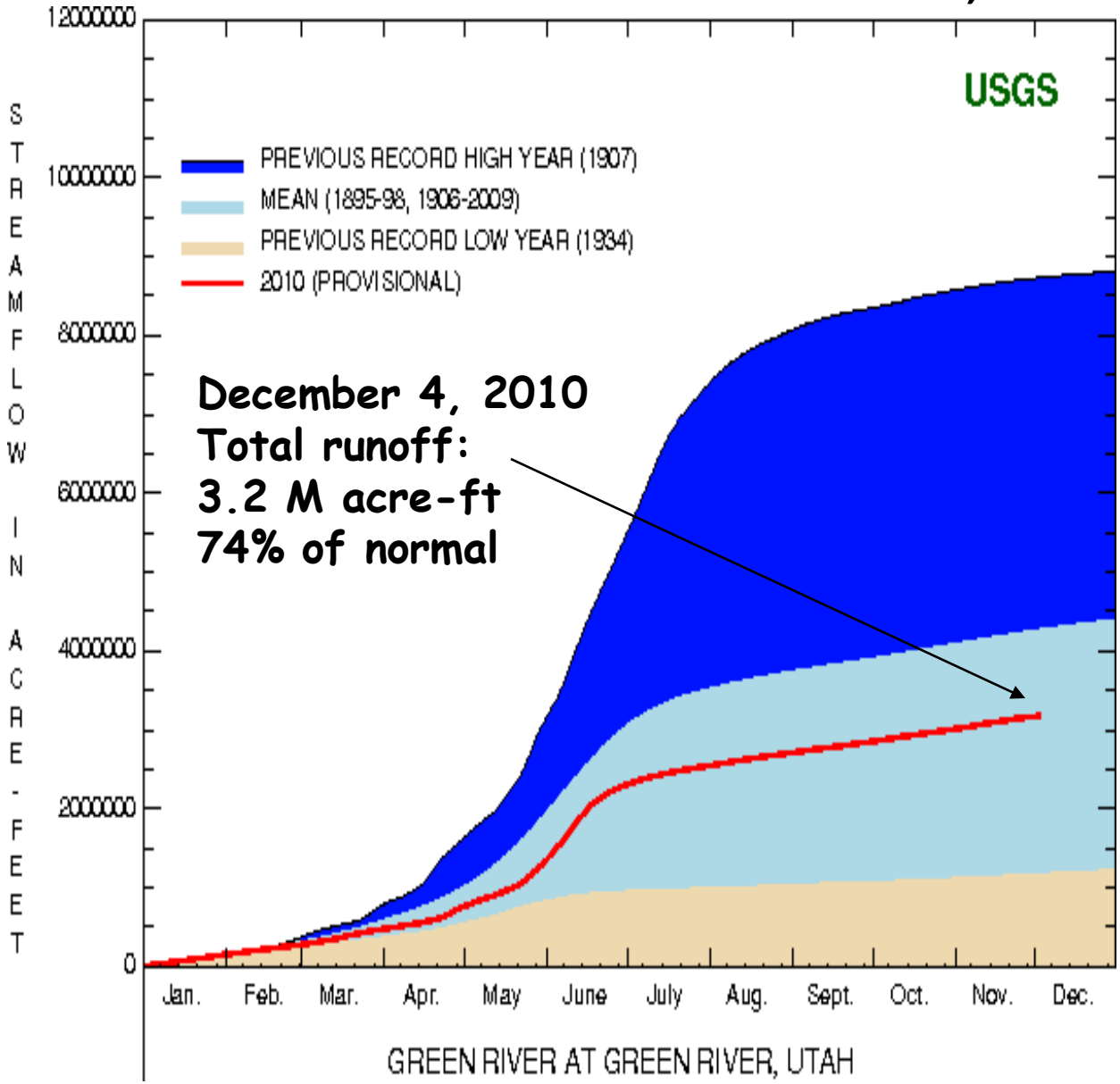
Cumulative Runoff

Colorado River at CO-UT Line

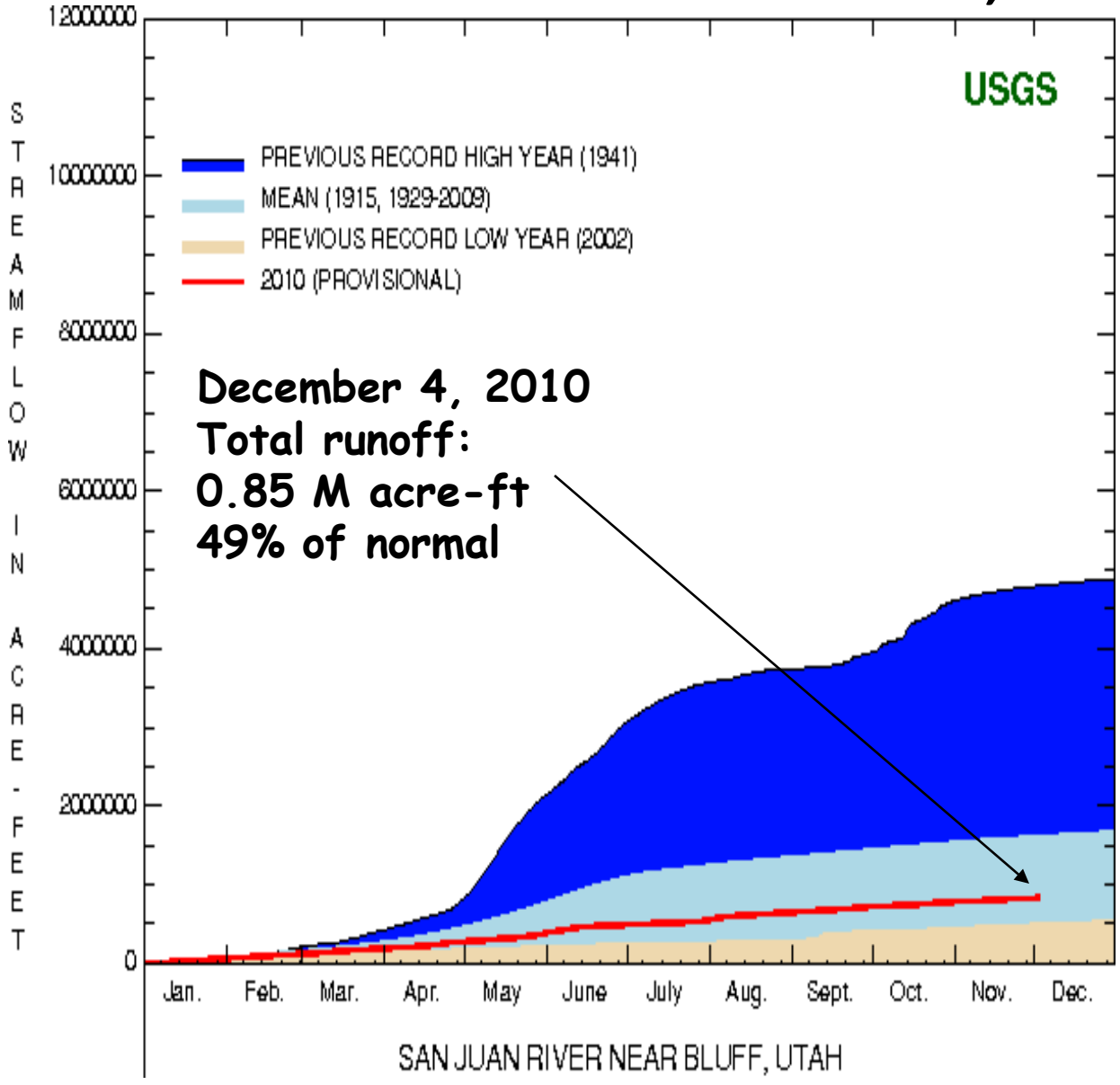


Cumulative Runoff

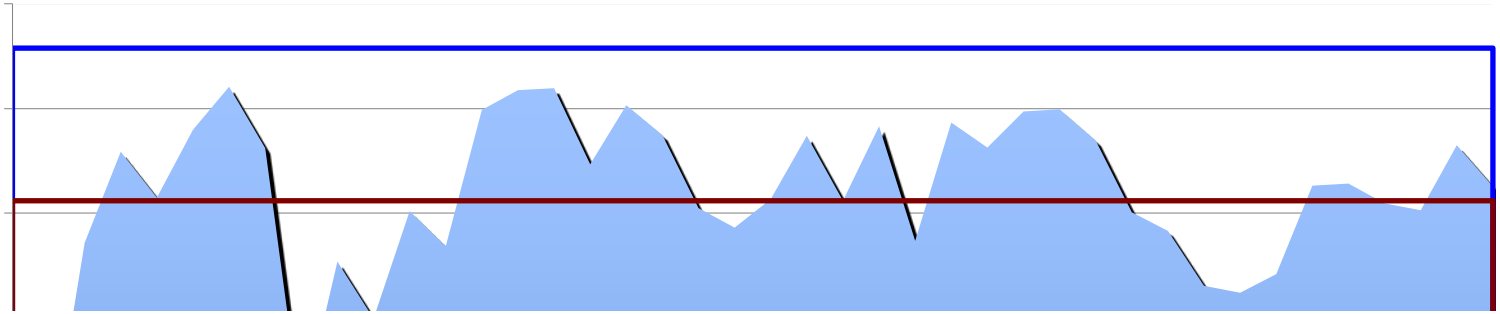
Green River at Green River, UT

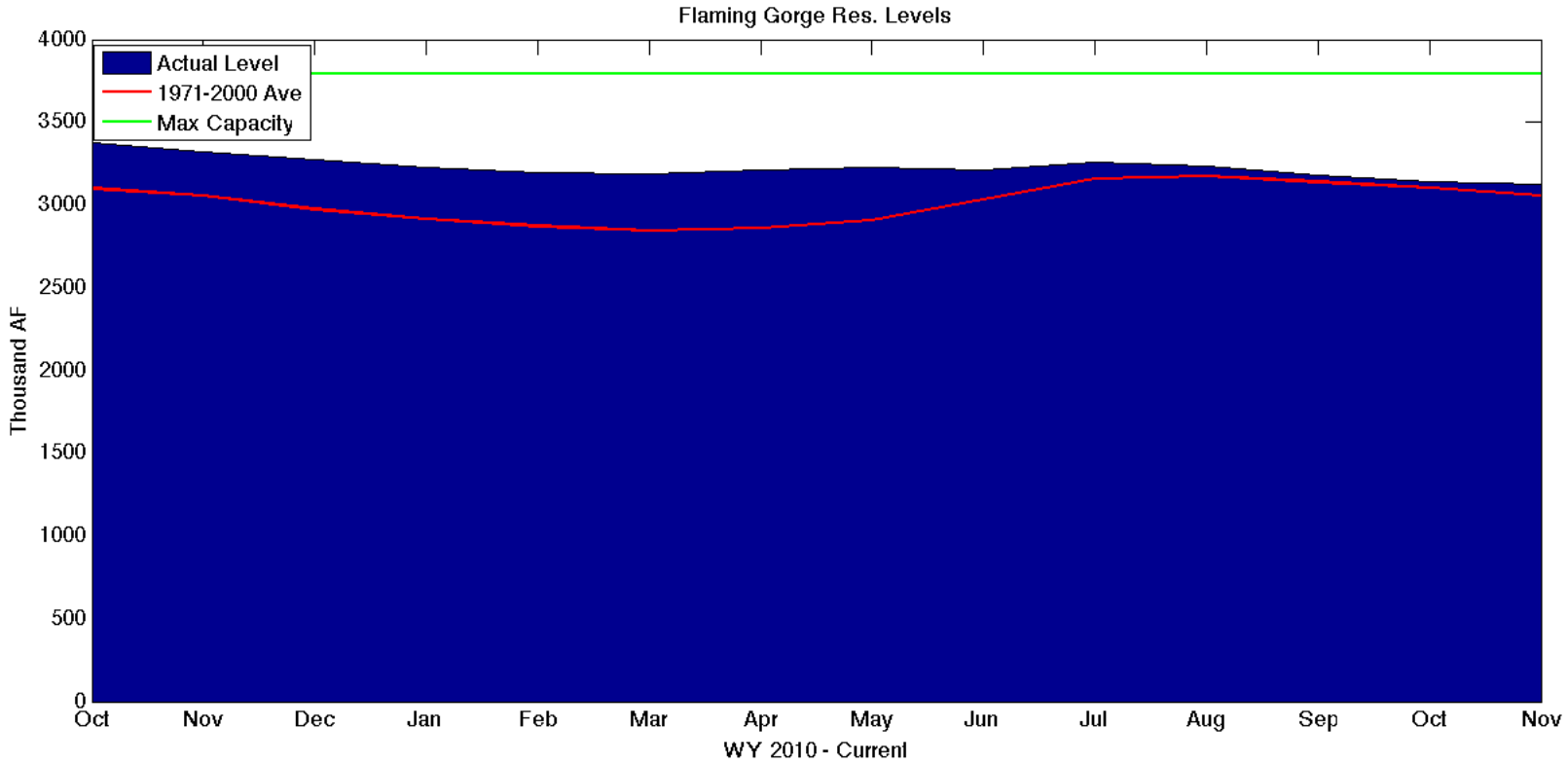


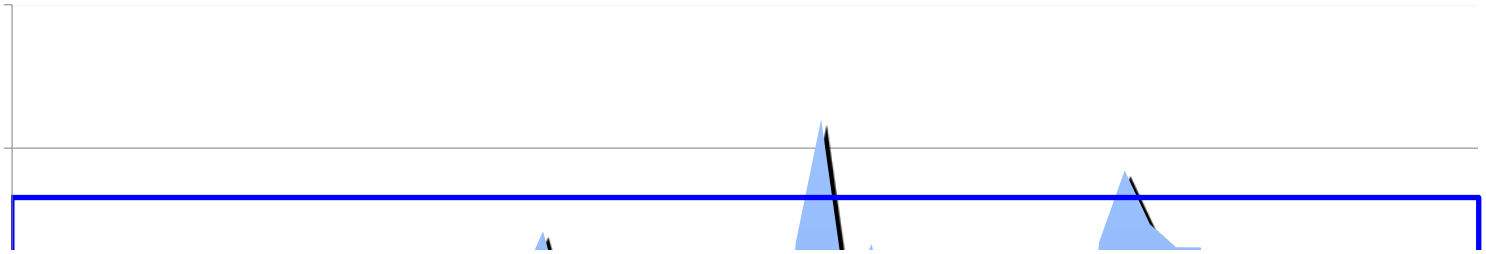
Cumulative Runoff
San Juan River at Bluff, UT



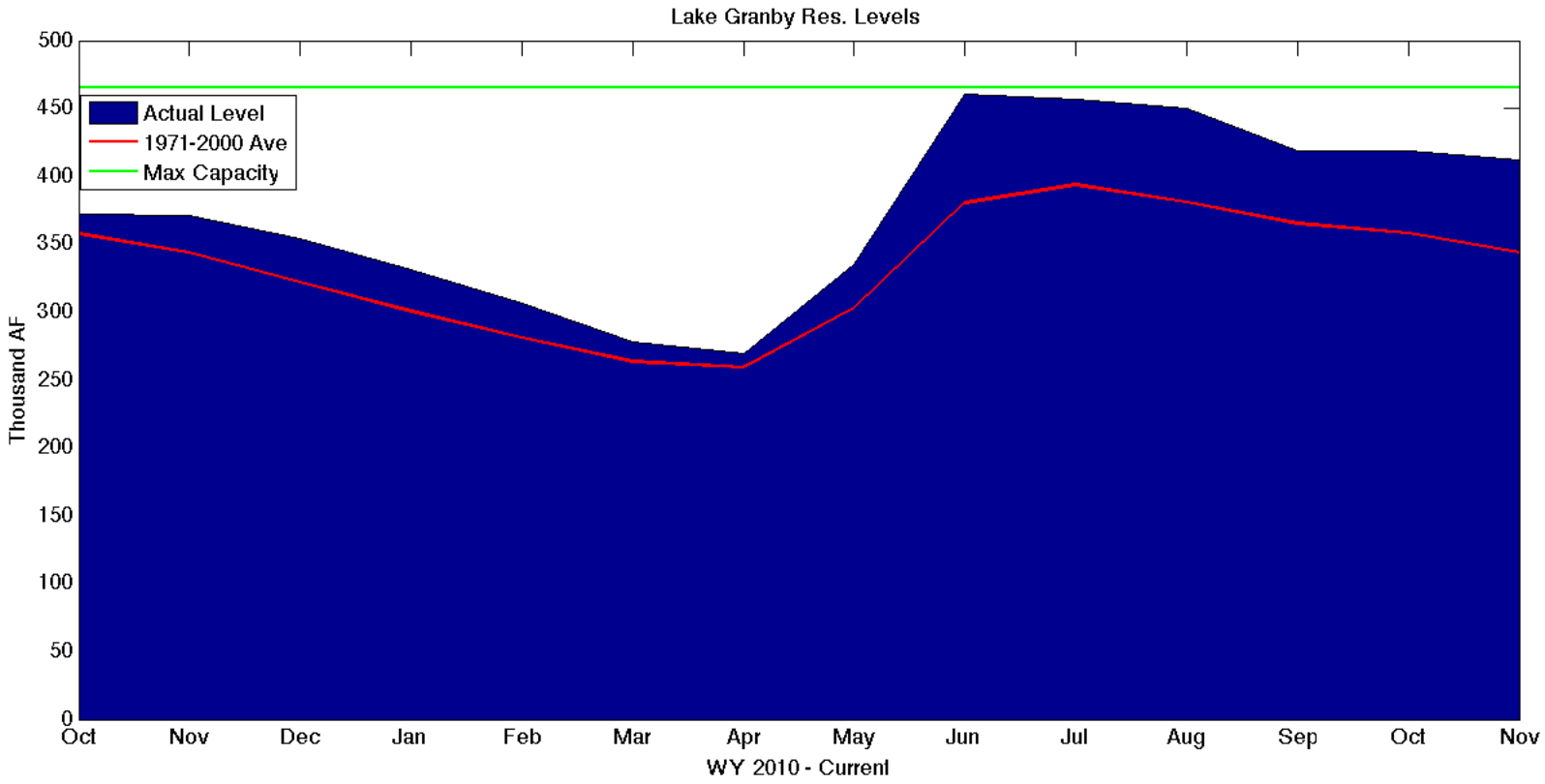
Reservoir Update

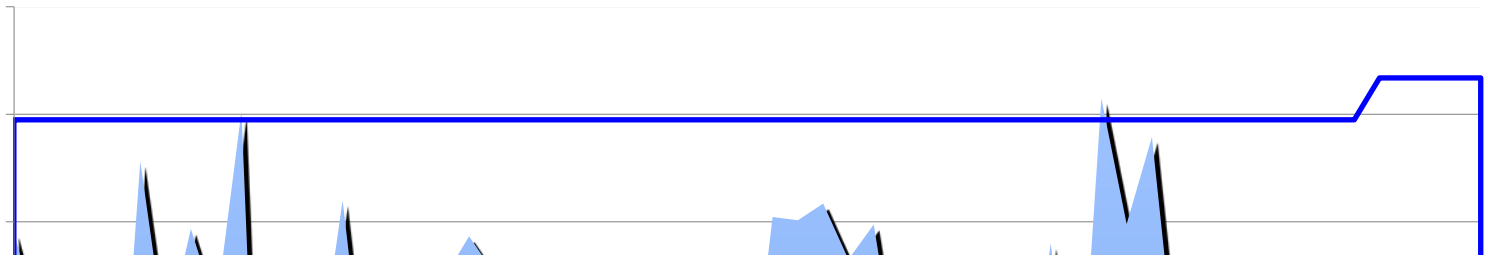

Max Capacity
1971-2000 Ave


Flaming Gorge Res. Levels
Actual Level
1971-2000 Ave
Max Capacity
Thousand AF
4000
3500
3000
2500
2000
1500
1000
500
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
WY 2010 - Current

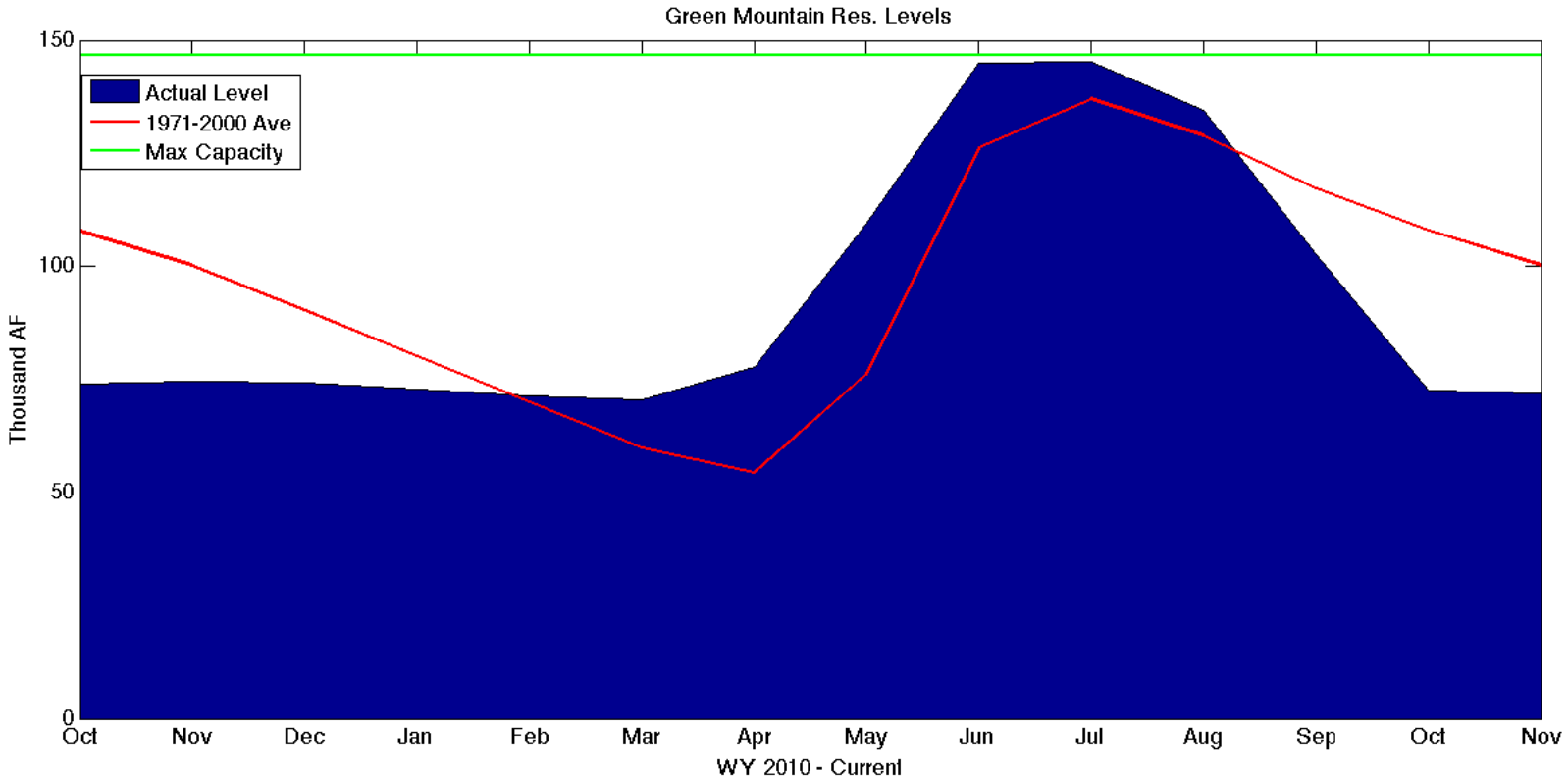


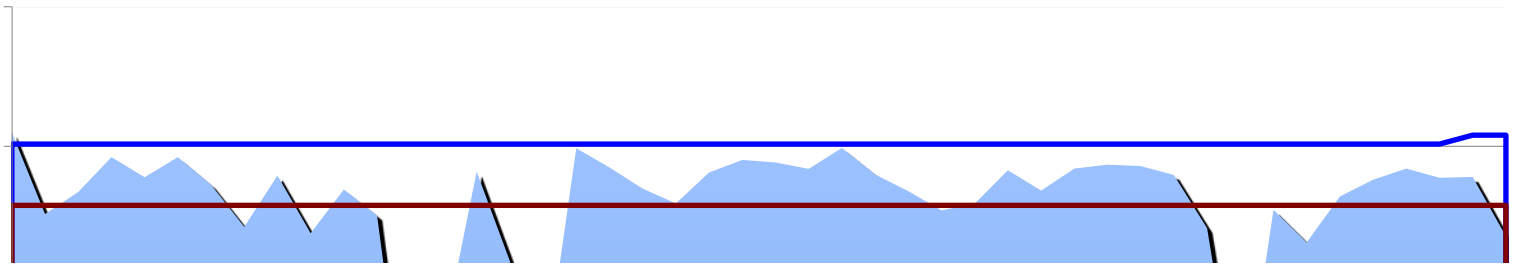
Max Capacity

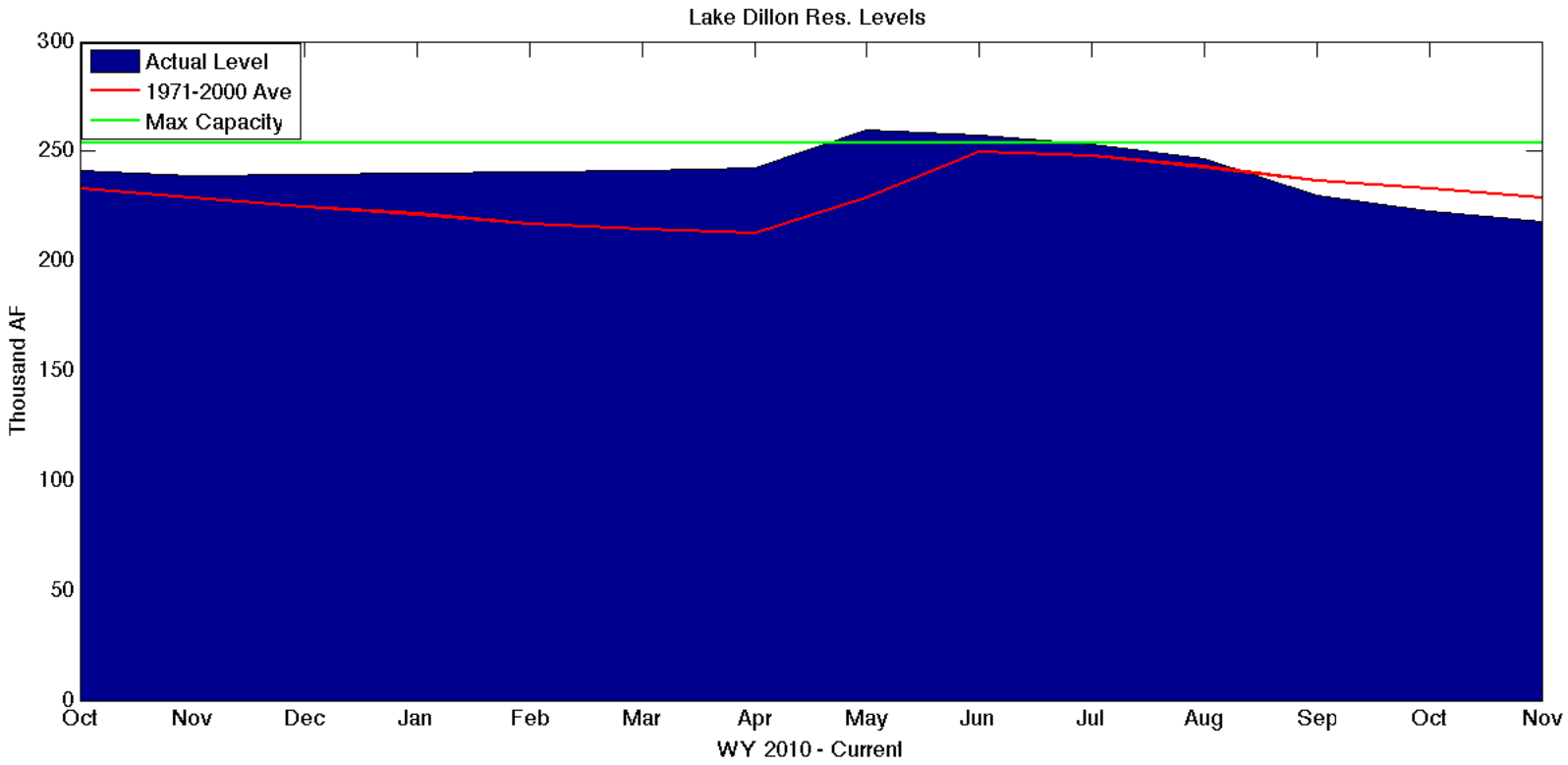


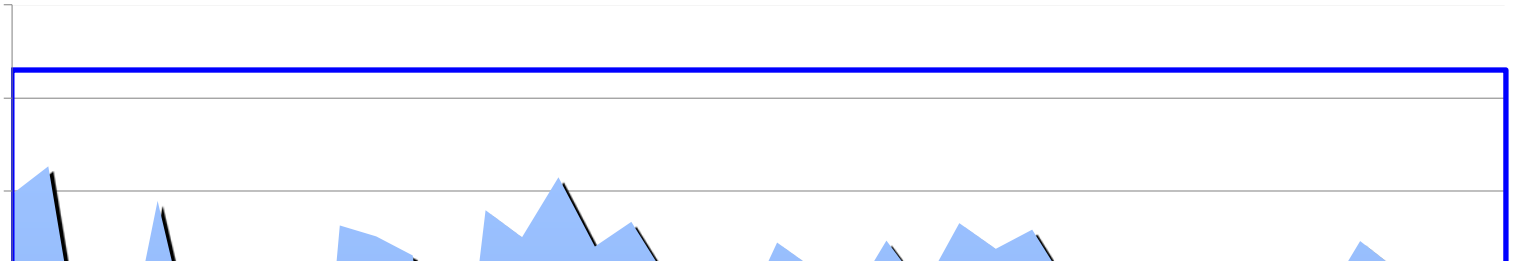


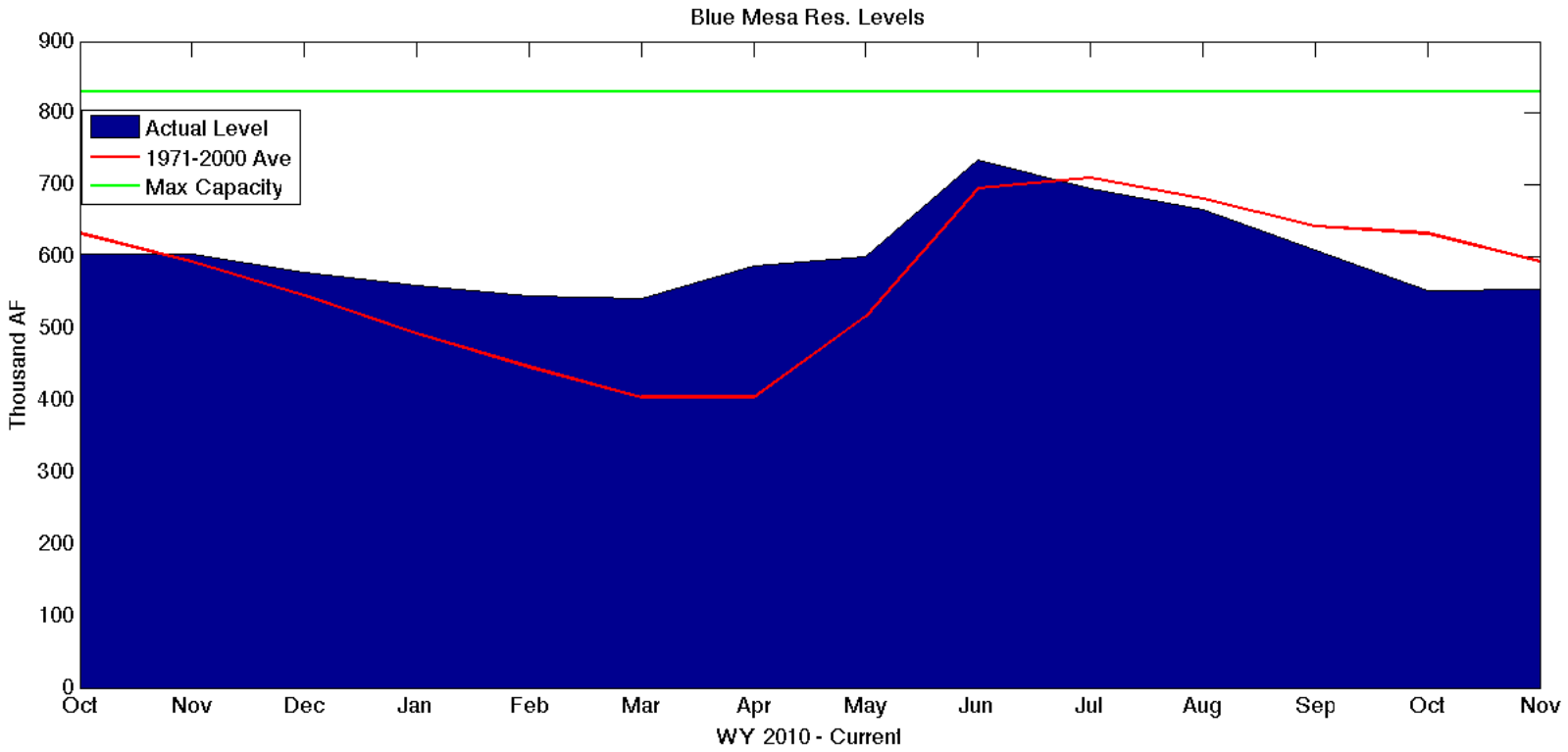
Max Capacity

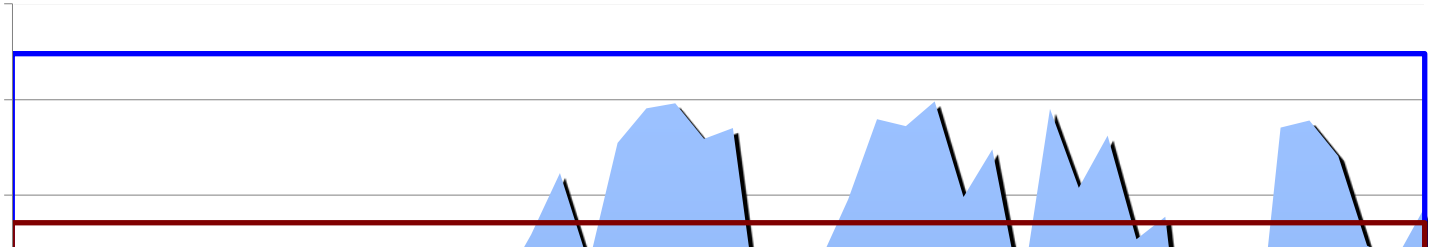



Max Capacity
1971-2000 Ave


Lake Dillon Res. Levels
Actual Level
1971-2000 Ave
Max Capacity
Thousand AF
300
250
200
150
100
50
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
WY 2010 - Current

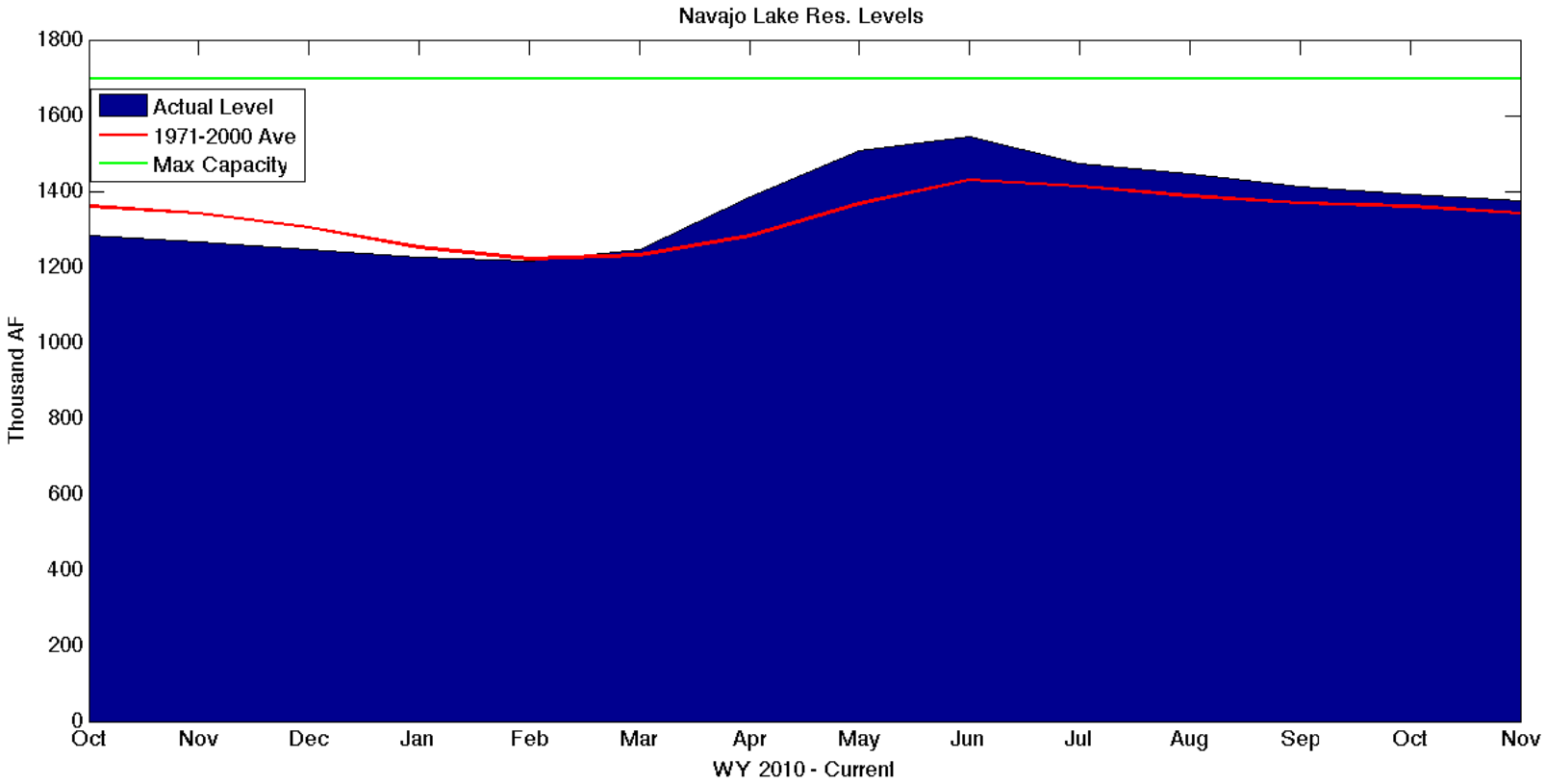

Max Capacity


Blue Mesa Res. Levels
Actual Level
1971-2000 Ave
Max Capacity
Thousand AF
900
800
700
600
500
400
300
200
100
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
WY 2010 - Current

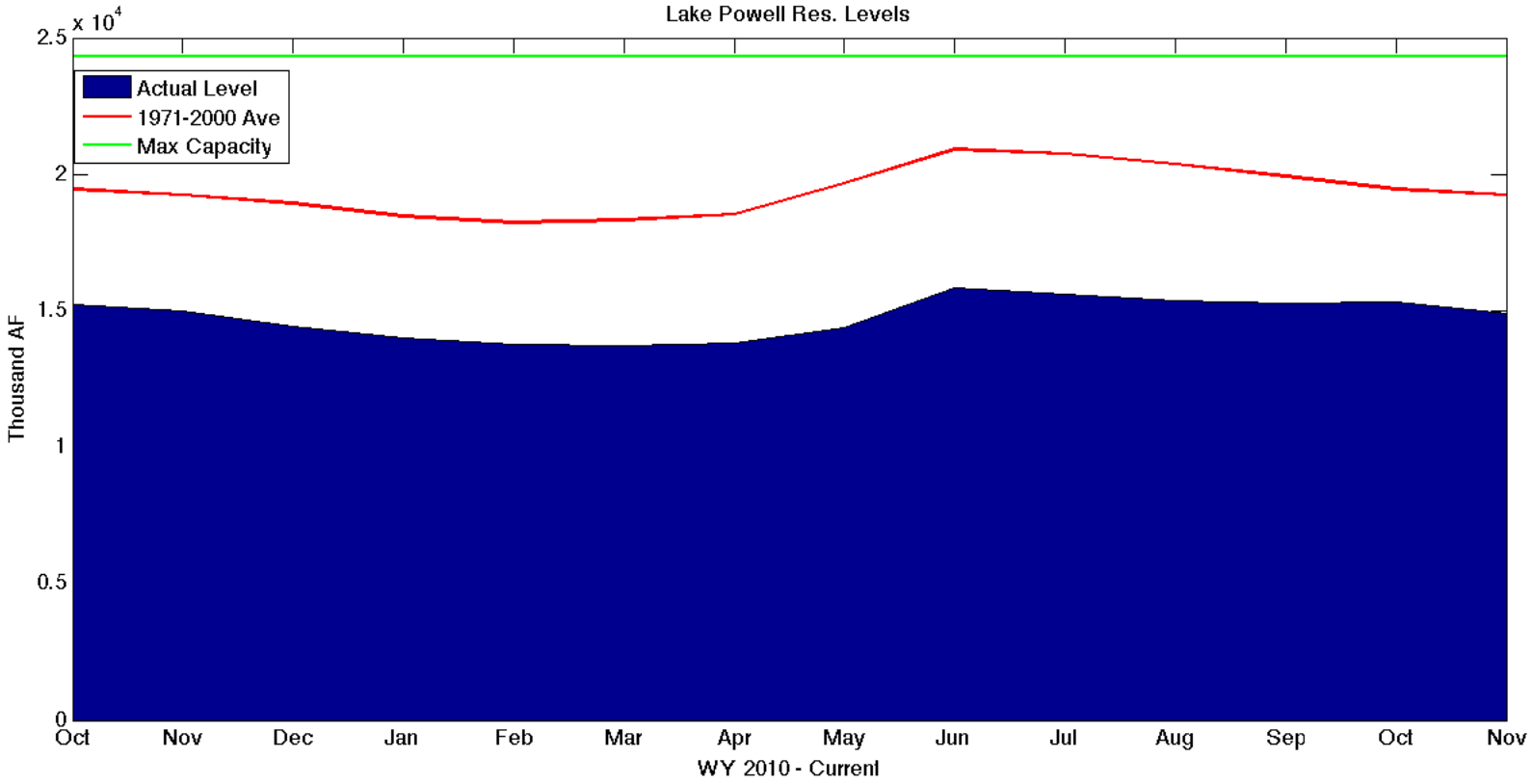


Max Capacity

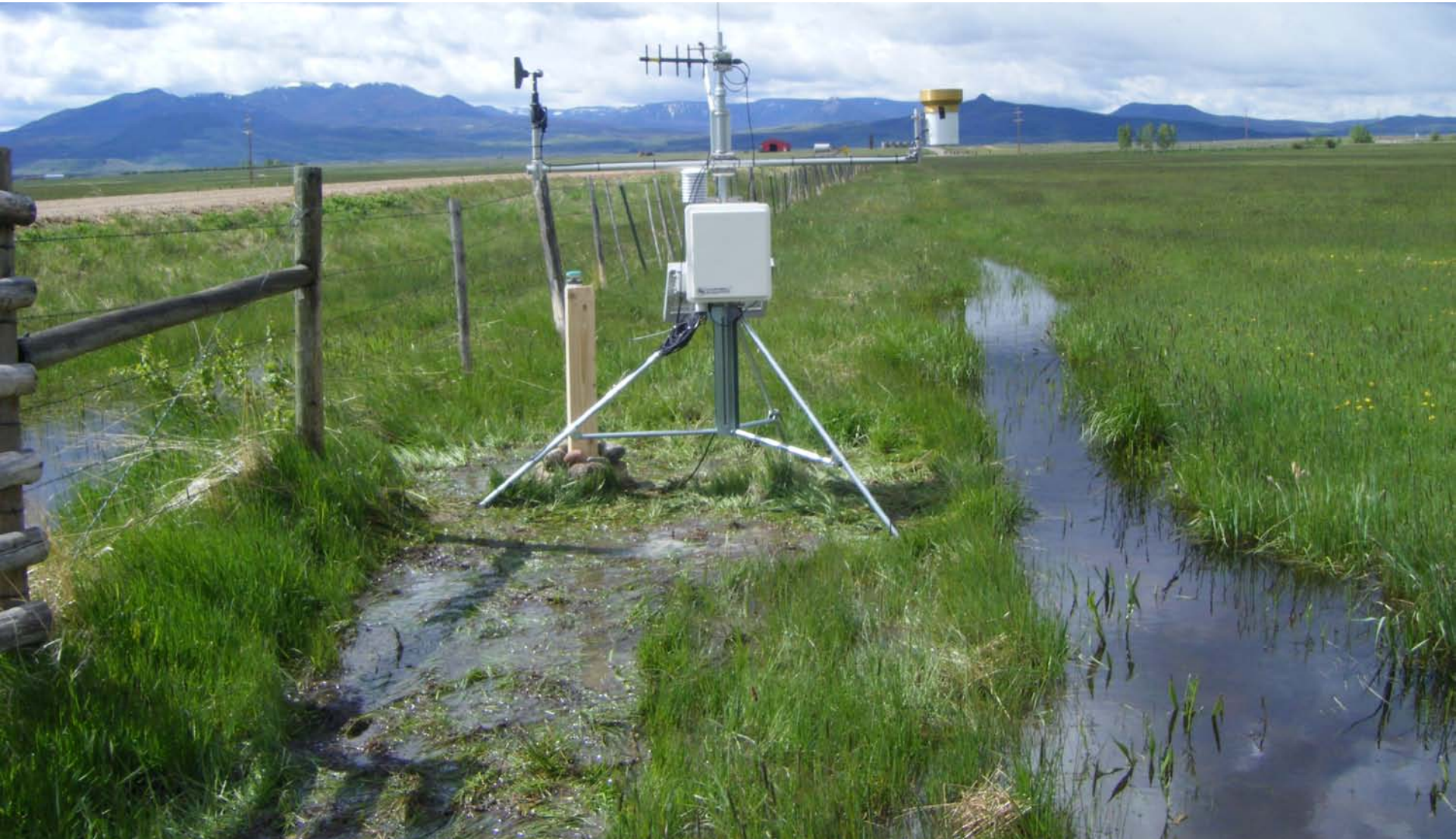
1971-2000 Ave



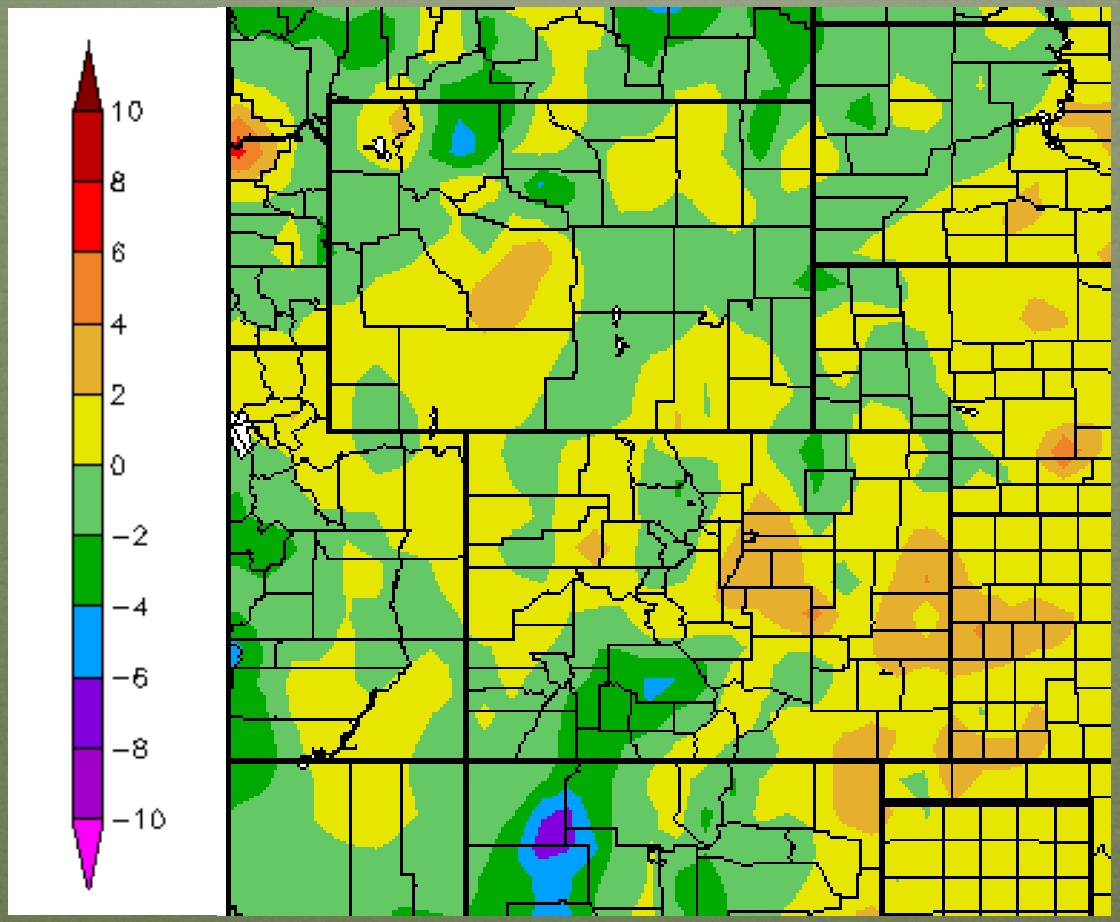
Max Capacity



Water Demand

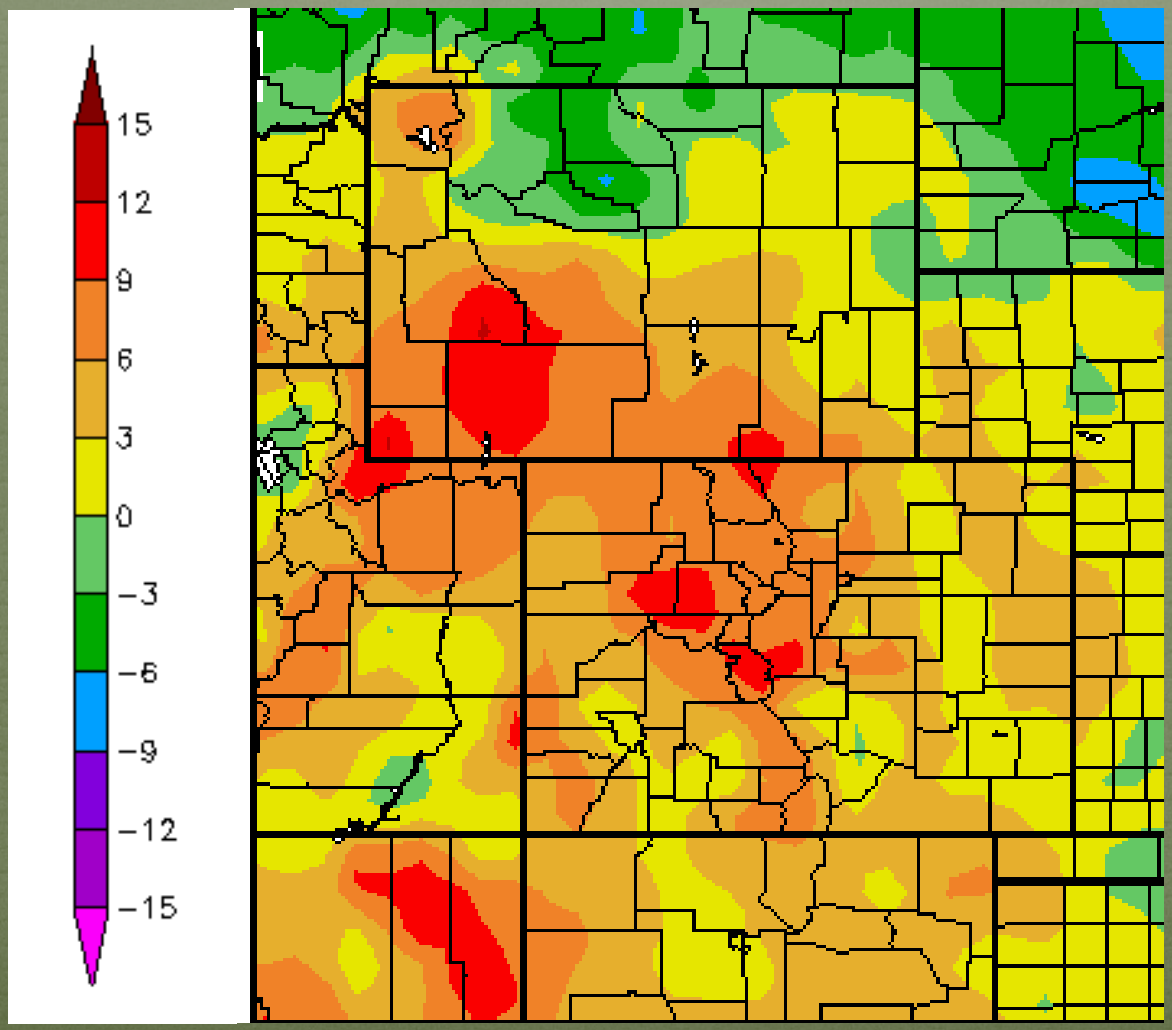


Temperature Departure from Normal
11/1/2010 – 11/30/2010

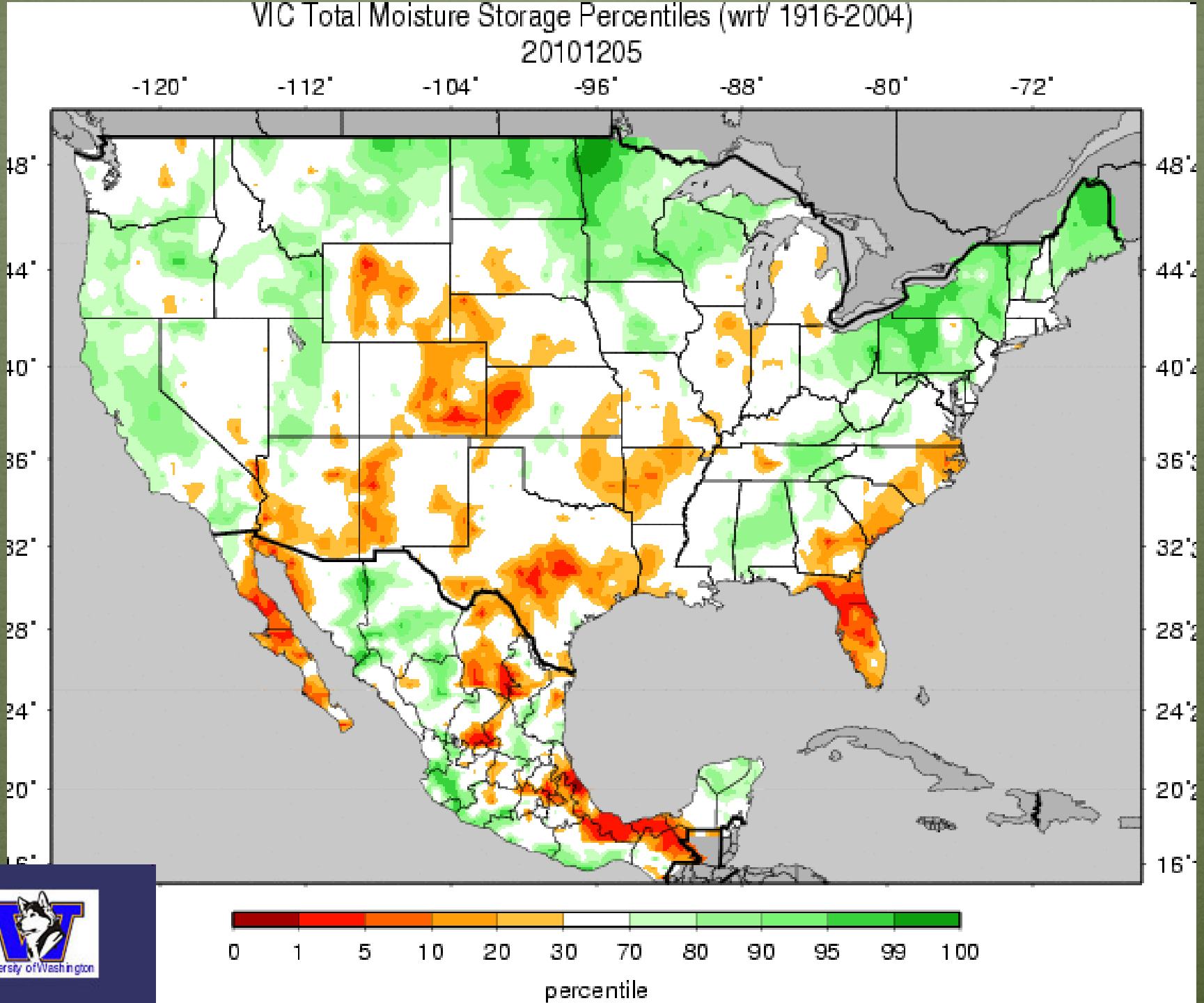


High Plains Regional Climate Center

Temperature Departure from Normal
12/1/2010 – 12/6/2010



High Plains Regional Climate Center



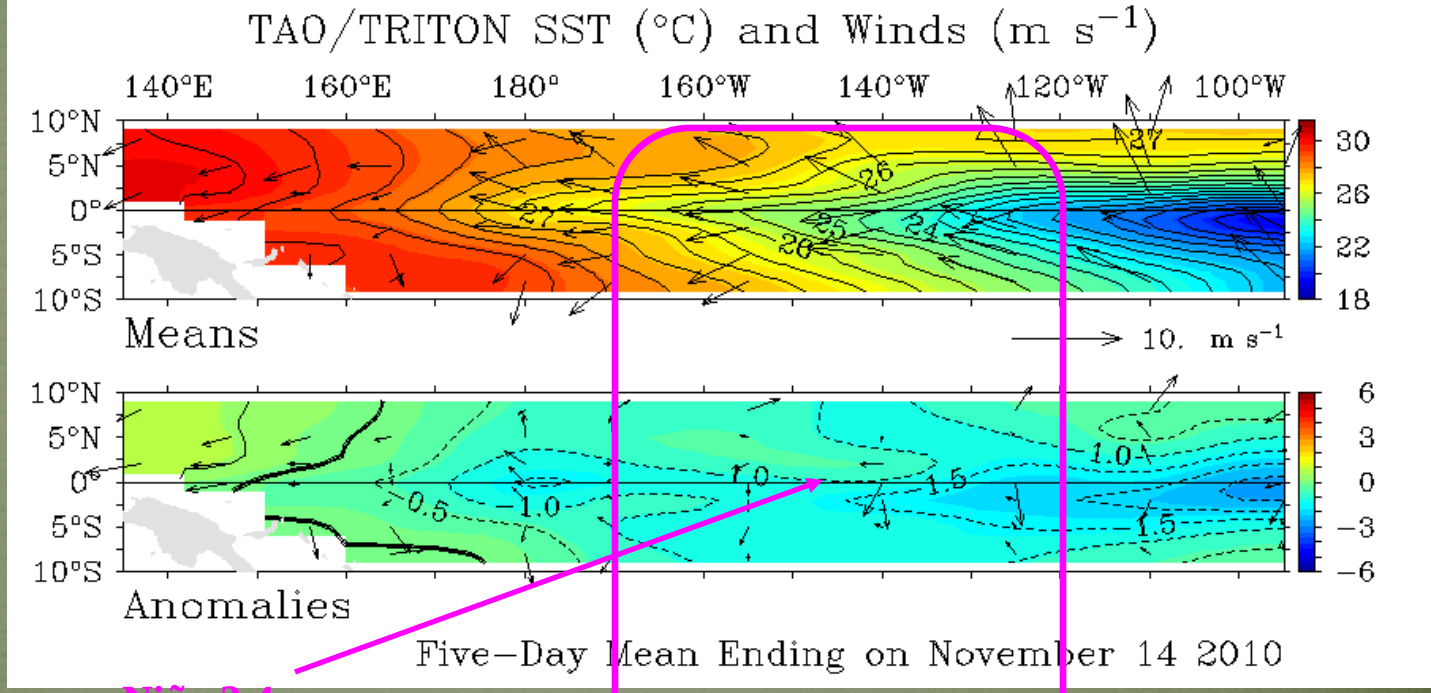
University of Washington

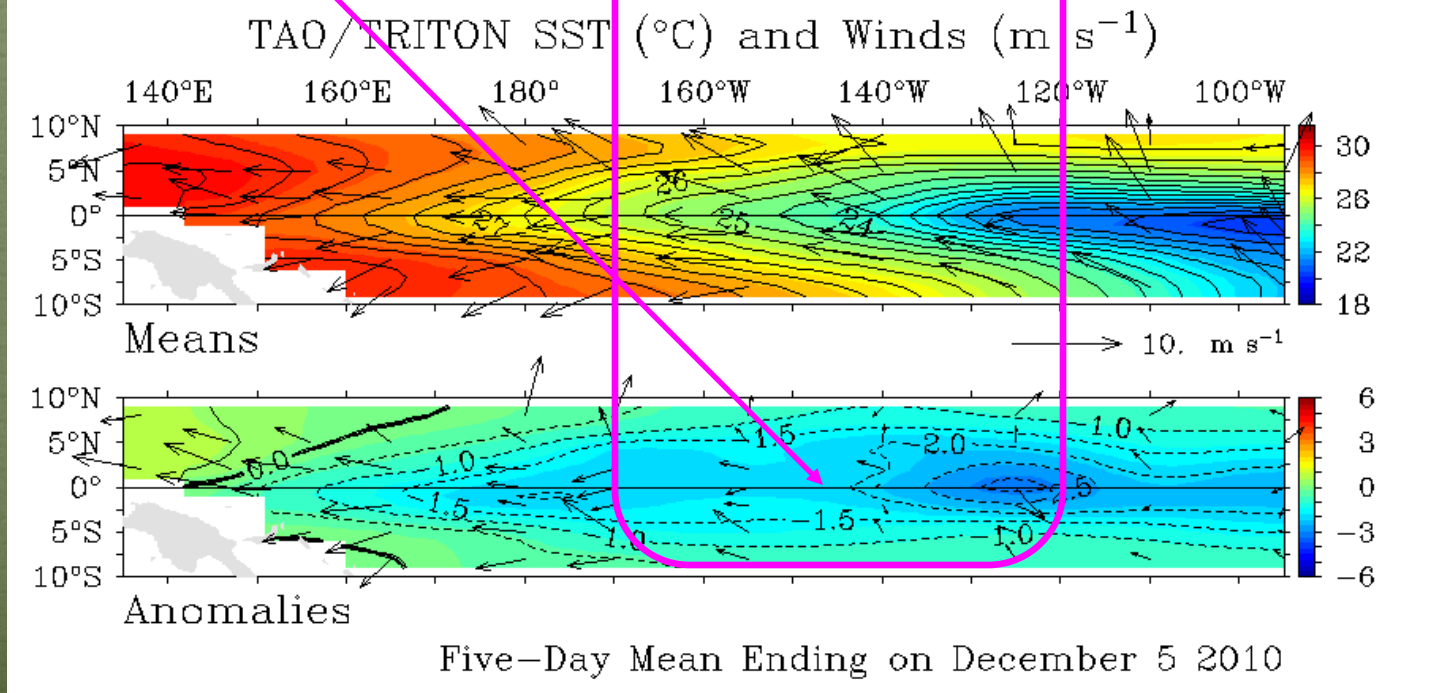
Upper Colorado Outlook into 2012

Klaus Wolter
University of Colorado, CIRES & NOAA-ESRL PSD 1, Climate Analysis Branch
klaus.wolter@noaa.gov

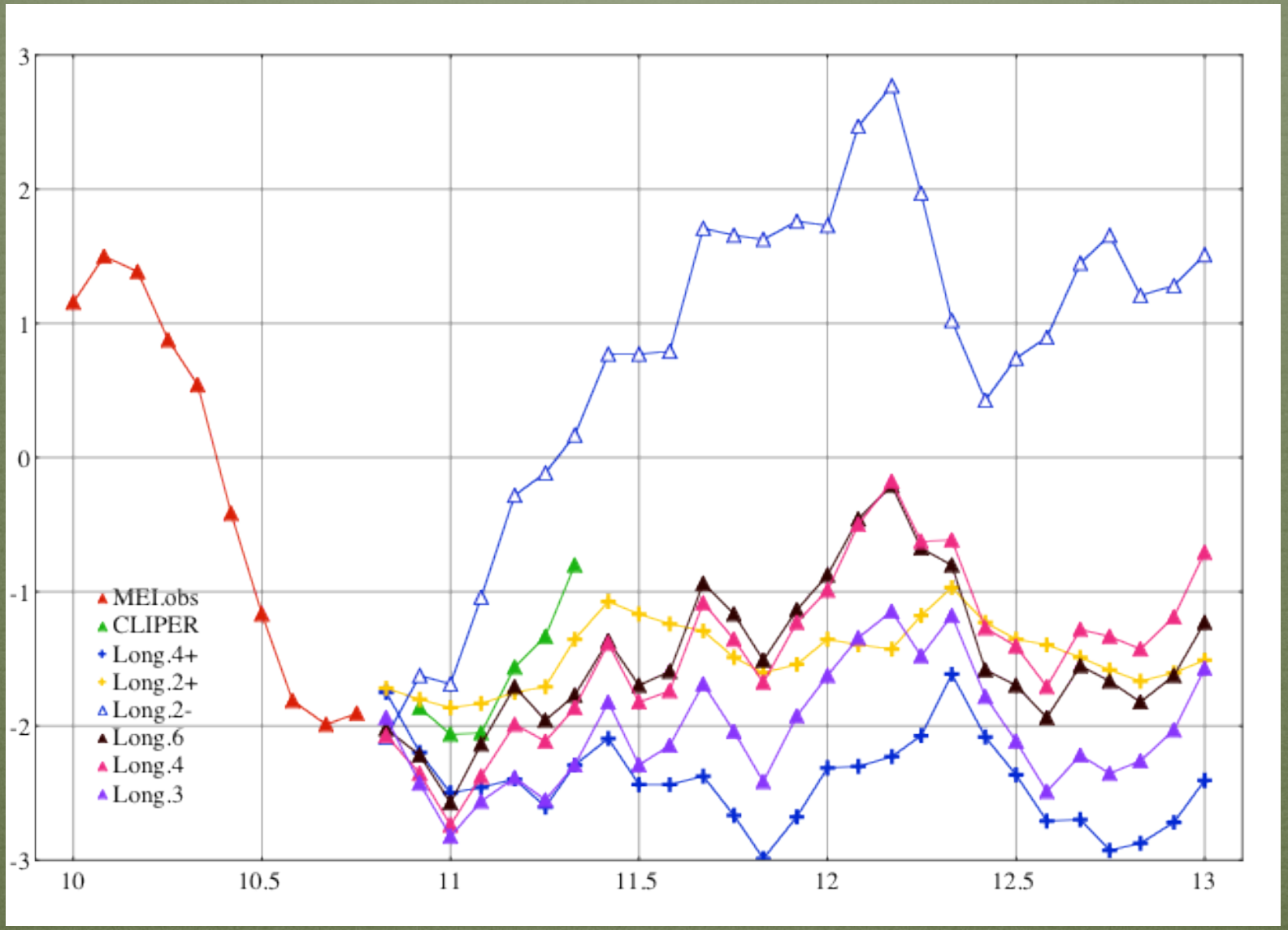
- **La Niña: Too Big to Fade!**
- **MEI Outlook into 2012 (1st cut)**
- **Expectations for next few weeks**
- **What does La Niña mean for the Upper Colorado Basin?**
- **Other influences?**

Current state of ENSO (bottom) compared to three weeks ago (top): our La Niña weakened for about a month or so (top), almost losing its SST anomalies of more than -1C; '2nd wind' has kicked in, with easterly wind anomalies right along the Equator across much of the basin helping to maintain this event.



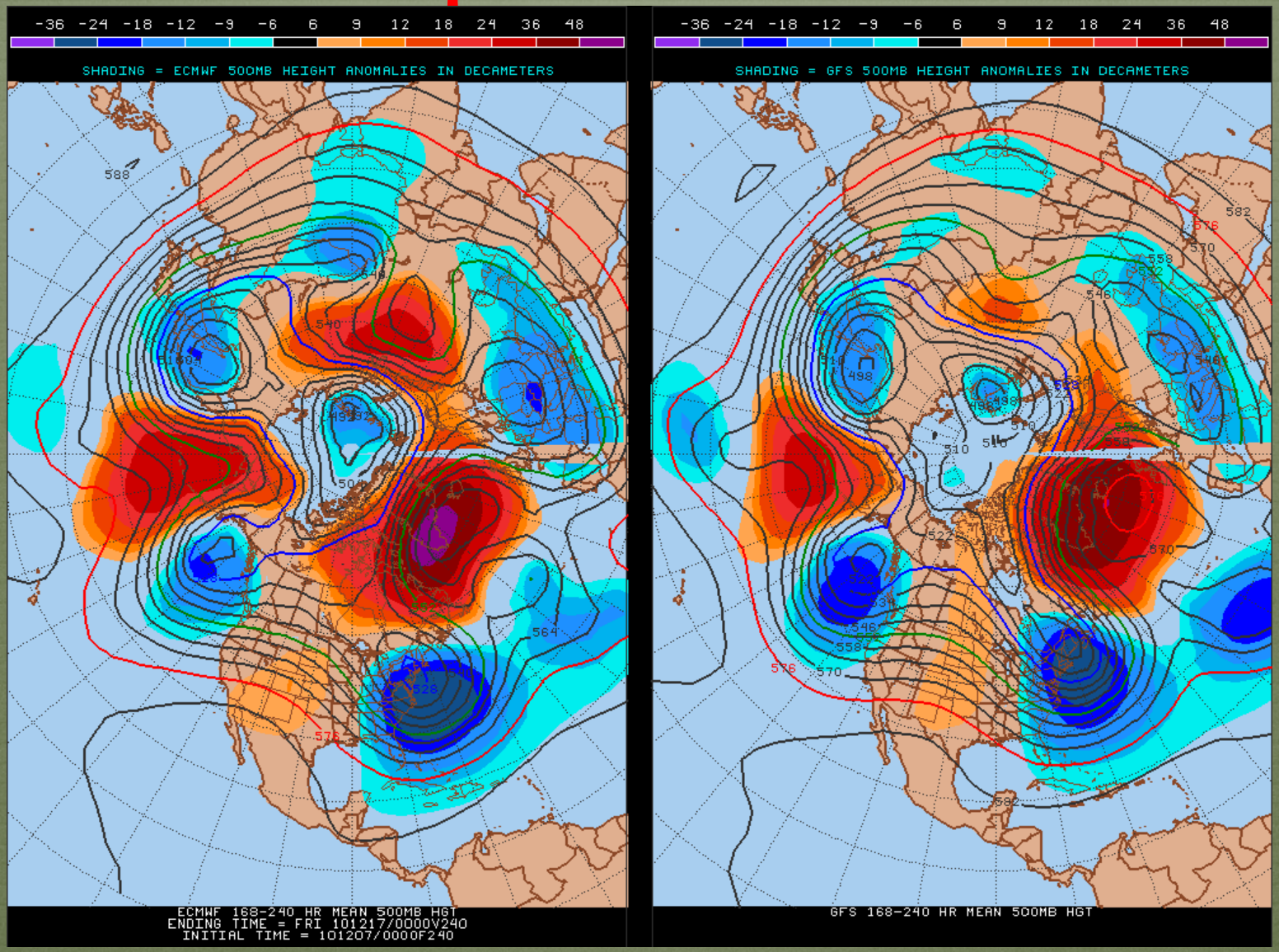


How long will this La Niña last?



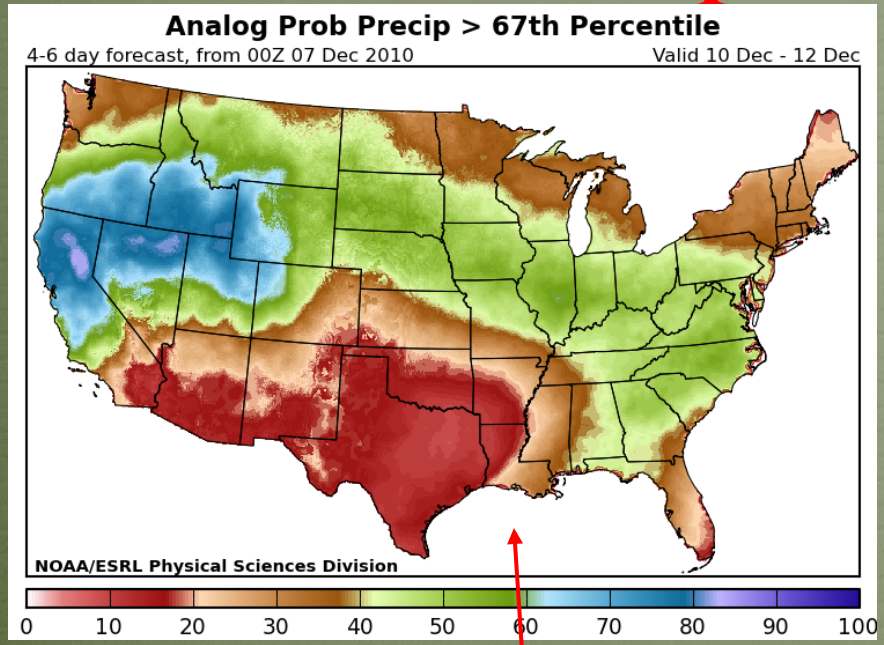
Two year analog cases, plus climatology and persistence thru next April (green line): 5 of 6 two-year analog predictions show persistent La Niña into 2012

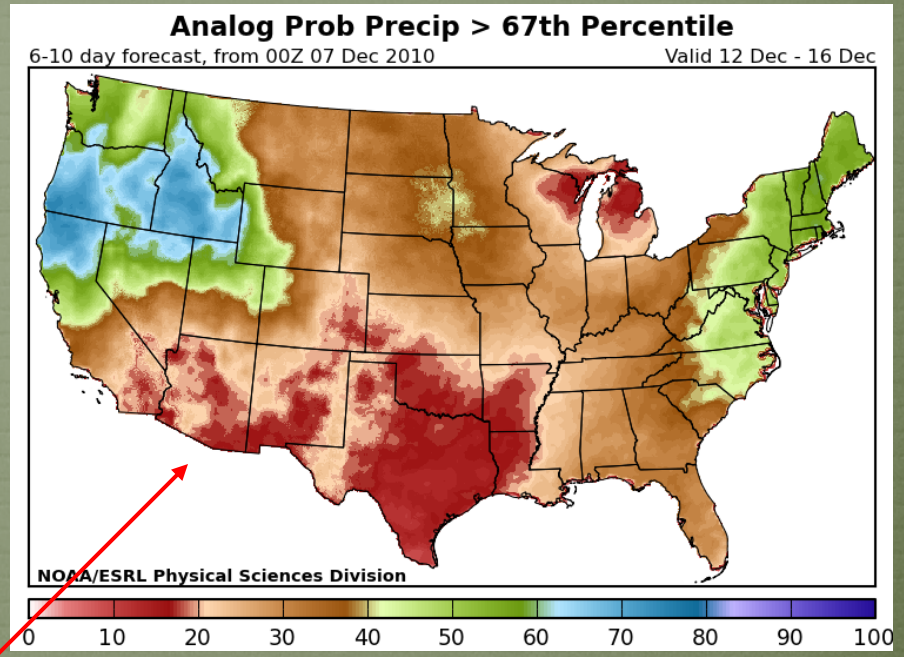
What can we expect in the next two weeks?

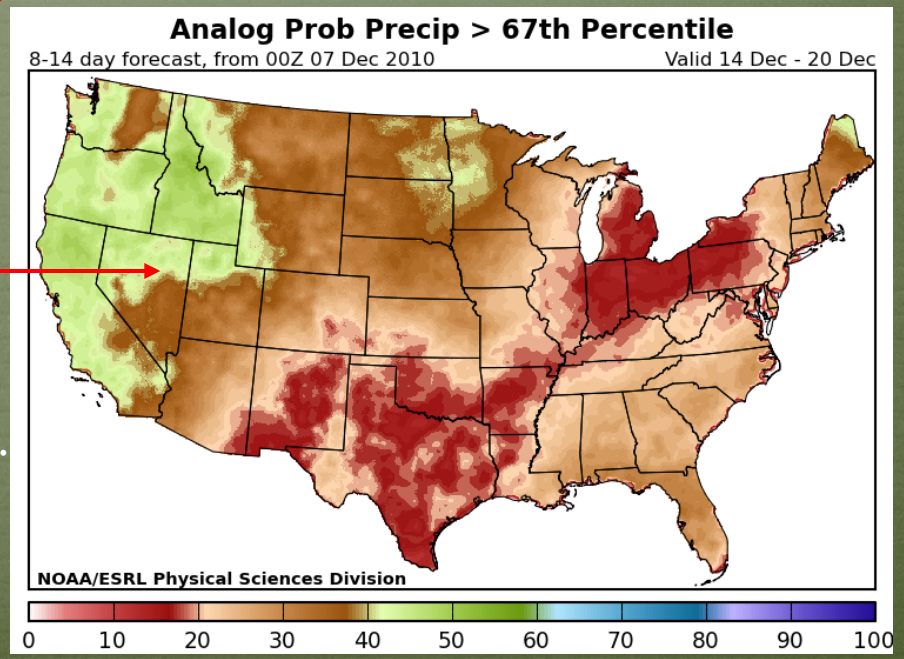


Agreement between European (left) and American model (GFS; right) for middle of next week – troughs to our west & east, and weak ridging right over us; negative NAO *déja vu* renders much of Europe and U.S. East coast cold!

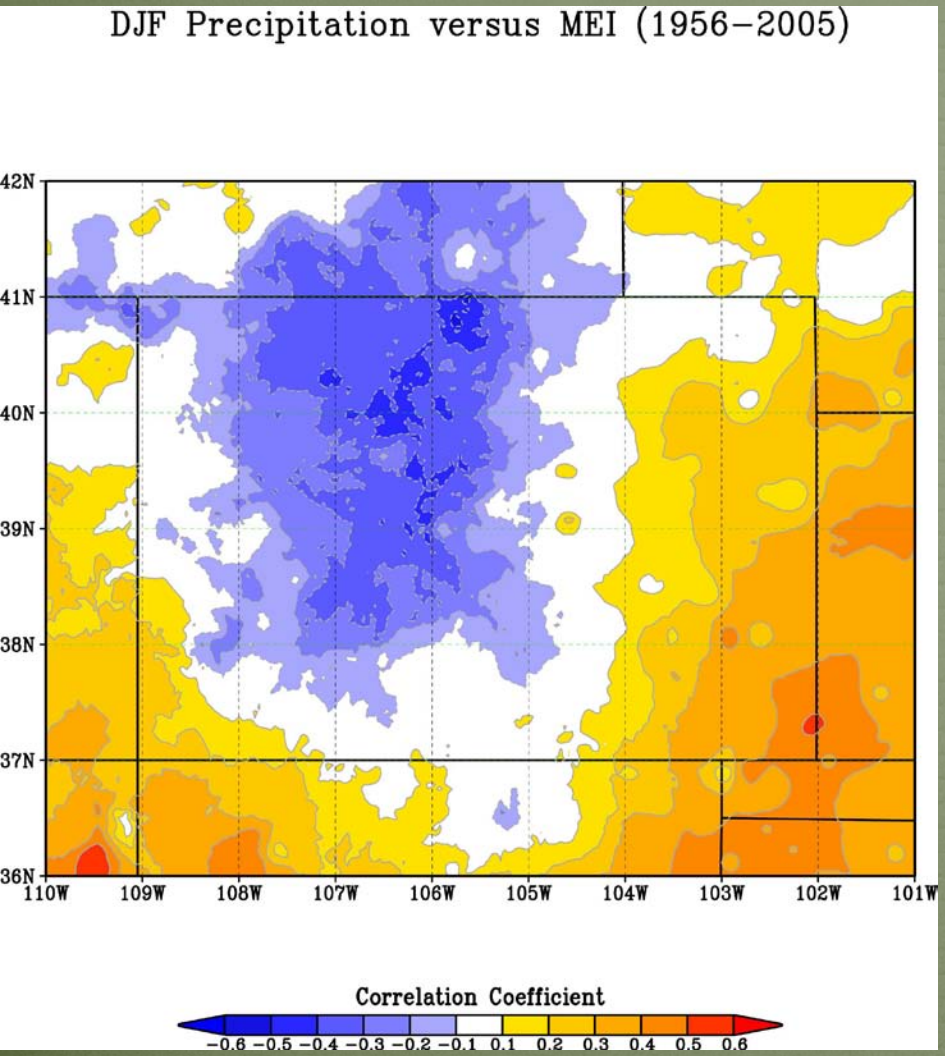
What can we expect in the next two weeks?

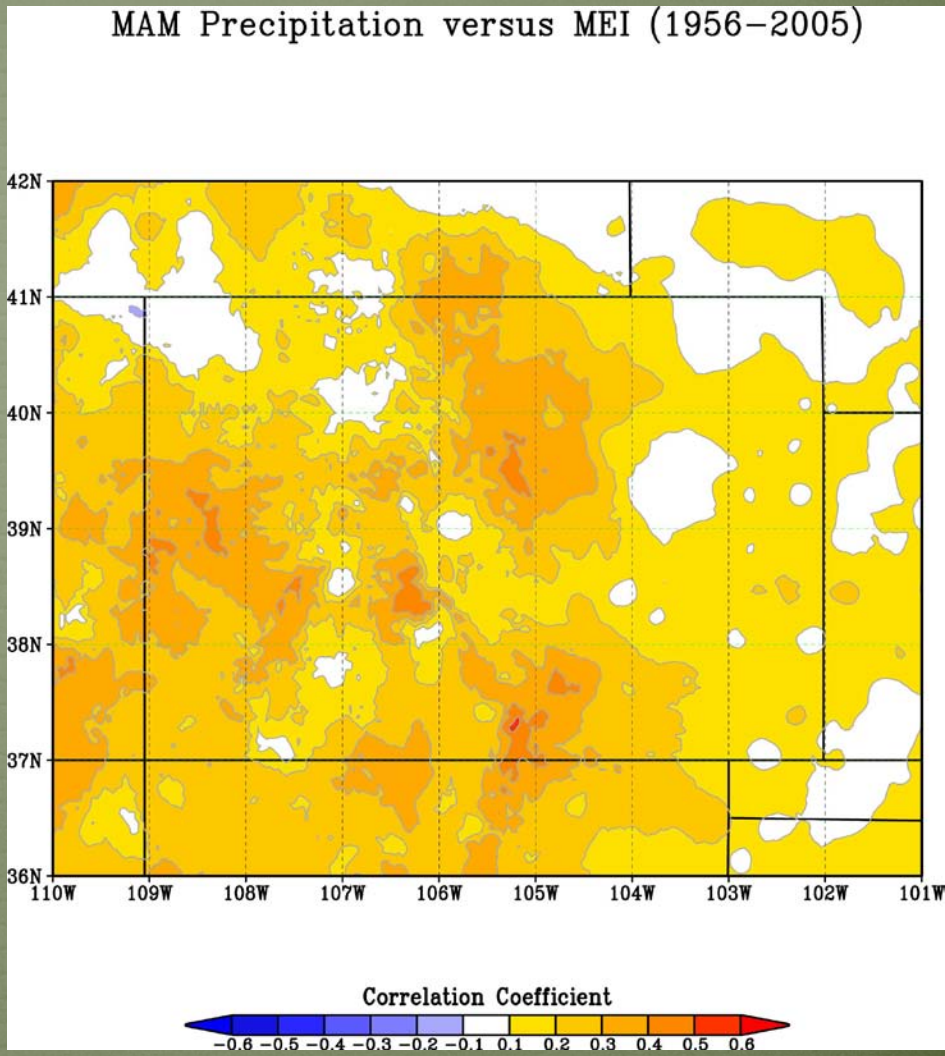






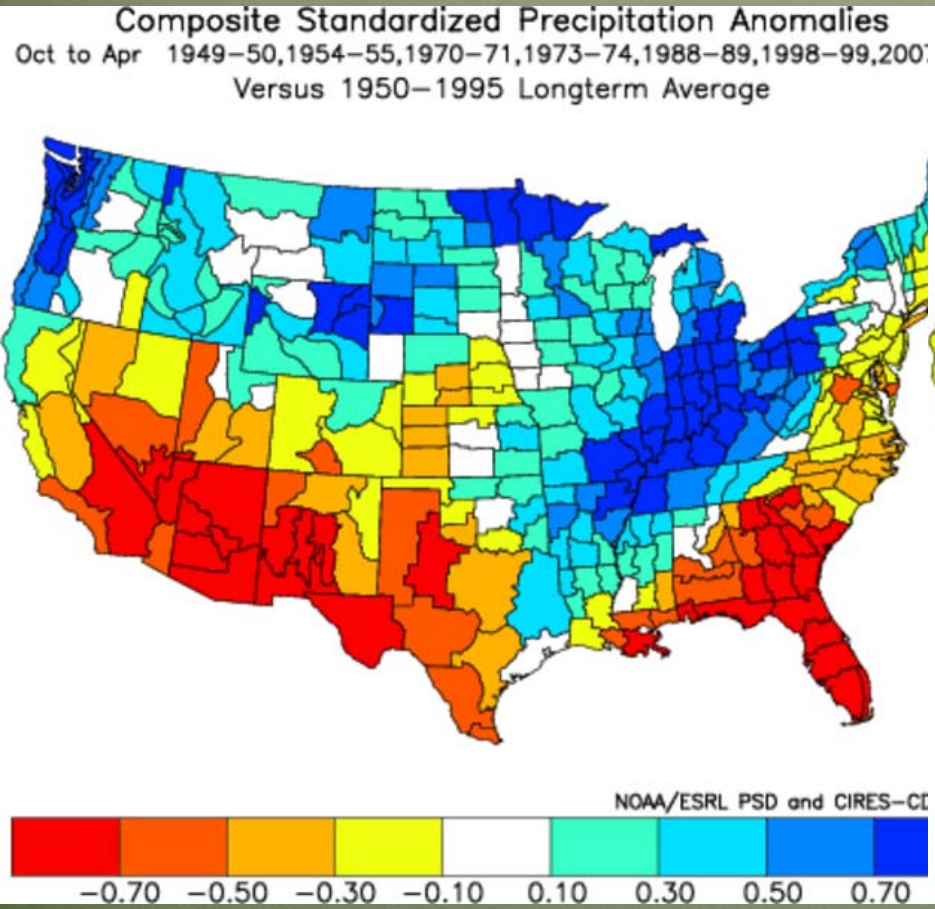
Precipitation chances for 4-6, 6-10, and 8-14 days from last night show a familiar wet pattern from northern California into northwest Colorado, weakening by next week. Best shot at precip statewide will be over the weekend, with southeast Colorado being least favored.

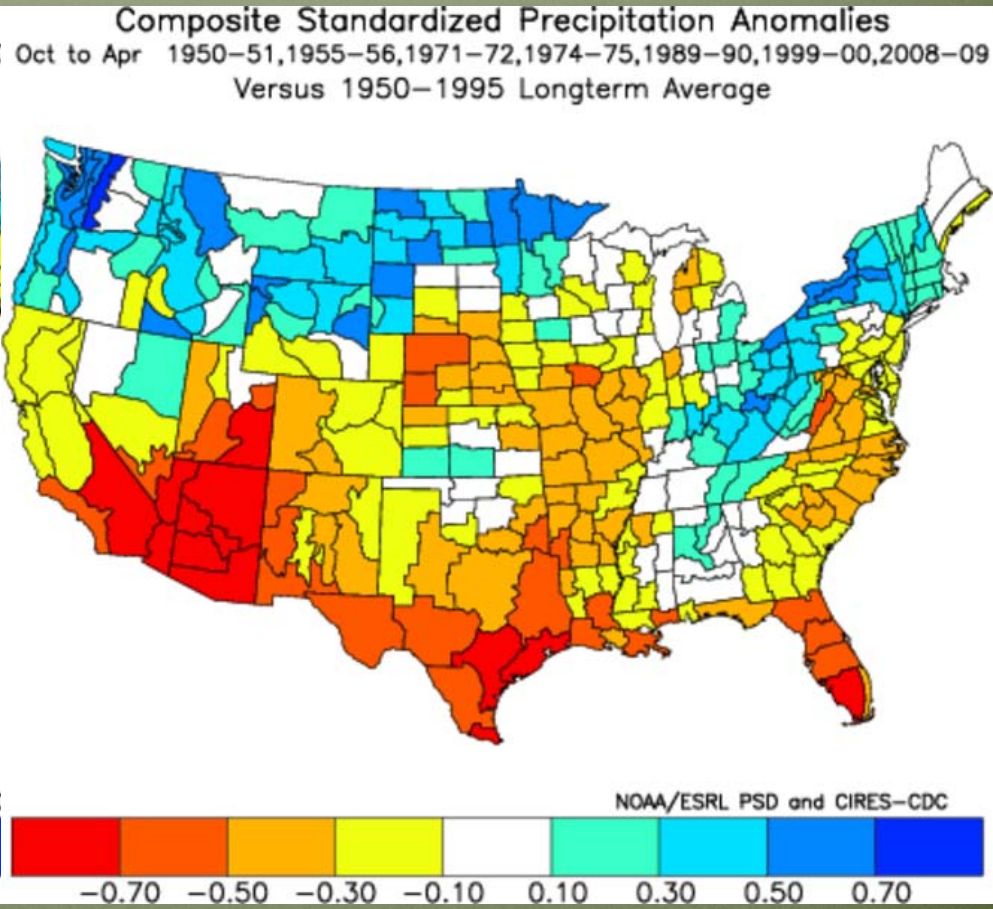




A little refresher on seasonal ENSO impacts: our mountains tend to be WET with La Niña rather than El Niño during WINTER only - spring goes back to being dry with La Niña. ***This year: a wet October-November was a good set-up for our northern mountains!***

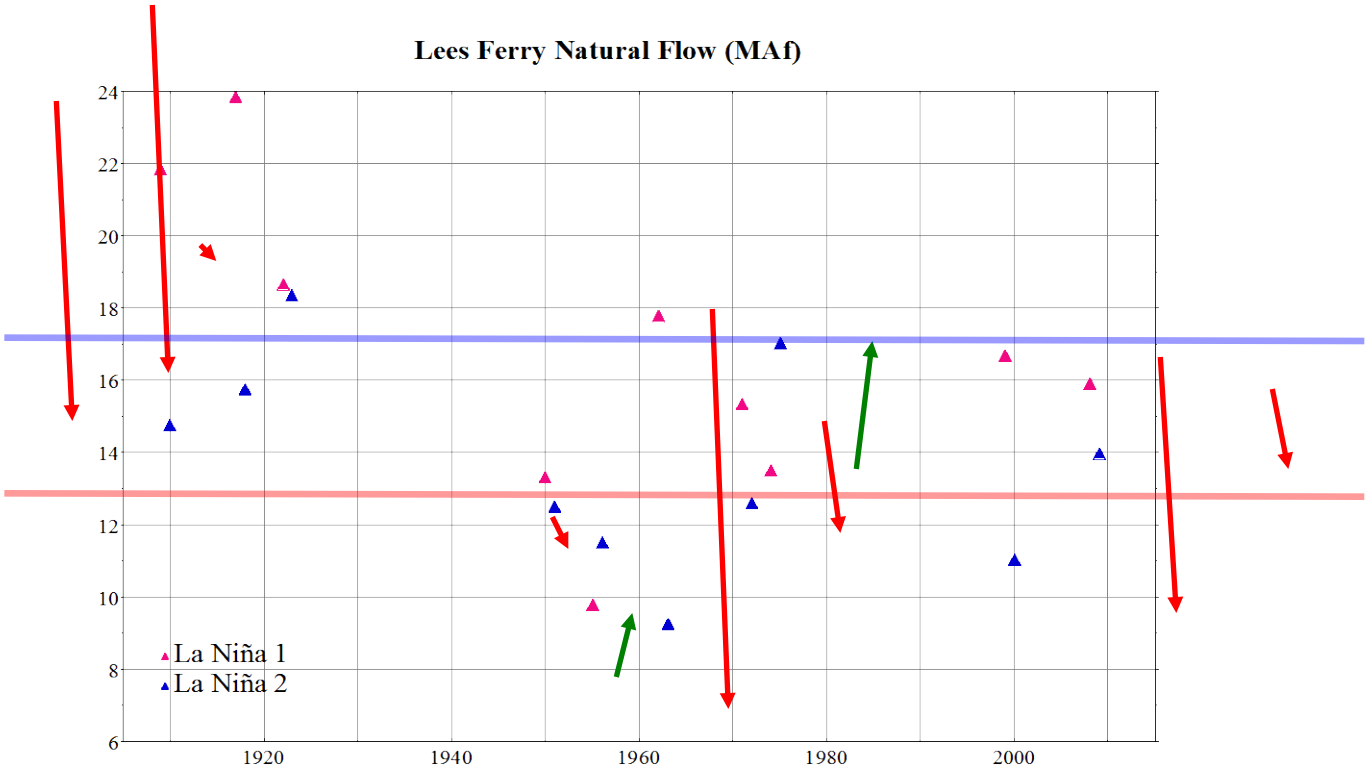
What is difference for Year 1 vs. Year 2 Las Niñas?





For Upper Basin, the second snow accumulation season (right) tends to be drier than the first one (left) in prolonged La Niña scenario. This is based on seven La Niña cases since 1949 with at least a tendency to continue into following winter.

What is difference for Year 1 vs. Year 2 Las Niñas?



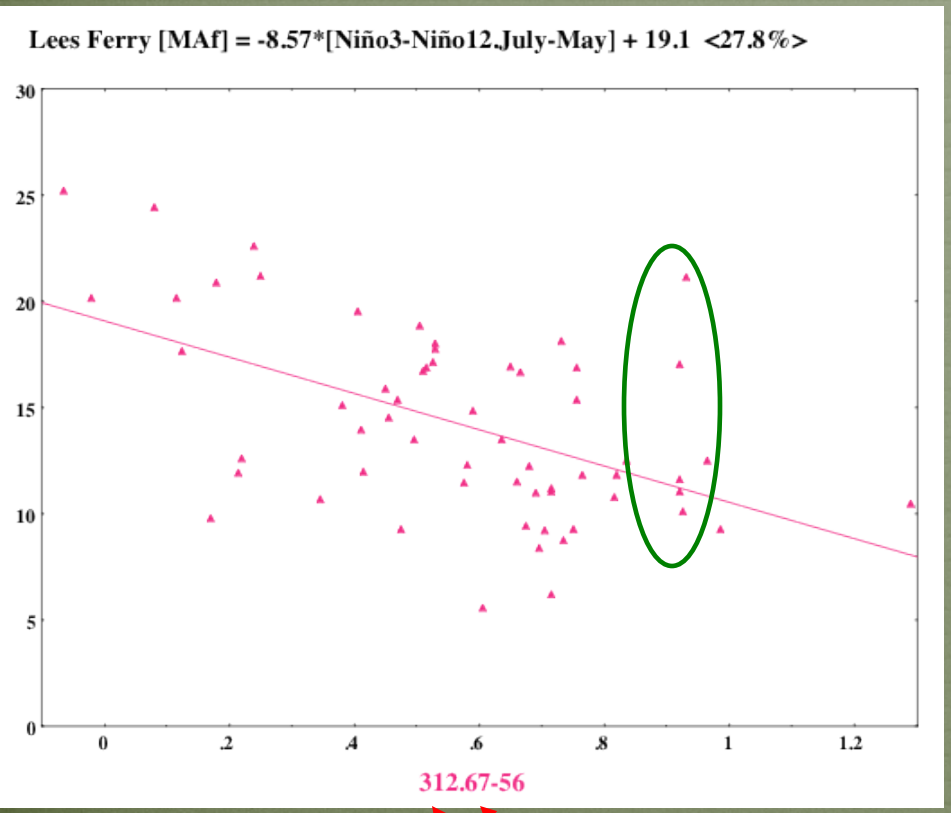
Mean flow for Year 1: 16.75 MAf (Δ= +1.7MAf)

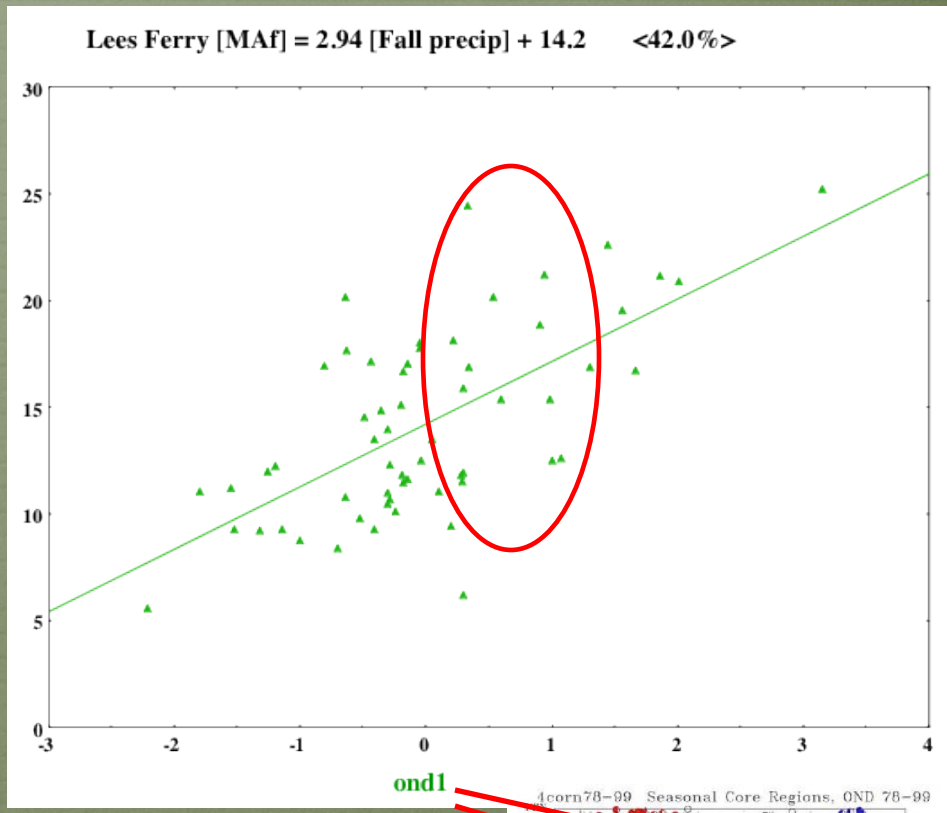
Mean flow for Year 2: 13.64 MAf (Δ= -1.4MAf)

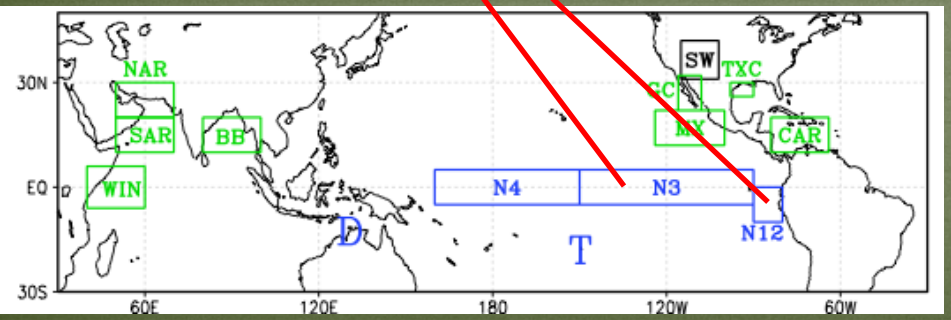
Difference is significant with more than 0.7 standard deviations!

A drier outcome has been typical (8 of 10 cases) for 2nd year runoff for the Colorado River. Six of the first year runoff totals were clearly above the long-term mean, while seven of the second year runoff totals were clearly below that.

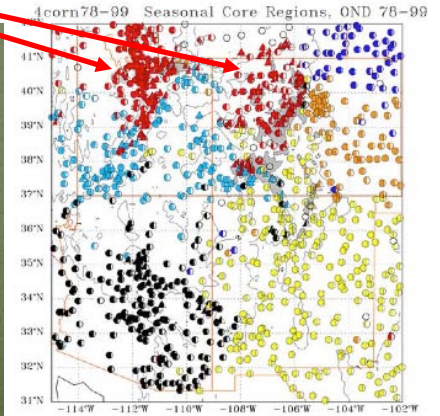
Lees Ferry naturalized runoff in Water Year 2011 - onset behavior of ENSO (left) + early season precip (right)



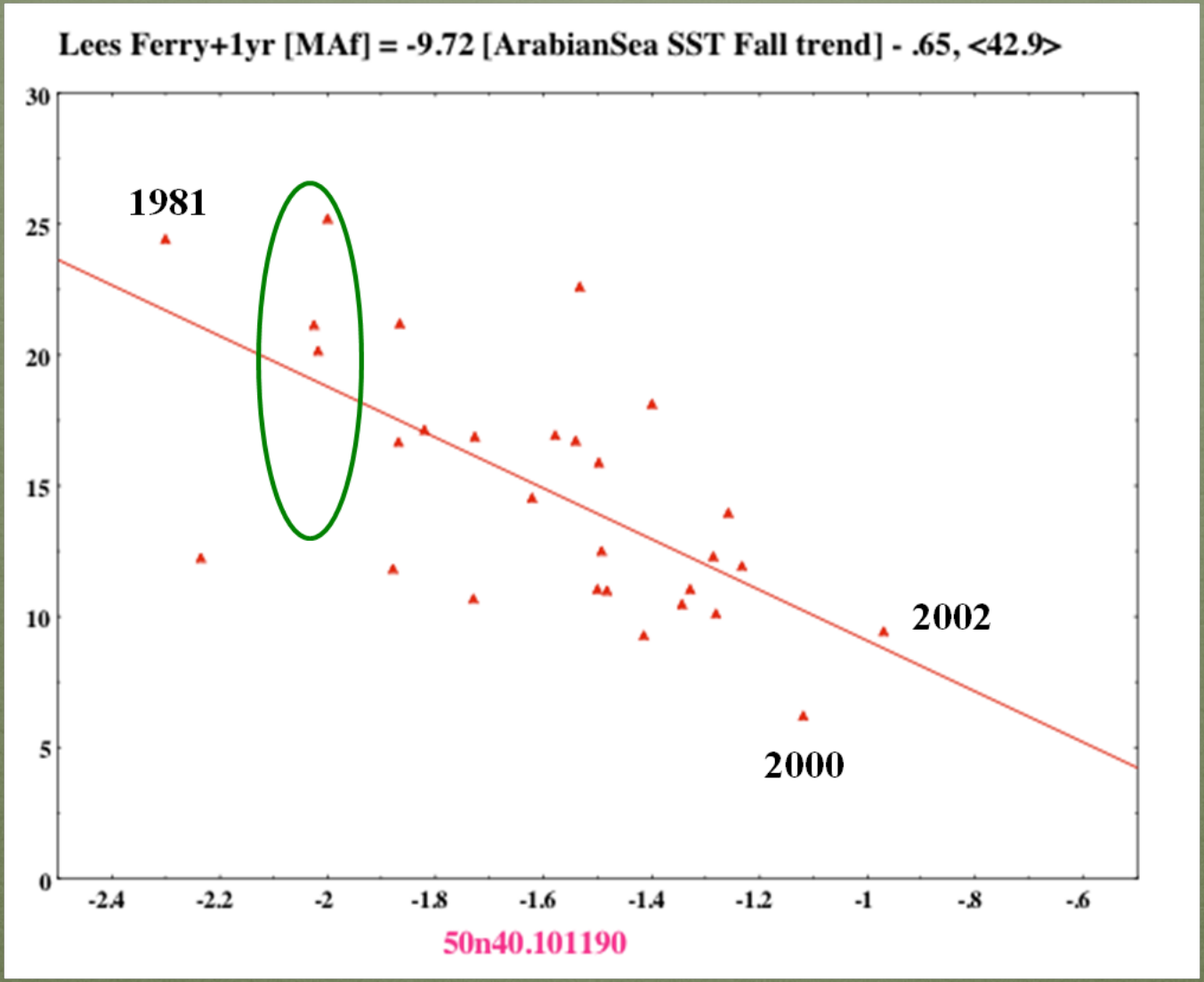




ENSO flavor favors low runoff (left), while early wetness favors high runoff (right) – so far. Need to assess what a 'near-normal' forecast has meant in the past.

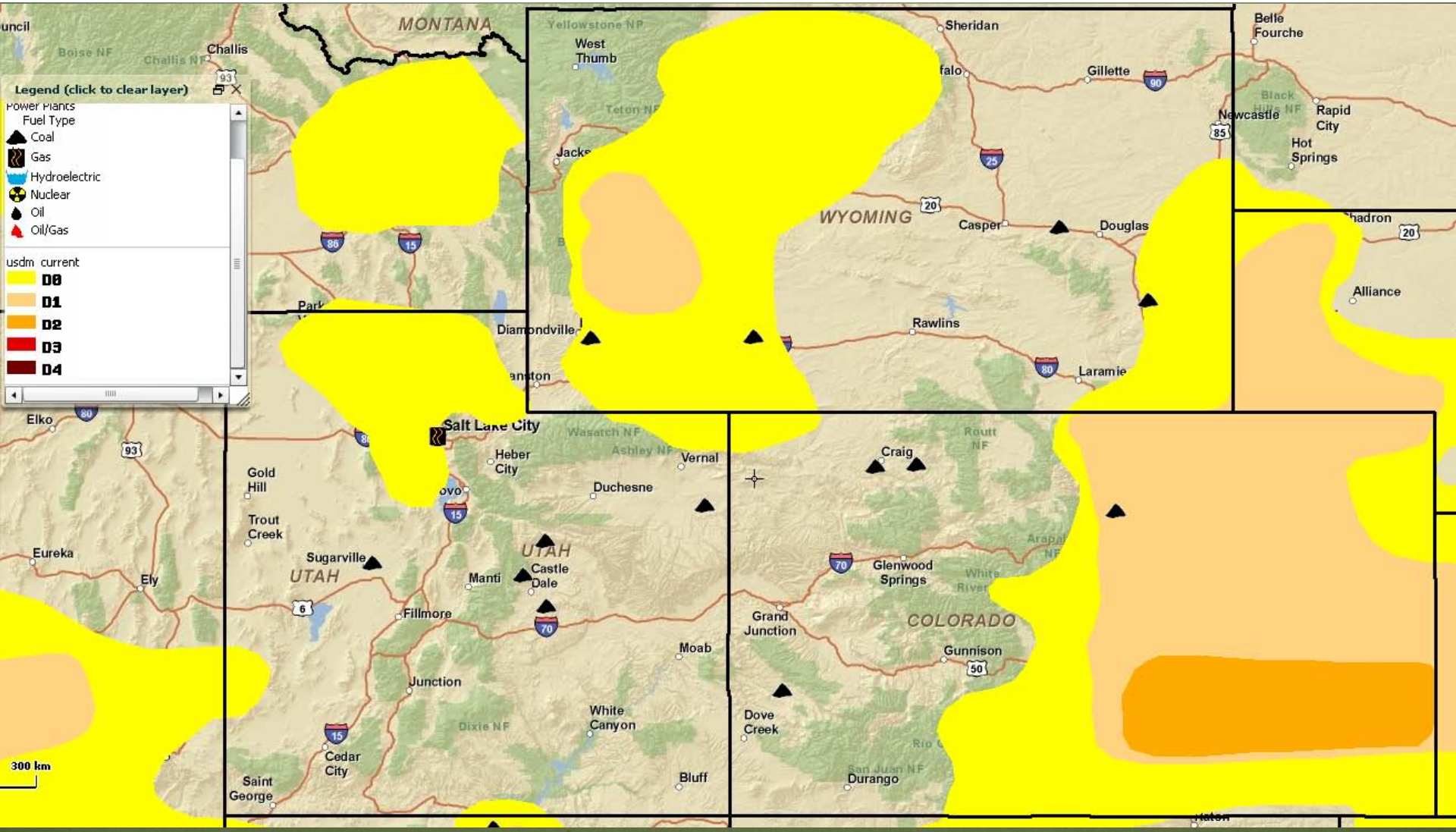


Lees Ferry naturalized runoff in Water Year 2012



Since 1980, this particular tendency in the north-south temperature difference across the Arabian Sea has been highly related to Year-2 runoff… this would favor the opposite (wet) outcome than the typical Year-2 La Niña scenario. Need to assess hindcast skill – stay tuned!

Recommendations

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For more information

NIDIS Weekly Climate, Water and Drought Assessment Summary

Upper Colorado River Basin

December 7, 2010

Precipitation and Snowpack

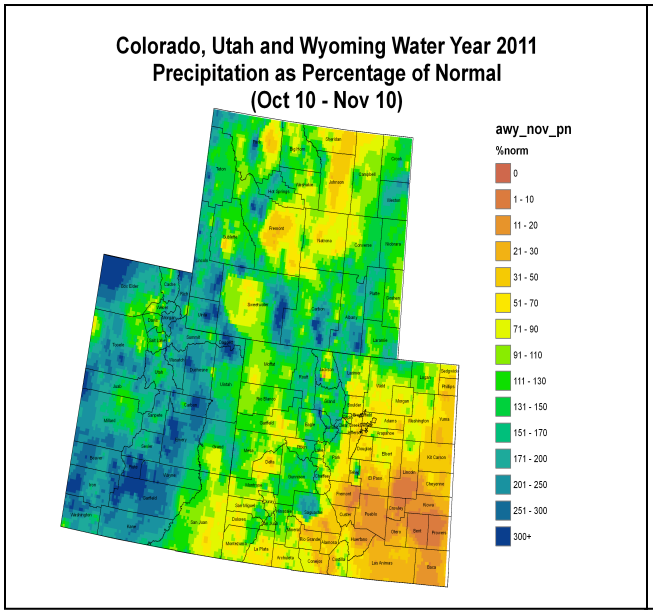


Fig. 1: WYTD precip as percent of ave.

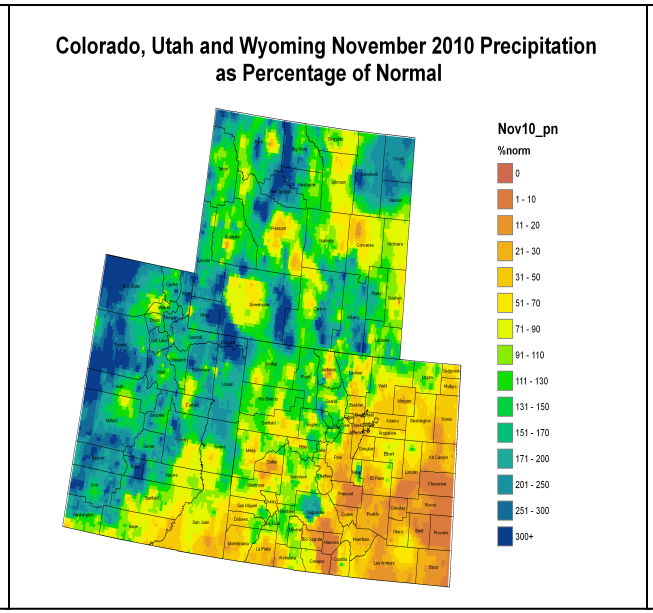


Fig. 2: November precip as percent of ave.

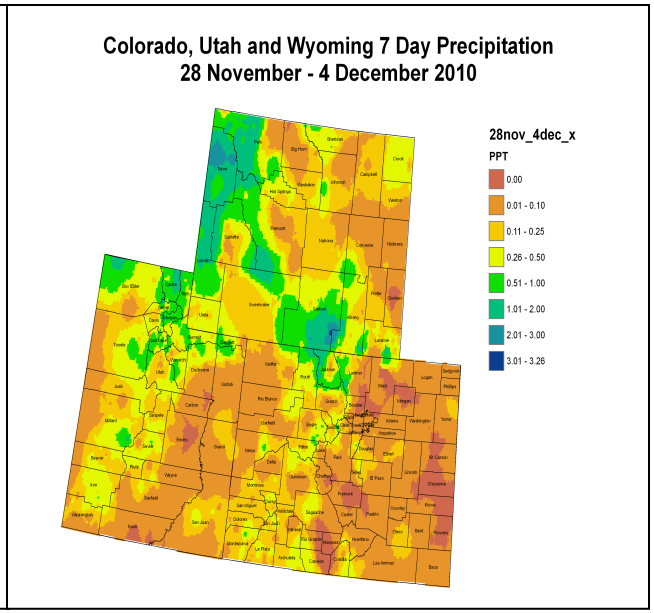


Fig. 3: Nov. 28 – Dec. 4 precip in inches.

For the current water year (October – November 2010), the western portion of the Upper Colorado River Basin (UCRB) has received plenty of moisture with several counties in Utah seeing over 200% of average (Fig. 1). For the water year, and also for the month of November, the eastern plains of Colorado, the Rio Grande basin, and the four-corners region have been abnormally dry (Fig. 2). Parts of Sweetwater County, WY were also fairly dry for the month of November.

Last week, precipitation was mostly confined to the northern portion of the UCRB (Fig. 3). Parts of the Lower and Upper Green River basins received anywhere from a quarter of an inch to an inch of moisture for the past week. Areas of the North Platte basin received over an inch of precipitation. Much of the central part of the UCRB, the CO eastern plains and the Rio Grande basin stayed fairly dry for the week, with less than a tenth of an inch recorded throughout most of these areas.

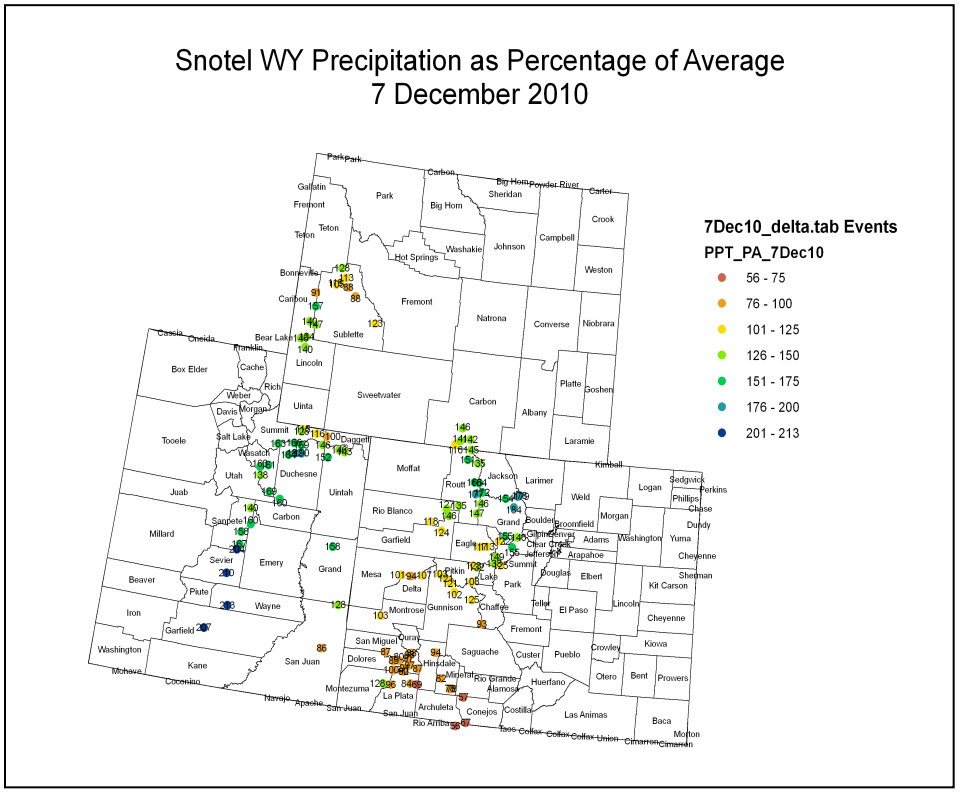


Fig. 4: SNOTEL WYTD precipitation percent of average.

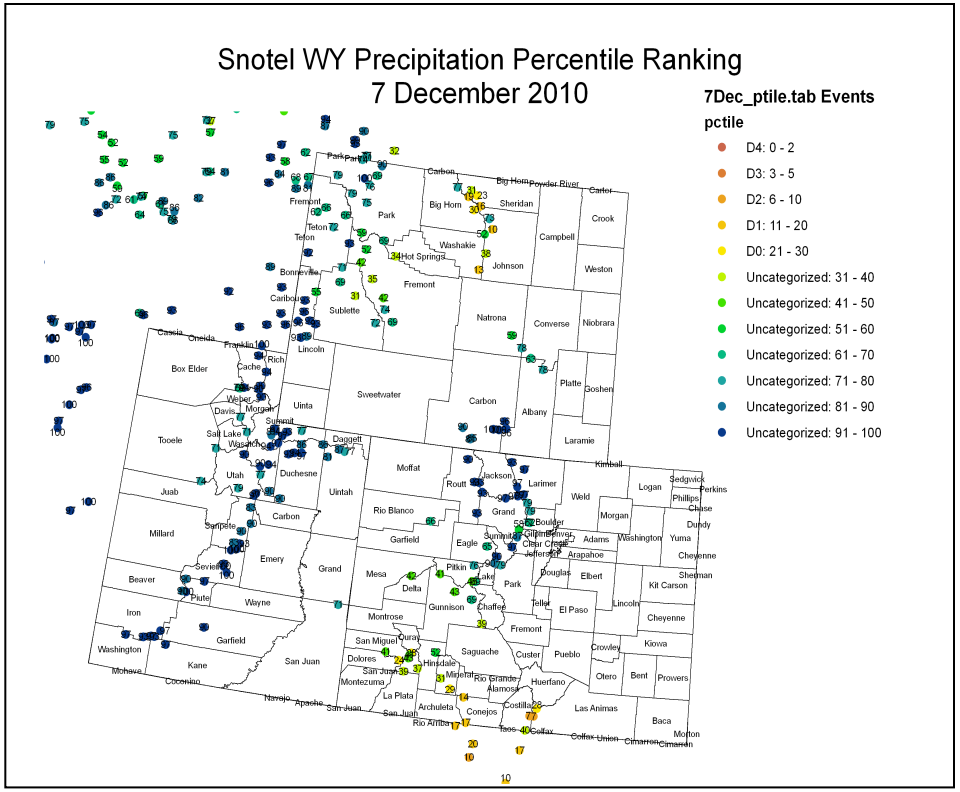


Fig. 5: SNOTEL WYTD precipitation percentiles (50% is median, 21-30% is Drought Monitor's D0 category).

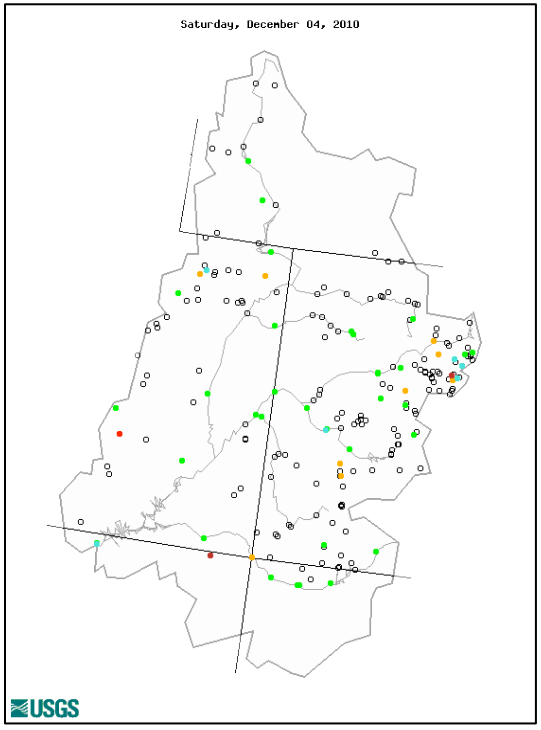
Though much of the central UCRB received below average precipitation for the week, the Colorado headwaters region still shows water-year-to-date (WYTD) percents of average over 100 (Fig. 4); much of the western UCRB in Utah is still over 150% of average for the water year. SNOTEL sites in the San Juan basin have received less than 100% of average precipitation for the water year. The Upper Green River basin saw some improvements this past week, with most sites now recording near 100% of average for the water year.

Percentile rankings for the SNOTEL stations around the UCRB show most stations ranked fairly high (Fig. 5). Aside from several stations in the Rio Grande basin, most stations are showing percentiles in the 70s to 90s—meaning less than thirty percent of the water years on record have been wetter by this time. The lowest percentiles in the south match up with areas of lowest percents of average, meaning that it is rare for these areas to have such dry beginnings to the water year.

Streamflow

As of December 4th, about 76% of the USGS streamgages in the UCRB recorded normal (25th – 75th percentile) or above normal 7-day average streamflows (Fig. 6). Though an increasing number of streams have frozen over, the majority of gages still recording show decent 7-day average flows for this time of year. The Colorado headwaters region currently has the highest density of gages reporting below normal flows.

Looking at hydrographs around the UCRB, key sites are showing near normal discharges and look pretty good in terms of seasonal flow conditions (Fig. 7). 7-day average discharge at the Colorado River at the CO-UT state line is at 84% of normal, while discharges on the Green River at Green River, UT and on the San Juan River near Bluff, UT are both over 90% of normal. All three gages show 7-day average discharge within the normal percentile range, though all show below normal cumulative runoff for the calendar year. The San Juan River site is likely to see only 50% of its normal cumulative runoff for the calendar year.



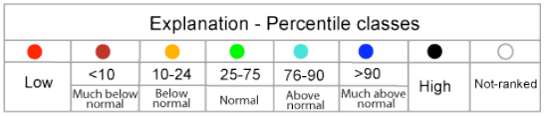


Fig. 6: USGS 7-day average streamflow compared to historical streamflow for December 4th in the UCRB.

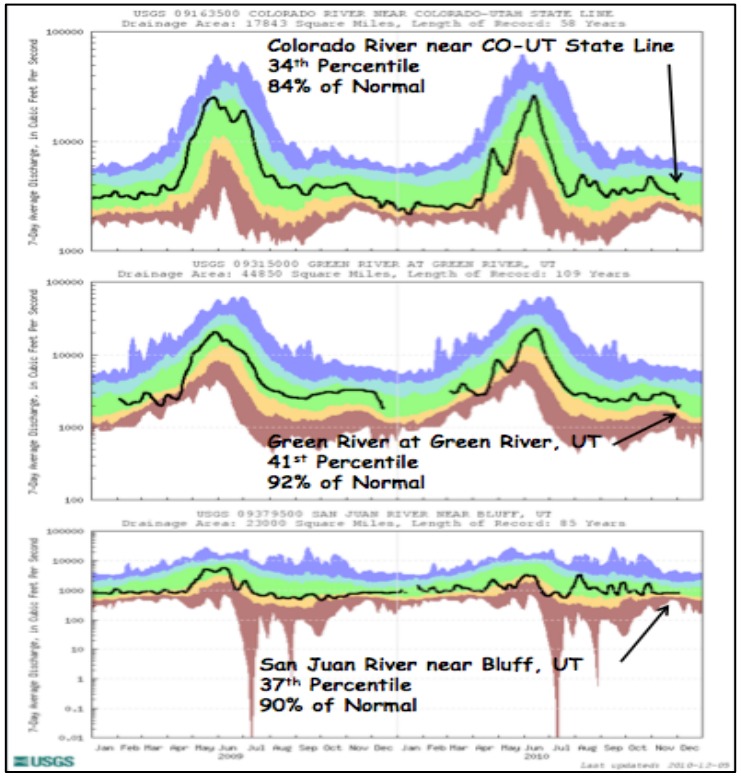


Fig. 7: USGS 7-day average discharge over time at the CO-UT state line (top), Green River, UT (middle) and Bluff, UT (bottom).

Water Supply and Demand

Last week saw a return to above average temperatures for the UCRB. The northern region of the UCRB was the warmest with anomalies of +4° to +6°F. The eastern plains saw closer to average temperatures for the week. Soil conditions have continued to deteriorate just east of the UCRB, in the plains of Colorado (Fig. 8), and dry soil conditions are also still showing up in northwestern NM.

Most of the reservoirs in the UCRB stayed fairly steady over the past week, with storage drops of less than 1,000 acre feet. Only Lake Powell, Lake Dillon, and Green Mountain Reservoir are below average for this time of year. Even though below average, both Lake Dillon and Green Mountain saw November releases that were much less than normal releases for this time of year. Many of the other reservoirs also experienced much smaller releases than is normal for November, including Blue Mesa—storage for November increased by over 3,000 acre feet though normally its storage decreases by 47,000 acre feet from November to December. Lake Powell (currently at 78% of average and 62% of capacity) released more than what was projected for November, but inflows into the reservoir were also greater than projected.

Precipitation Forecast

Next week, the northern portion of the UCRB has the best possibility of receiving precipitation, though totals could be lower than what recent storms have brought to the region. The southern part of the UCRB and the plains east of the UCRB could remain fairly dry over the next week. After this week, longer range forecasts show the possibility for drier conditions across the region with only small chances for precipitation.

The La Nina has recently strengthened after about a month of weakening. During the winter, La Nina is likely to provide wetter conditions for the northern mountains of the UCRB with drier than average conditions common in the spring for most of the UCRB. With this year's strong La Nina, it is likely that the La Nina will continue into 2012, and the second consecutive years of La Nina are consistently drier than the first (Fig. 9). However, there could be some ambiguity in this second year forecast. Another recent study has shown a correlation between temperature differences in the Arabian Sea and precipitation in the UCRB which would suggest the possibility for a wetter second year.

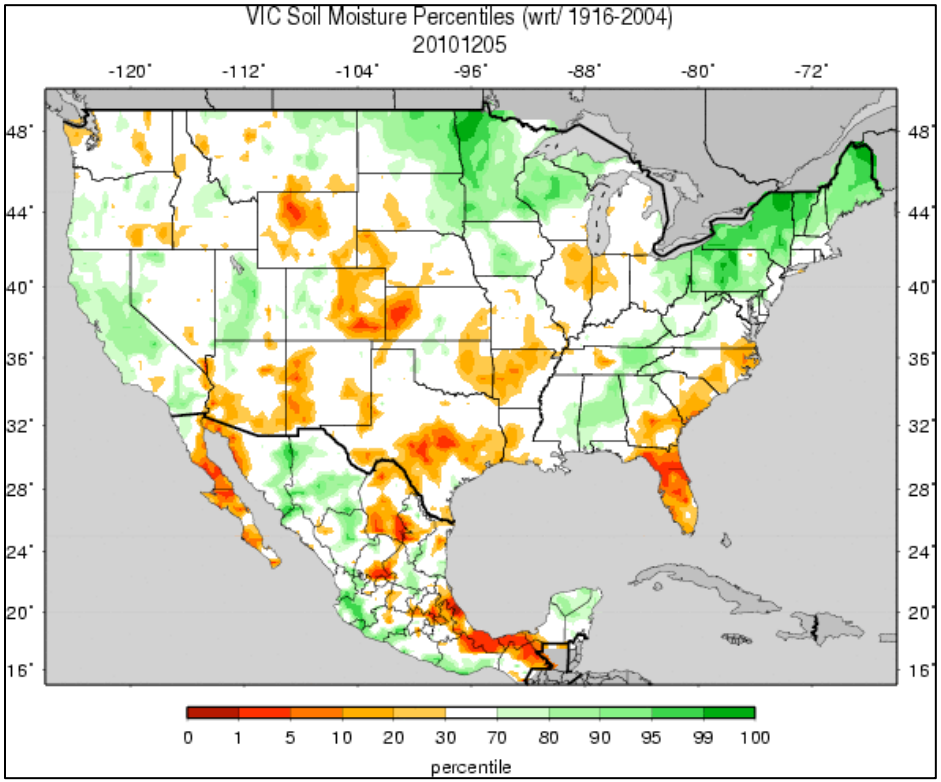


Fig. 8: VIC soil moisture percentiles as of December 5th.

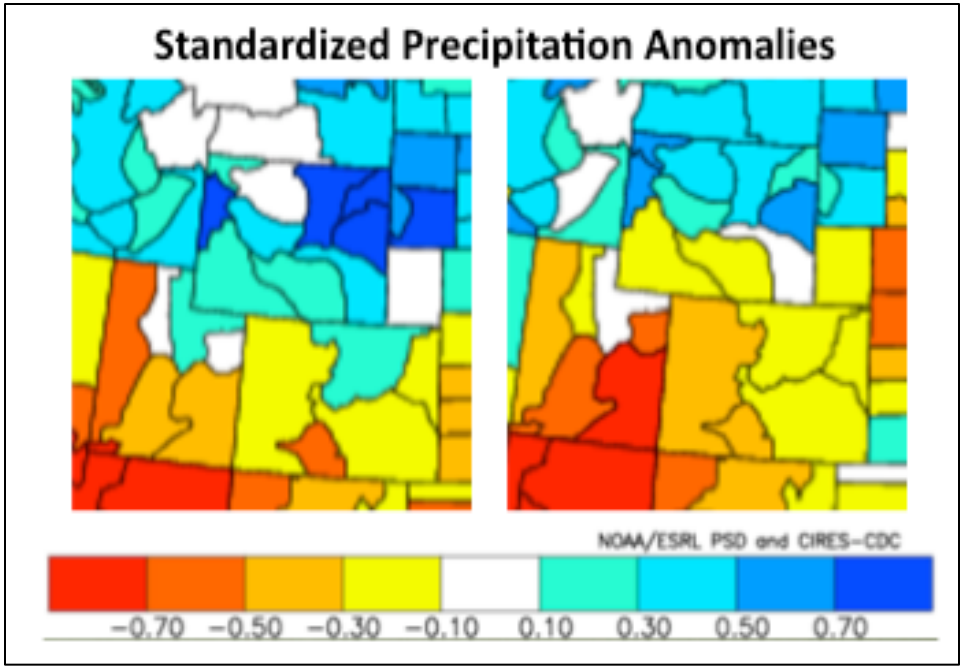
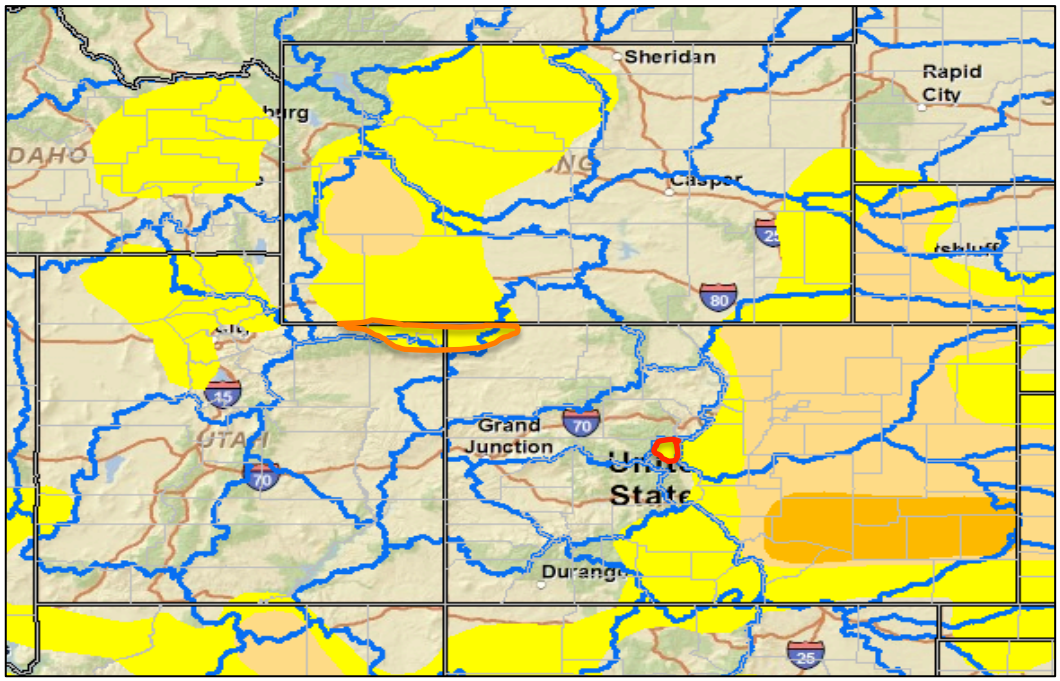
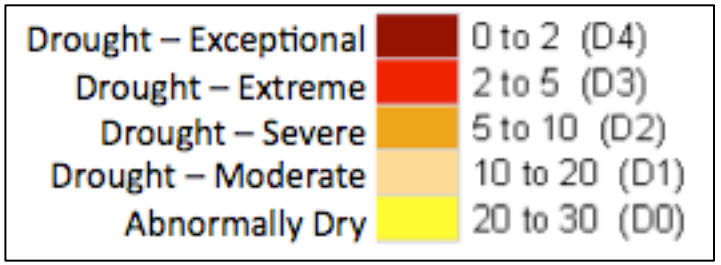


Fig. 9: Standardized precipitation anomalies for first year La Ninas (left) and second year La Ninas (right) compared to the long term average.

Drought and Water Discussion





Drought categories and their associated percentiles

Fig. 10: November 30th release of U.S. Drought Monitor for the UCRB

A couple of suggestions have been made for the current U.S. Drought Monitor map (Fig. 10). First, the removal of D0 from Lake County, CO has been suggested (Fig. 10, red line). According to the Pueblo NWS office, Climax, CO in the region is currently at 136% of average precipitation for August – November.

It has also been suggested that D0 be removed from northeastern UT and northwestern CO (Fig. 10, orange line). Poor soil conditions in southwestern WY do not extend into CO or UT. Streamflow and SNOTEL in the area seem to be in good condition. Unfortunately, precipitation data are rather sparse in the area, so it is difficult to know exactly how to define the boundary between D0 and nothing.