CBRFC Water Supply Webinar
December 5, 2013

CBRFC Staff
(Kevin Werner, Ashley Nielson, Brenda Alcorn, Stacie Bender, Tracy Cox, Greg Smith, Brent Bernard)

These slides: http://www.cbrfc.noaa.gov/present/present2012.cgi

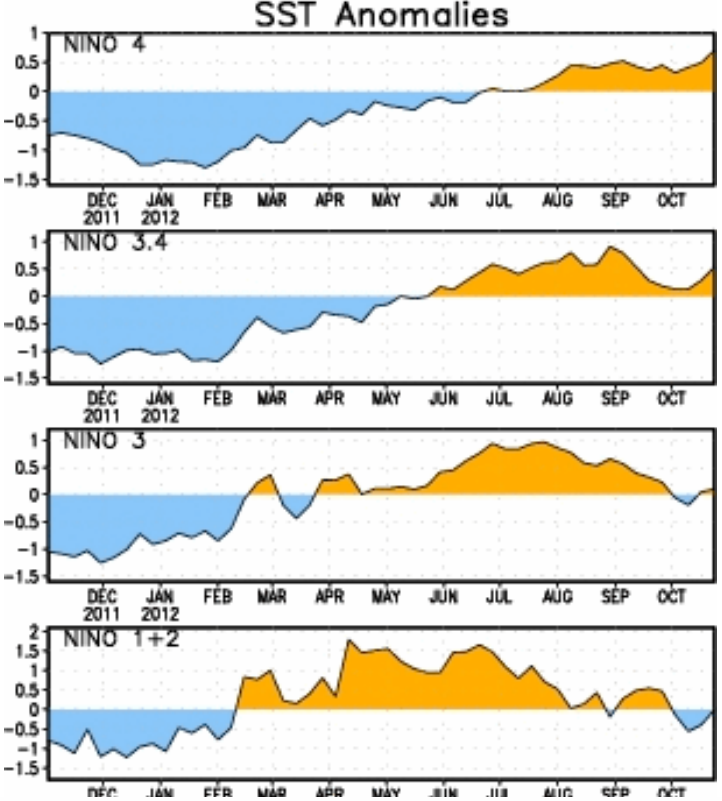
Outline

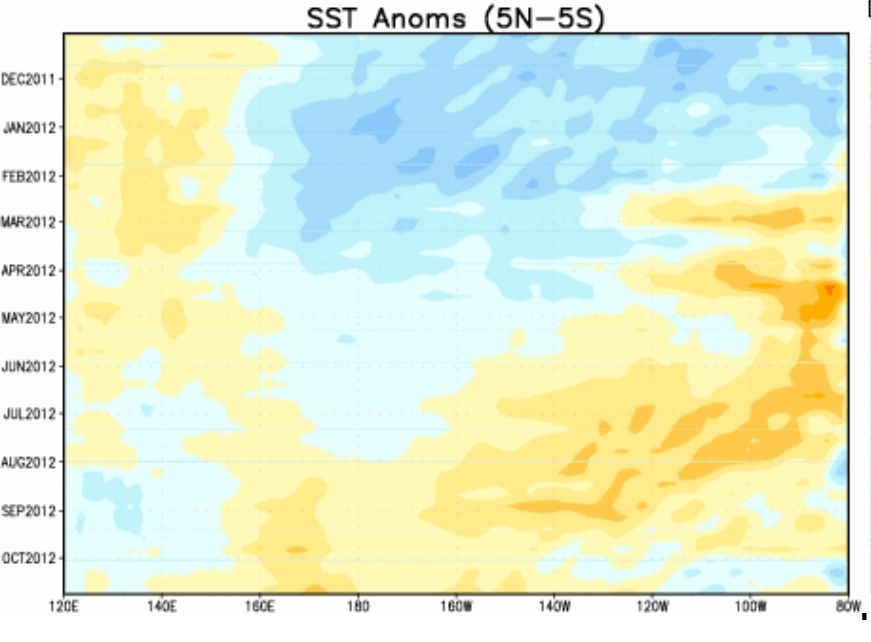
- 2013 Year in review
  - Weather/climate
  - Water supply forecast verification
  - Additional Verification resources
- 2014 Look ahead
  - Climate forecasts
  - Antecedent conditions
  - Putting it altogether
- CBRFC update

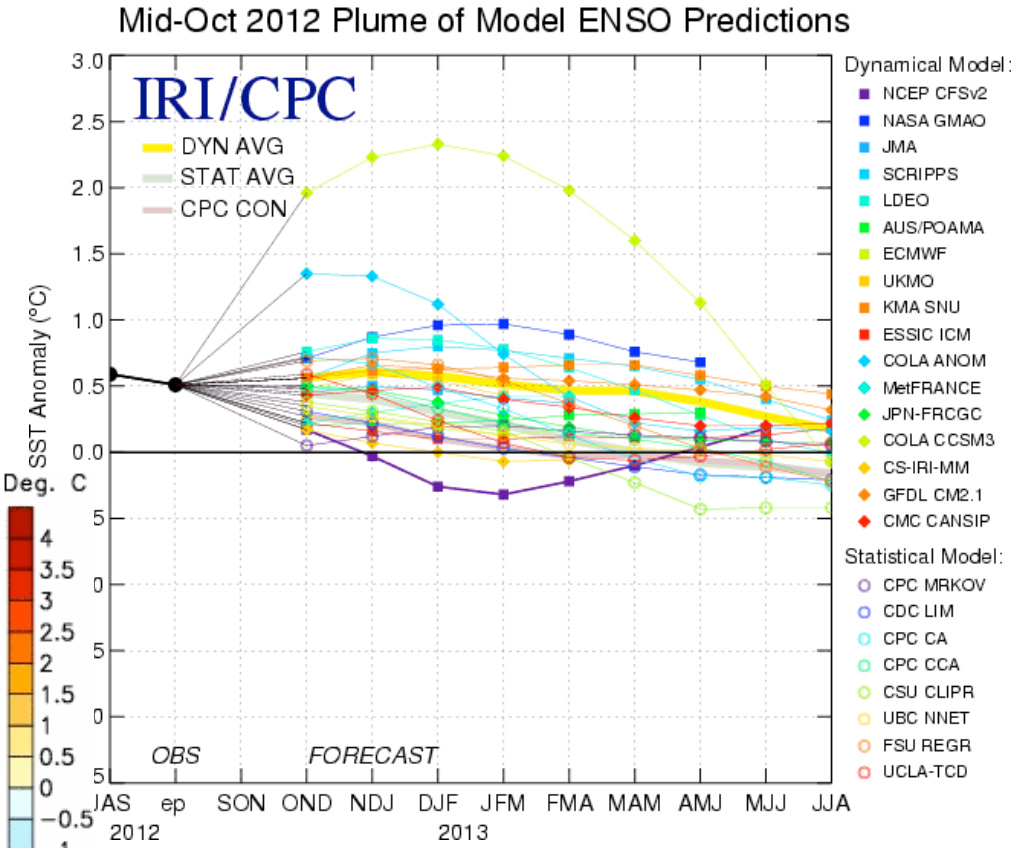
2013 Year in Review

- Climate forecasts
- Precipitation, Temperature, and Snowfall Review
- Water Supply Forecast Verification
- Additional Verification Resources

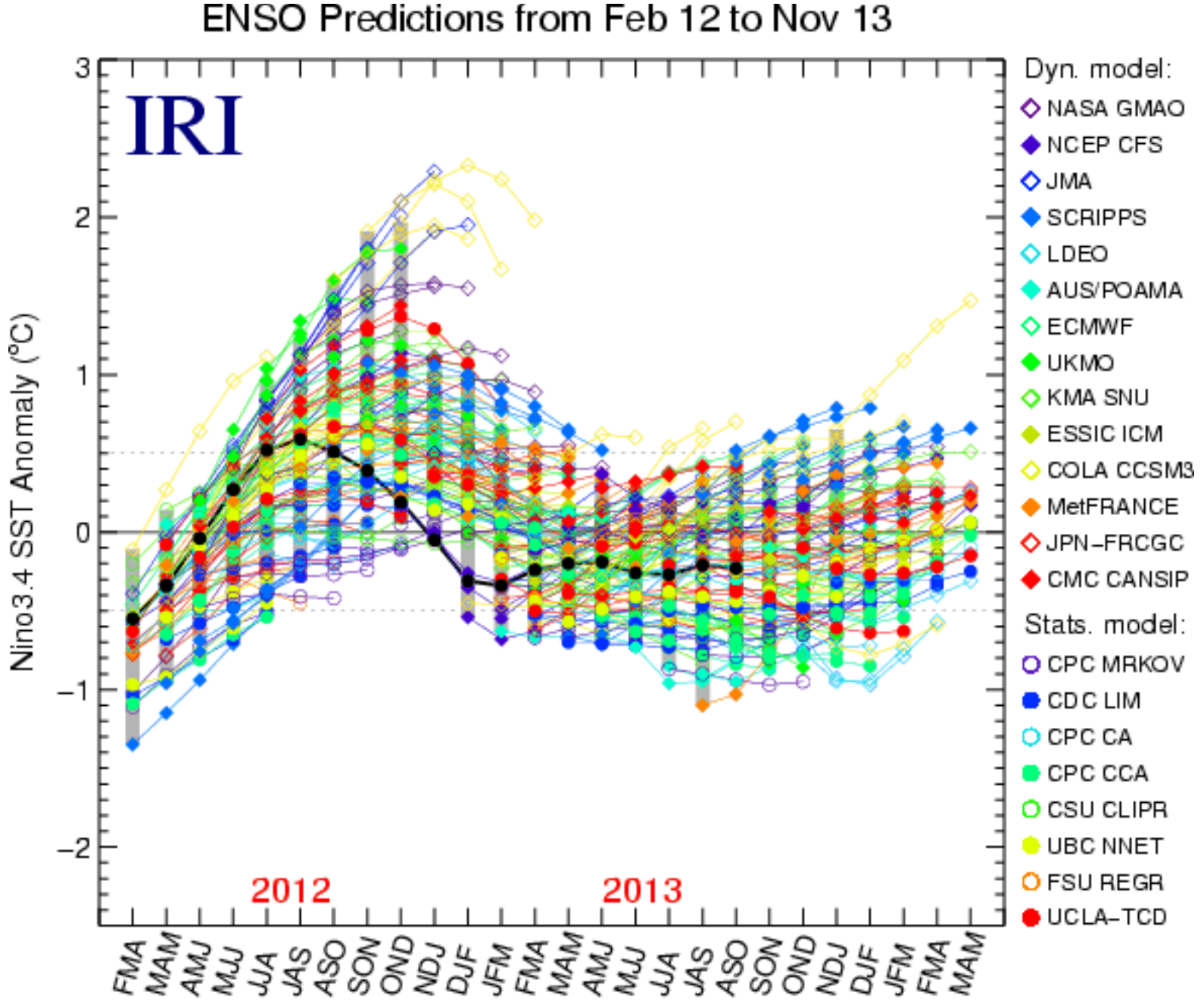
ENSO Neutral

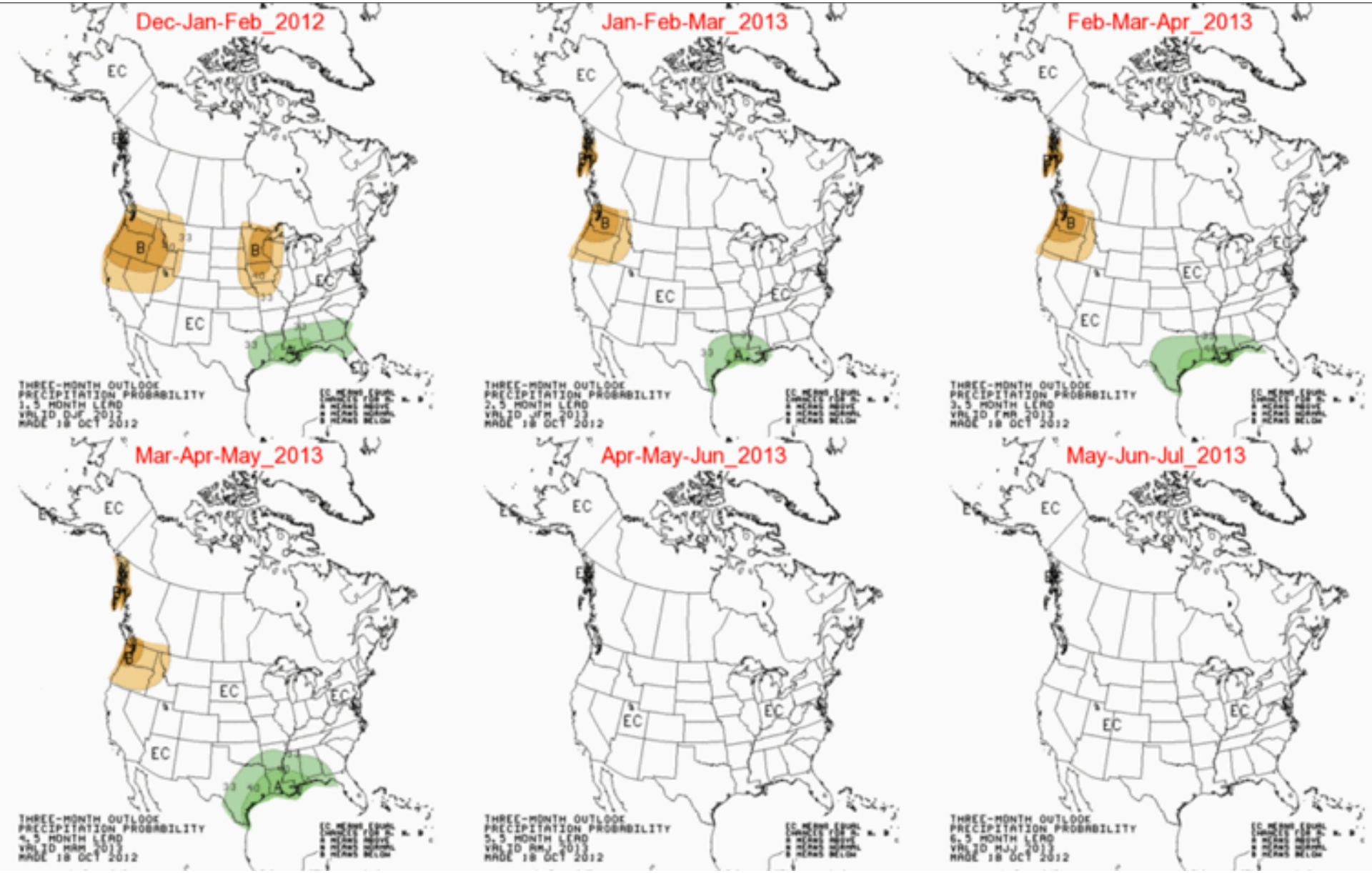




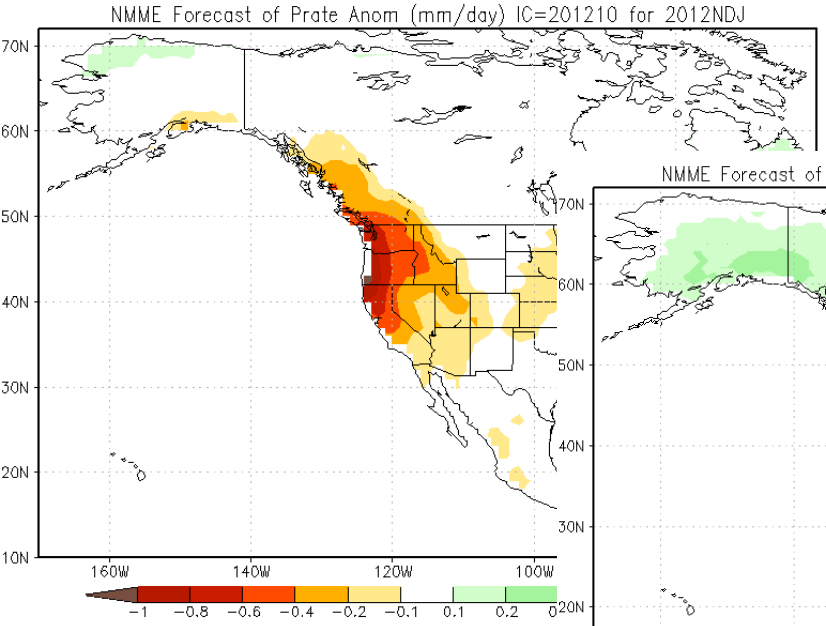


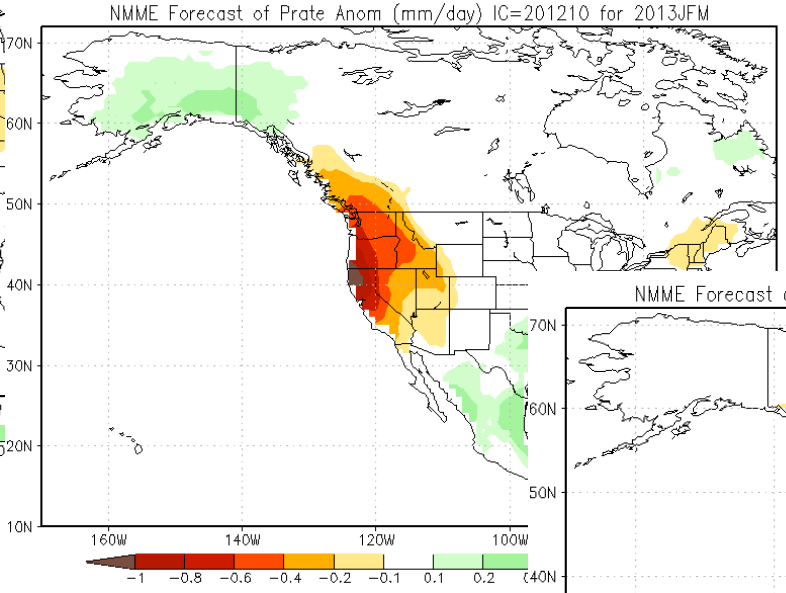
...ces: cpc.ncep.noaa.gov and
...lumbia.edu/climate/ENSO

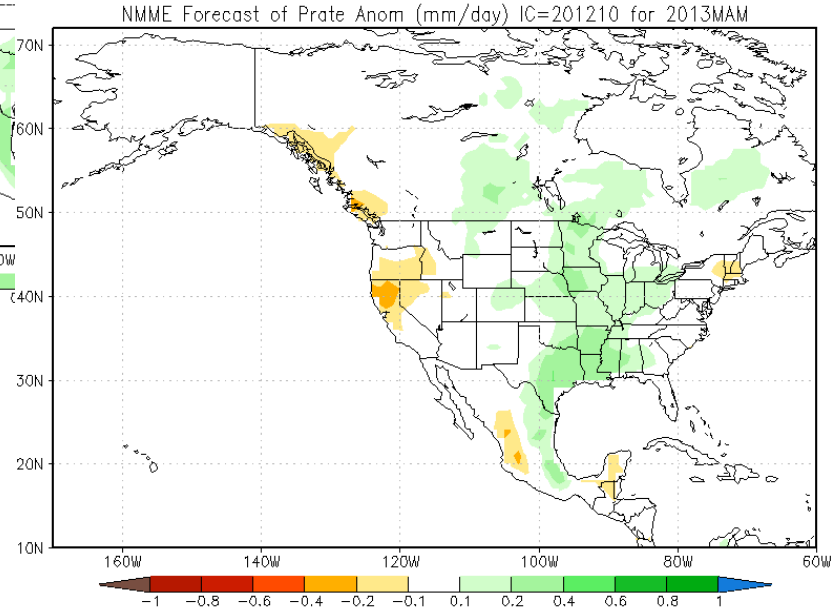

ENSO Predictions from Feb 12 to Nov 13
IRI
Nino3.4 SST Anomaly (°C)
3
2
1
0
−1
−2
2012
2013
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
Dyn. model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
COLA CCSM3
MetFRANCE
JPN−FRCGC
CMC CANSIP
Stats. model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA−TCD


Dec-Jan-Feb_2012
Jan-Feb-Mar_2013
Feb-Mar-Apr_2013
Mar-Apr-May_2013
Apr-May-Jun_2013
May-Jun-Jul_2013
EC
B
A
THREE-MONTH OUTLOOK
PRECIPITATION PROBABILITY
MADE 18 OCT 2012

National Multi Model Ensemble (NMME) 11/2012 forecasts

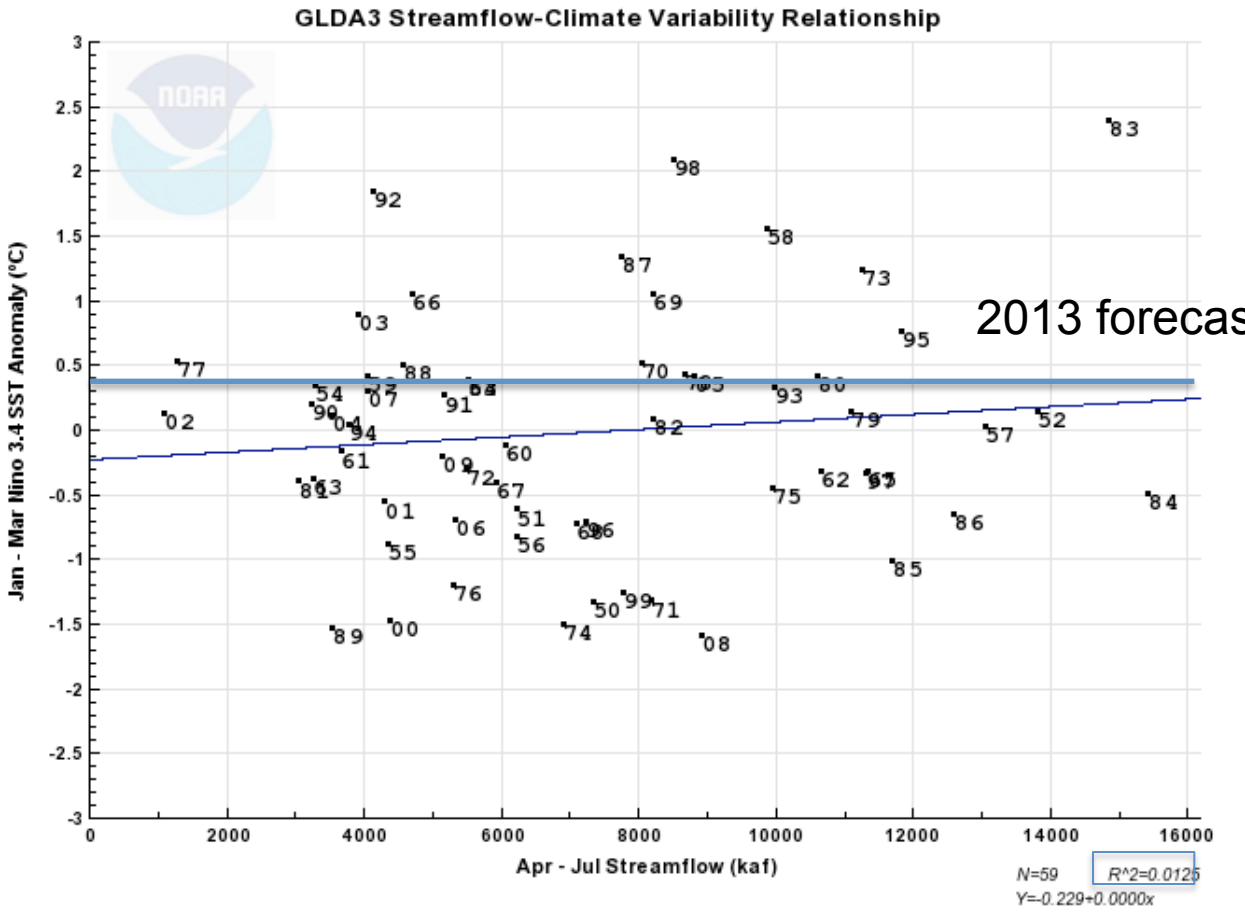




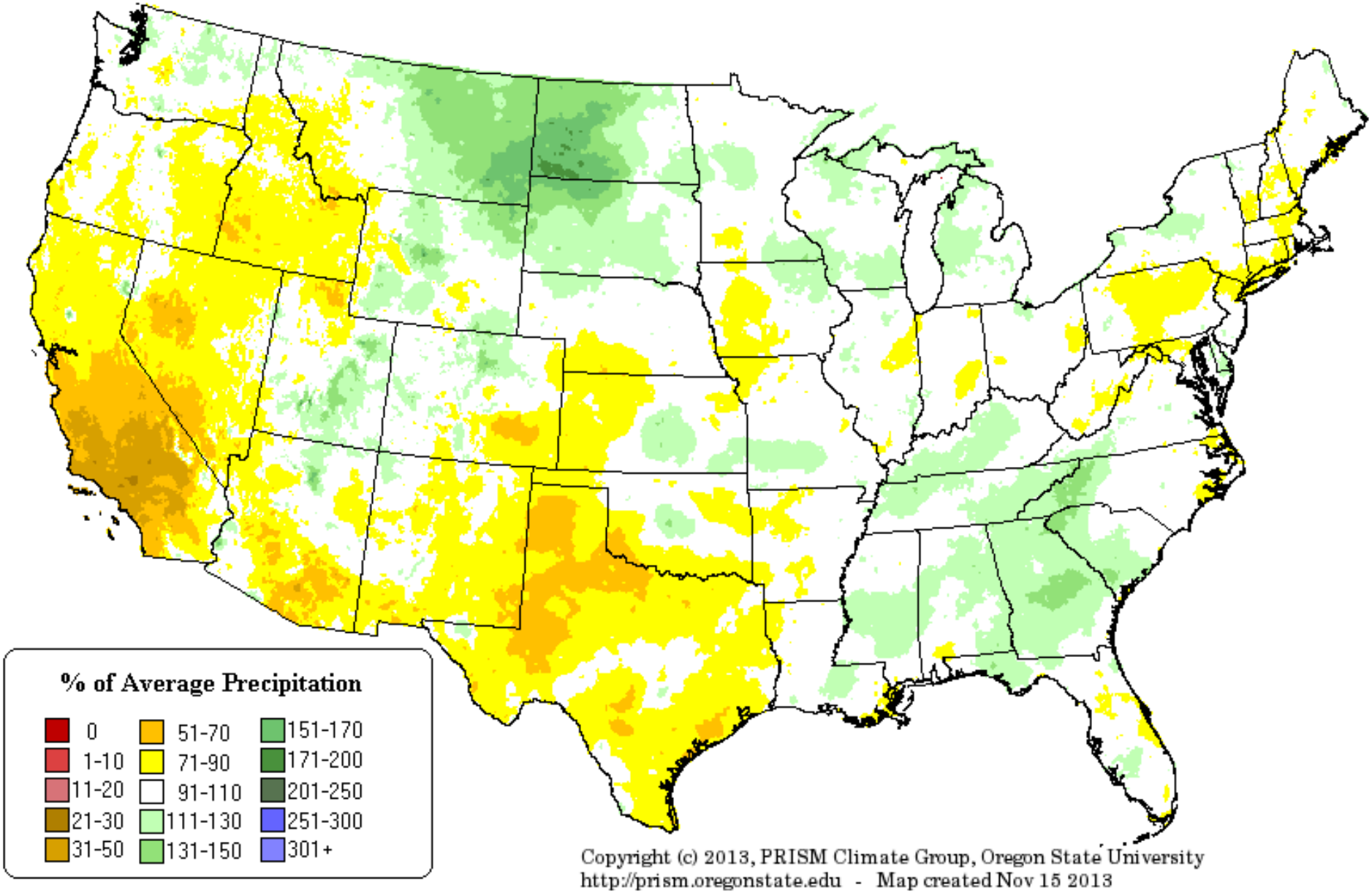


ENSO and Streamflow

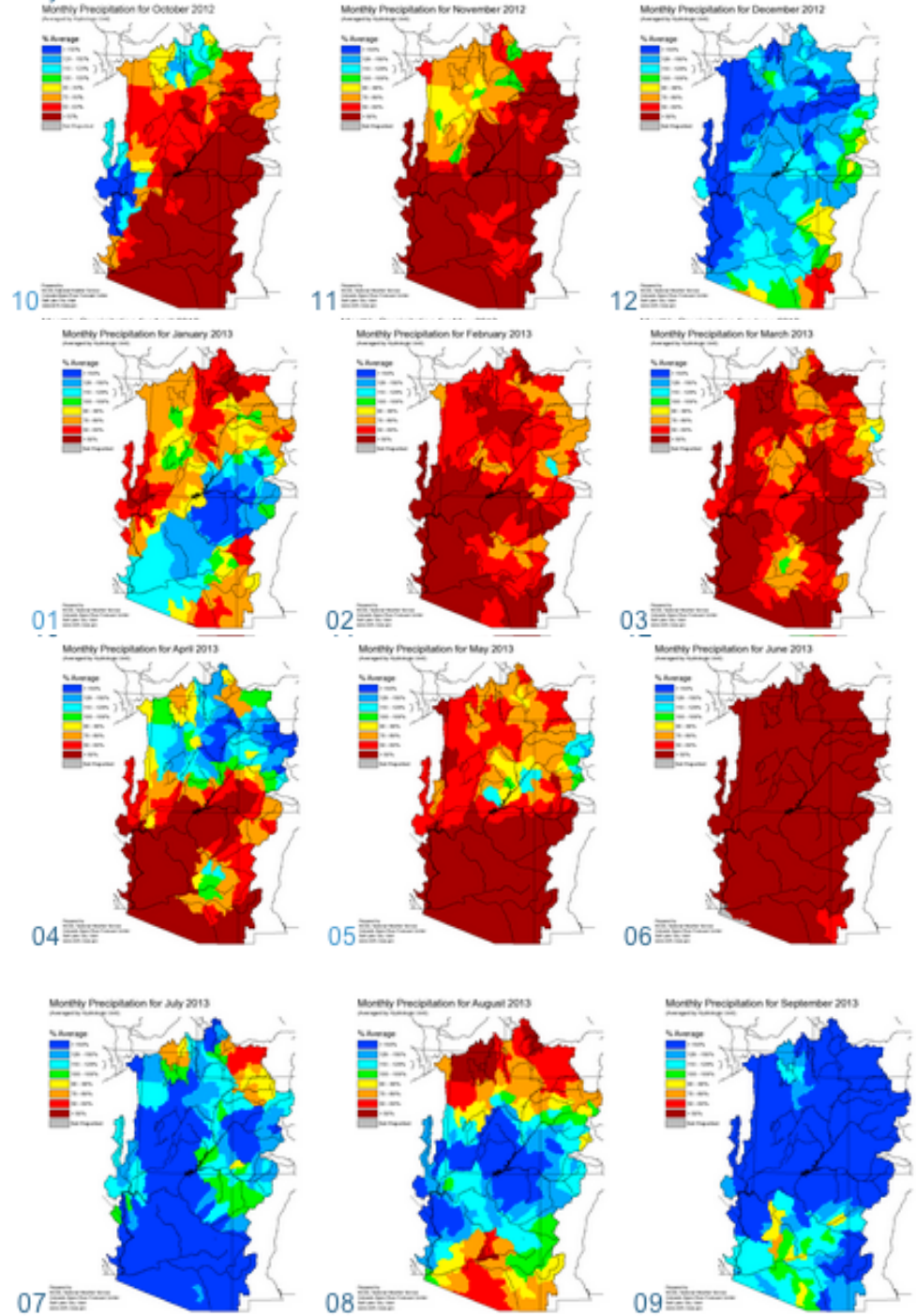
- Very low correlations in most of upper basin (right: Lake Powell)
- La Nina correlated with low streamflow in lower basin at around 0.2 – 0.3
- Weaker correlations for San Juan Basin with low streamflow and Upper Green with high streamflow



12-month Percent of Average Precipitation: Oct 2013

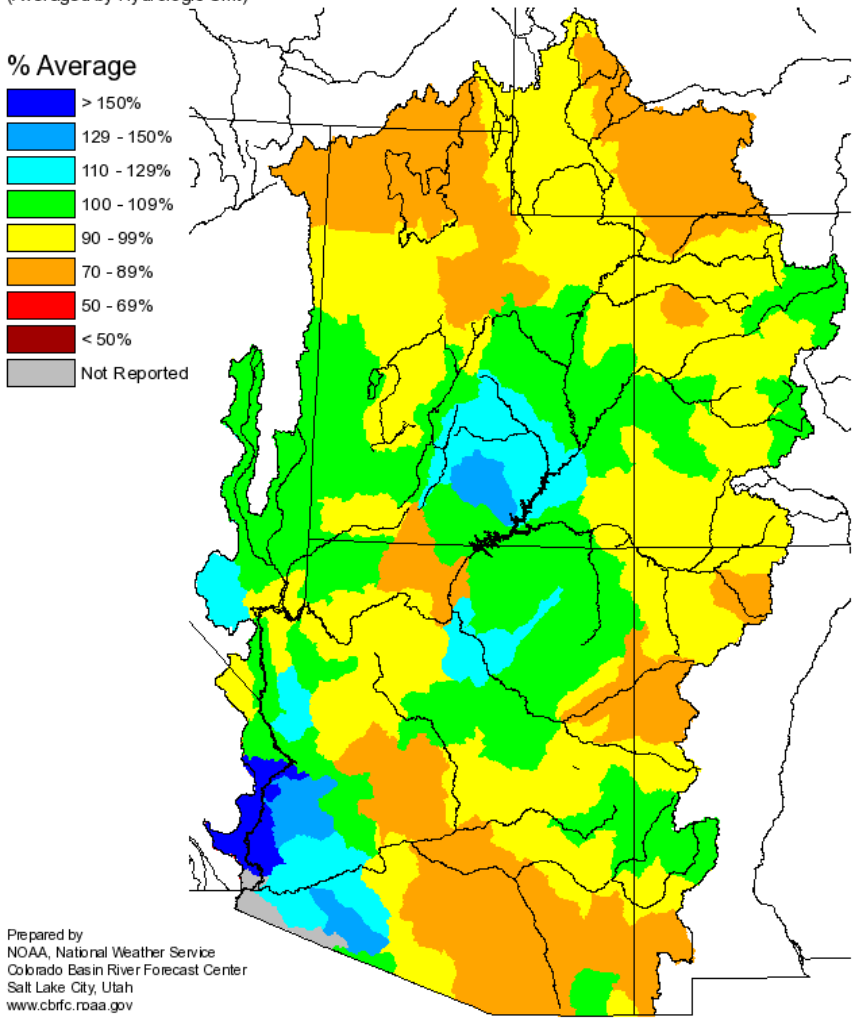


Copyright (c) 2013, PRISM Climate Group, Oregon State University
http://prism.oregonstate.edu - Map created Nov 15 2013



Seasonal Precipitation, October 2012 - September 2013

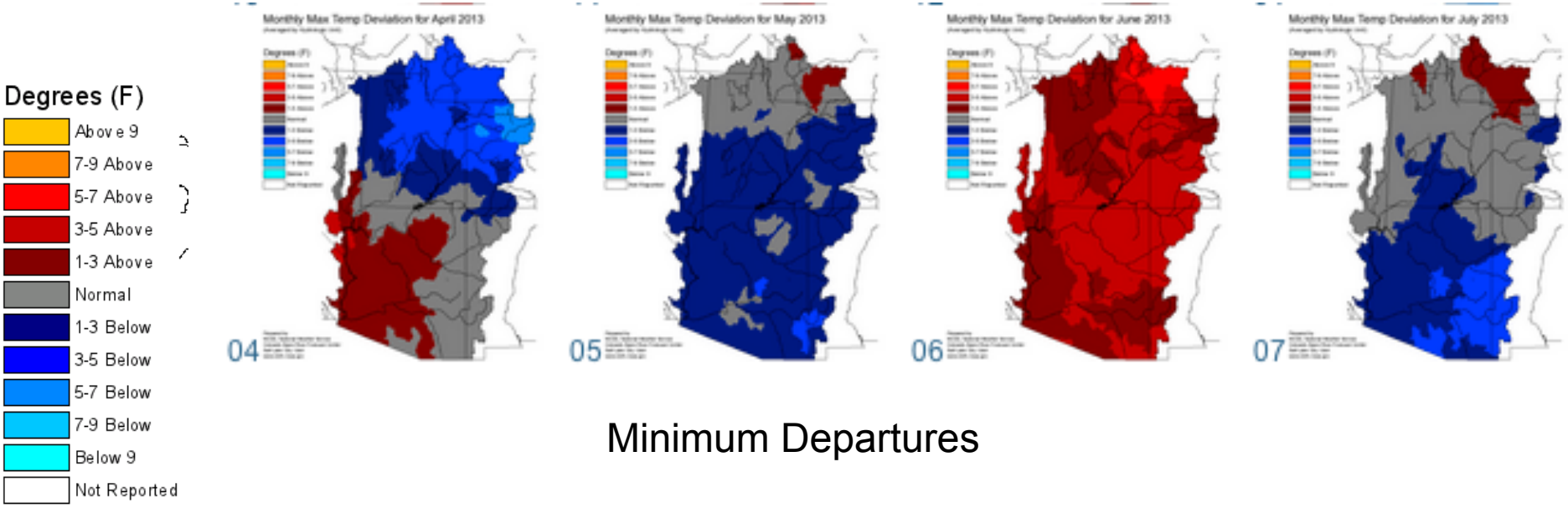
(Averaged by Hydrologic Unit)



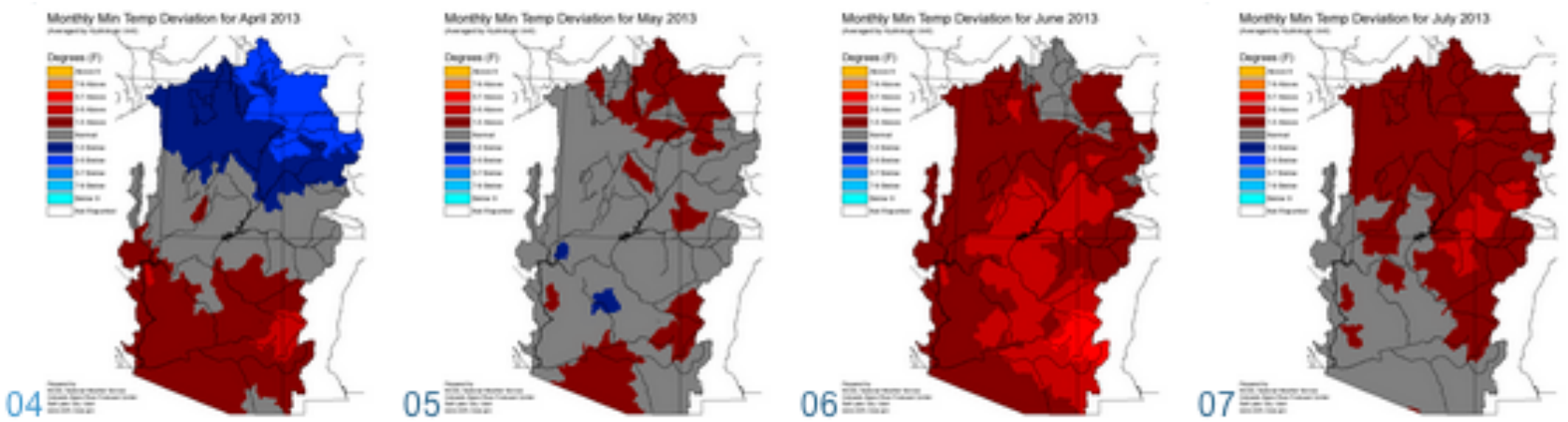
Prepared by
NOAA, National Weather Service
Colorado Basin River Forecast Center
Salt Lake City, Utah
www.cbrfc.noaa.gov

March-July Temperature Departures from Average Maximum/Minimum

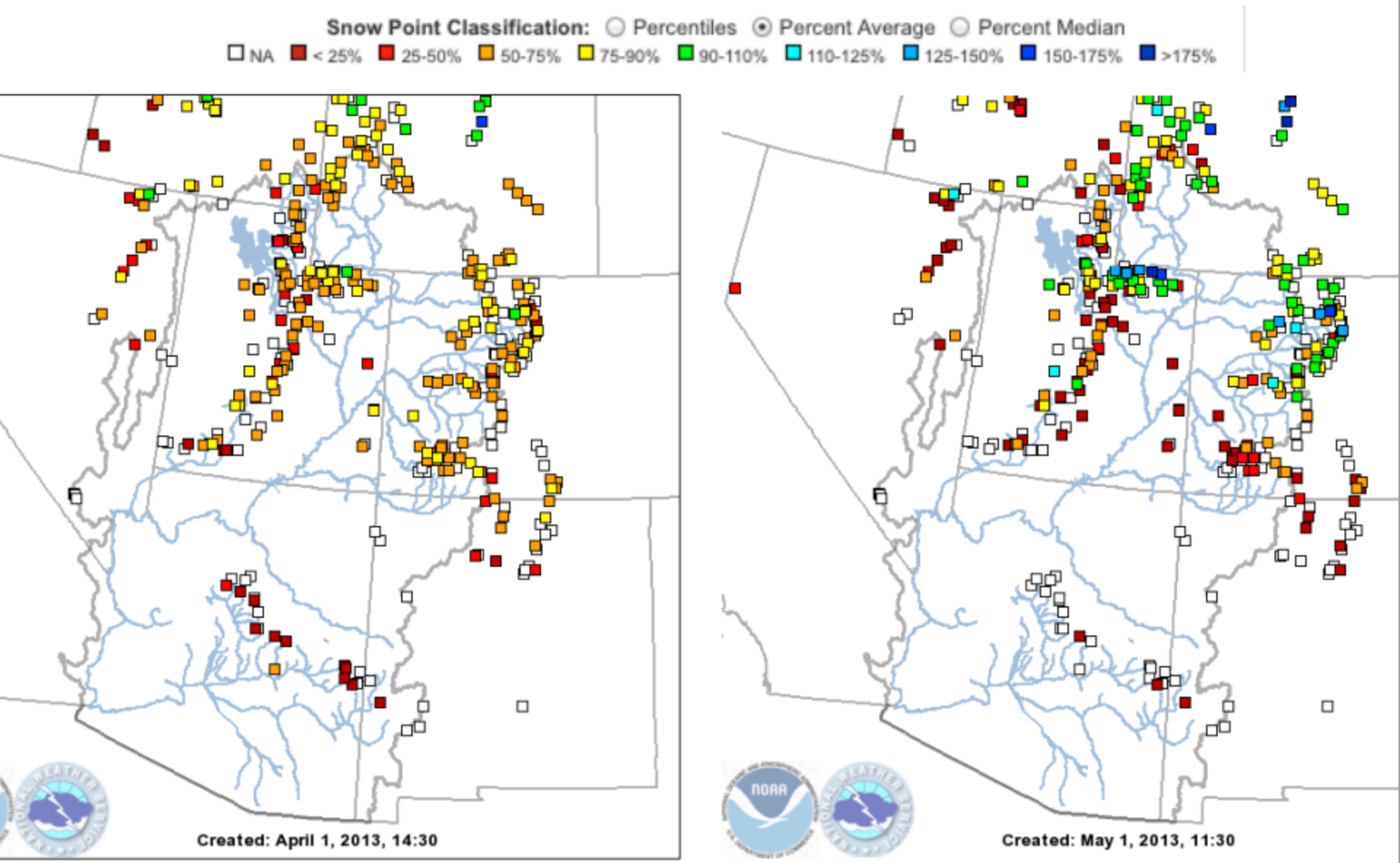
Maximum Departures



Minimum Departures



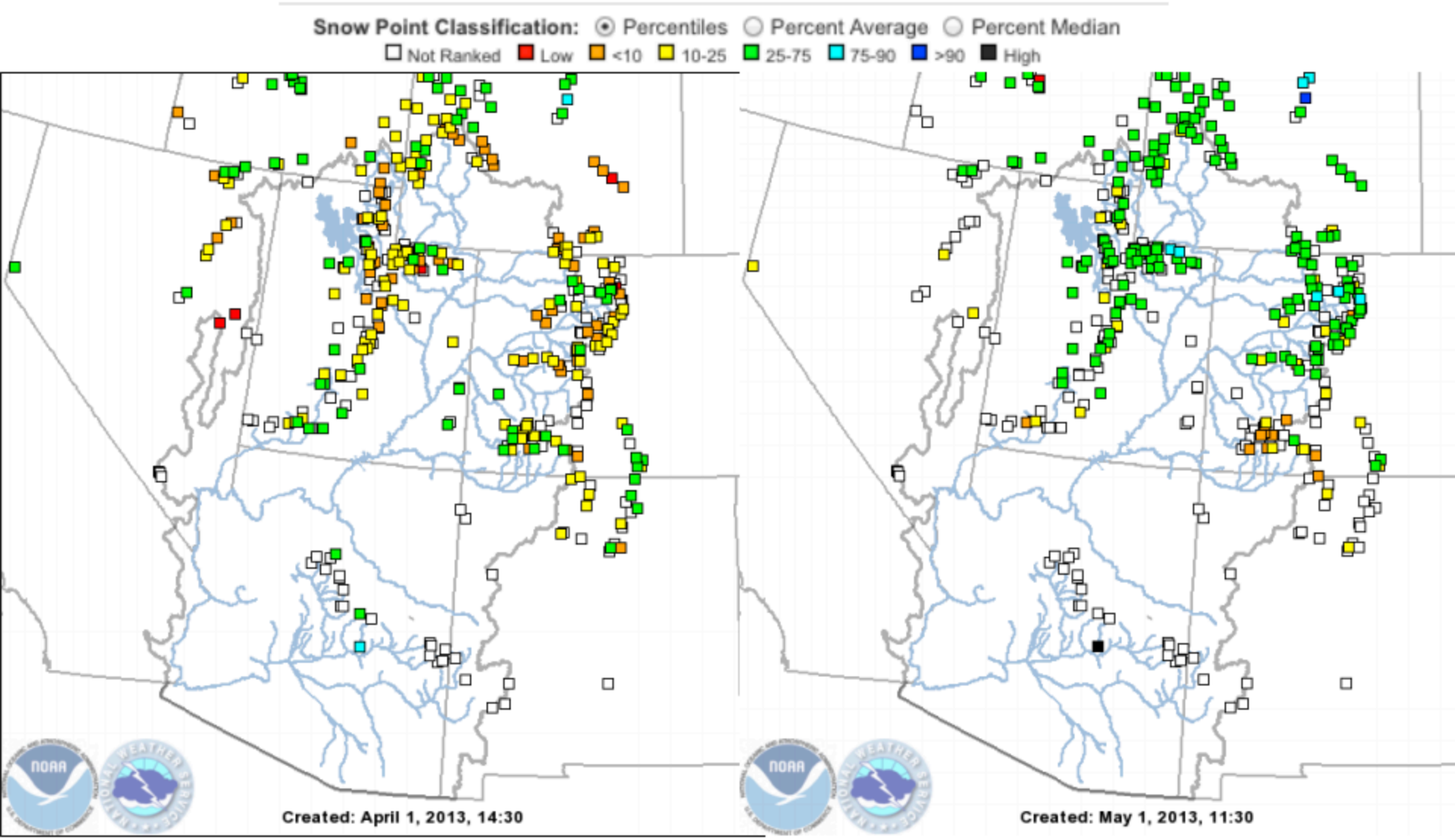
April Snow: Improved conditions north



Web Reference: http://www.cbrfc.noaa.gov/gmap/gmapm.php?scon=checked

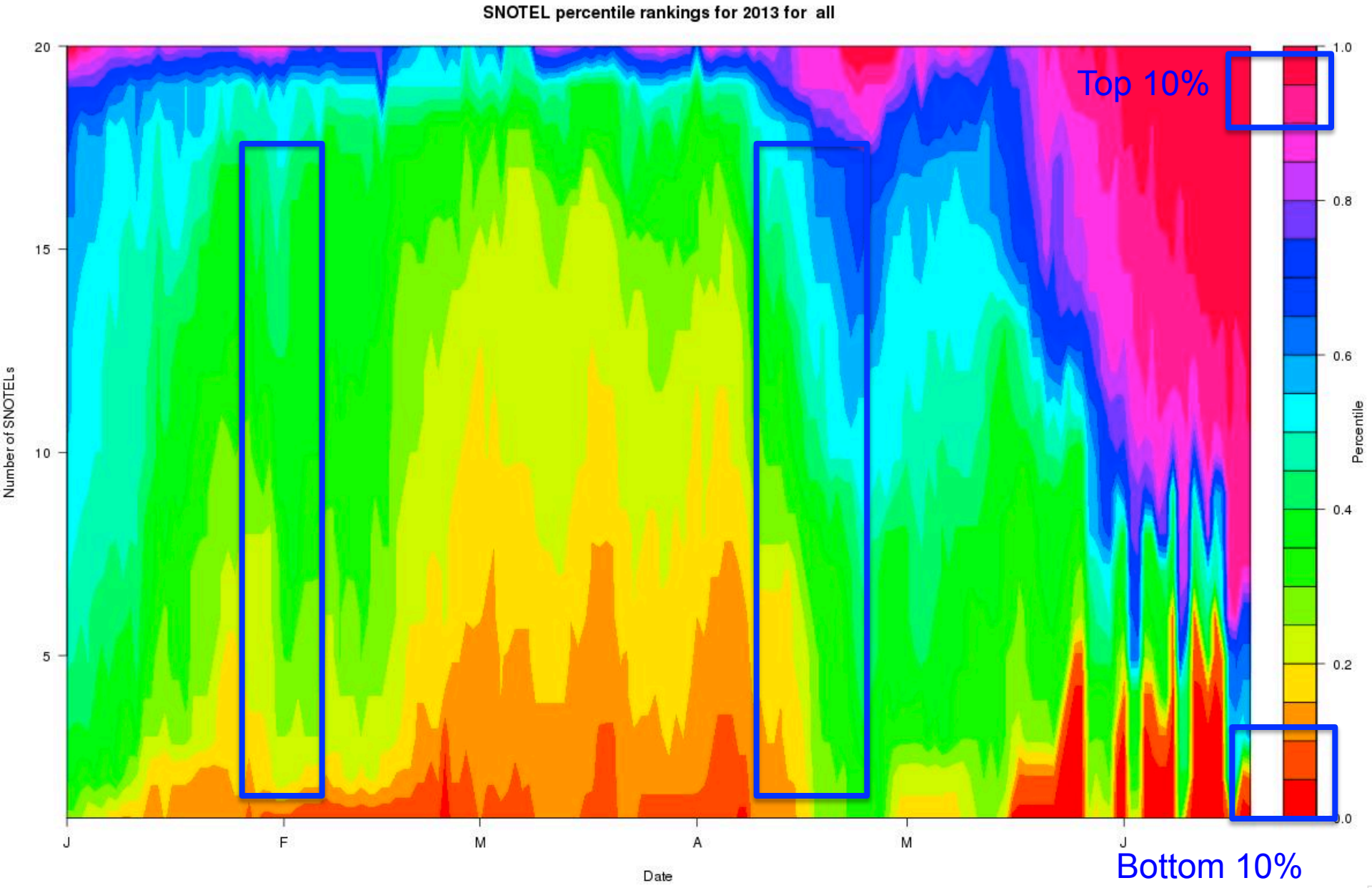
SNOTEL Ranking:

Improvement except San Juan & Virgin River Basins

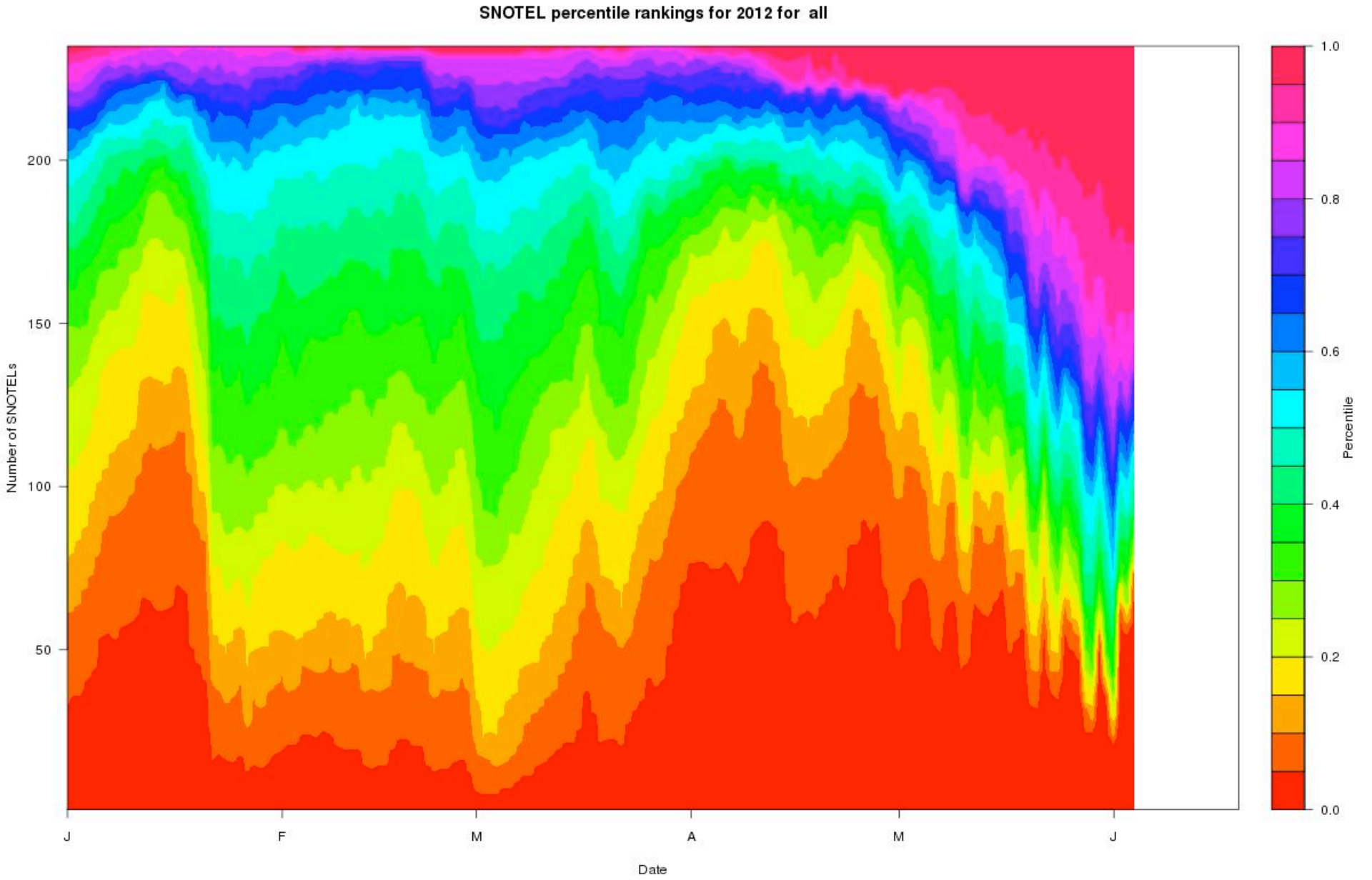


Web Reference: http://www.cbrfc.noaa.gov/gmap/gmapm.php?scon=checked

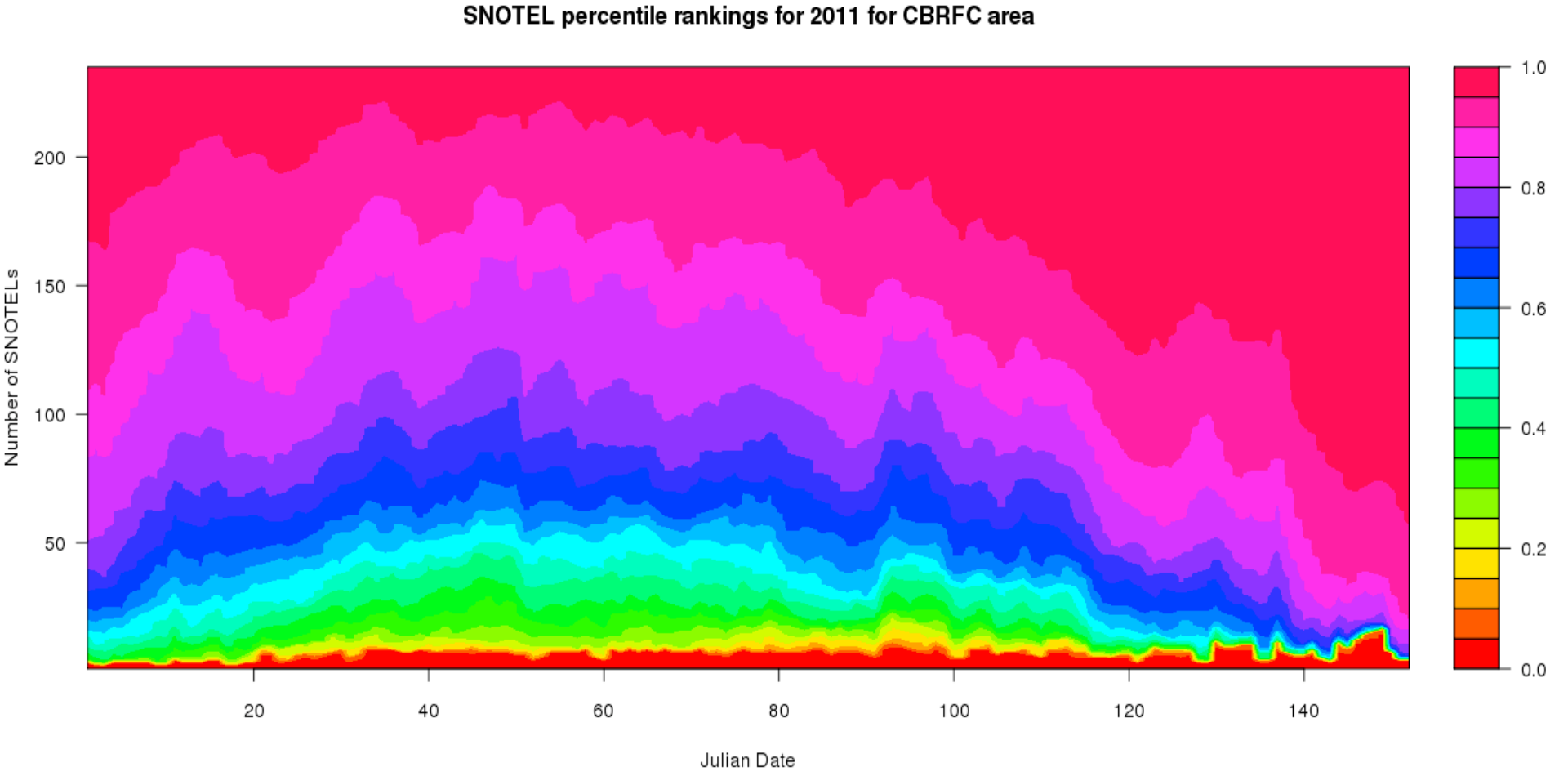
Storms



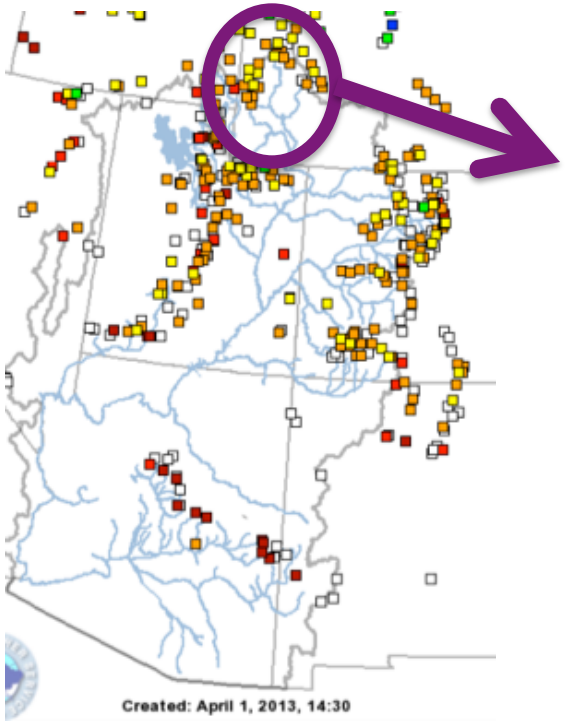
Web Reference: http://www.cbrfc.noaa.gov/snow/raster/

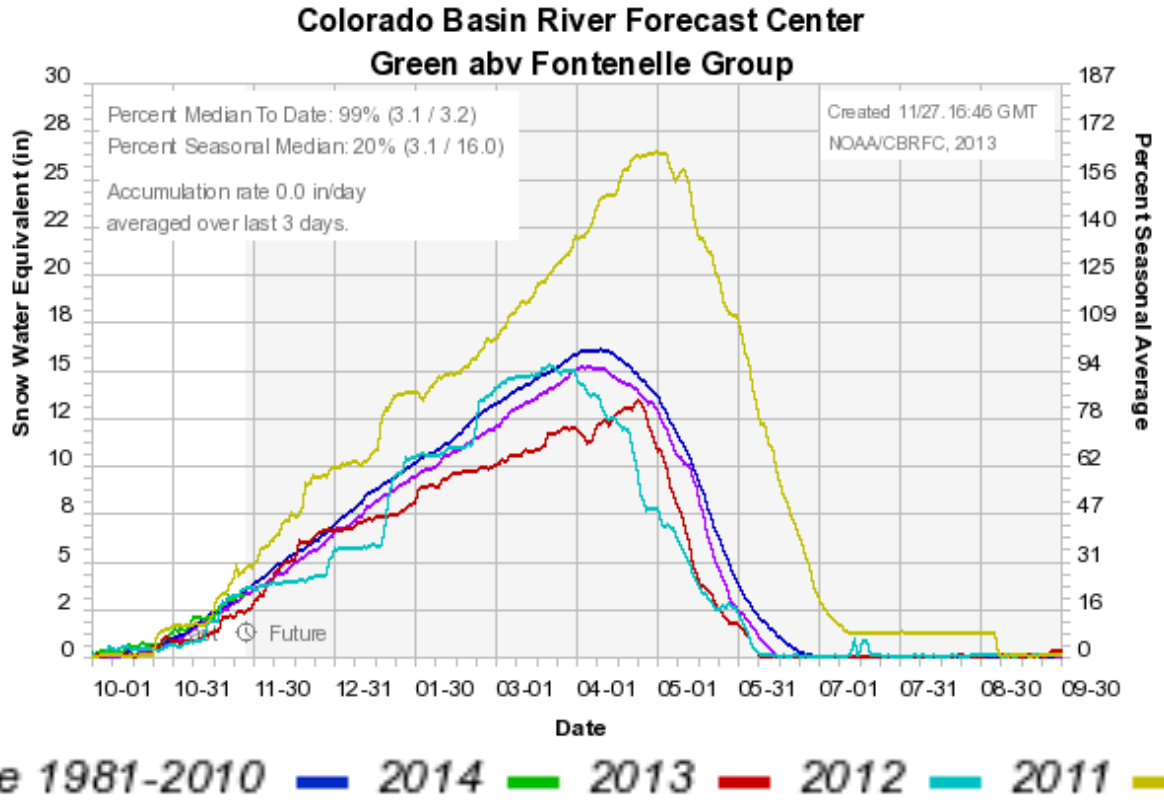


Web Reference: http://www.cbrfc.noaa.gov/snow/raster/


SNOTEL percentile rankings for 2011 for CBRFC area
Number of SNOTELs
200
150
100
50
20
40
60
80
100
120
140
Julian Date
1.0
0.8
0.6
0.4
0.2
0.0

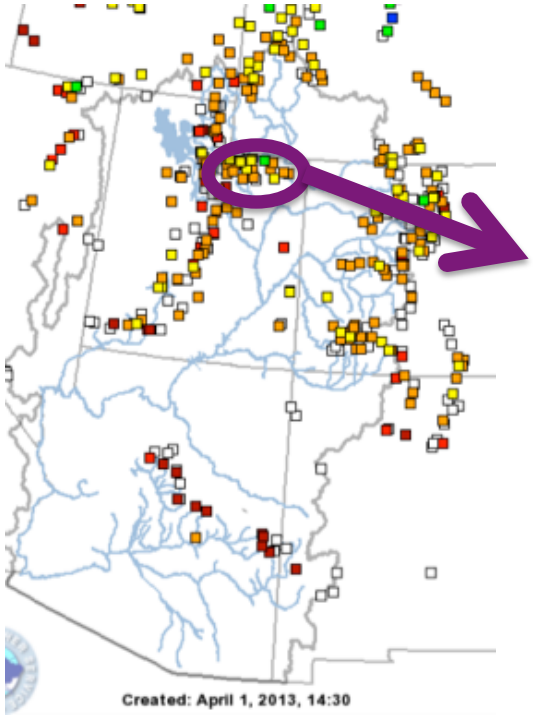
Snow: Upper Green Basin (Fontenelle)

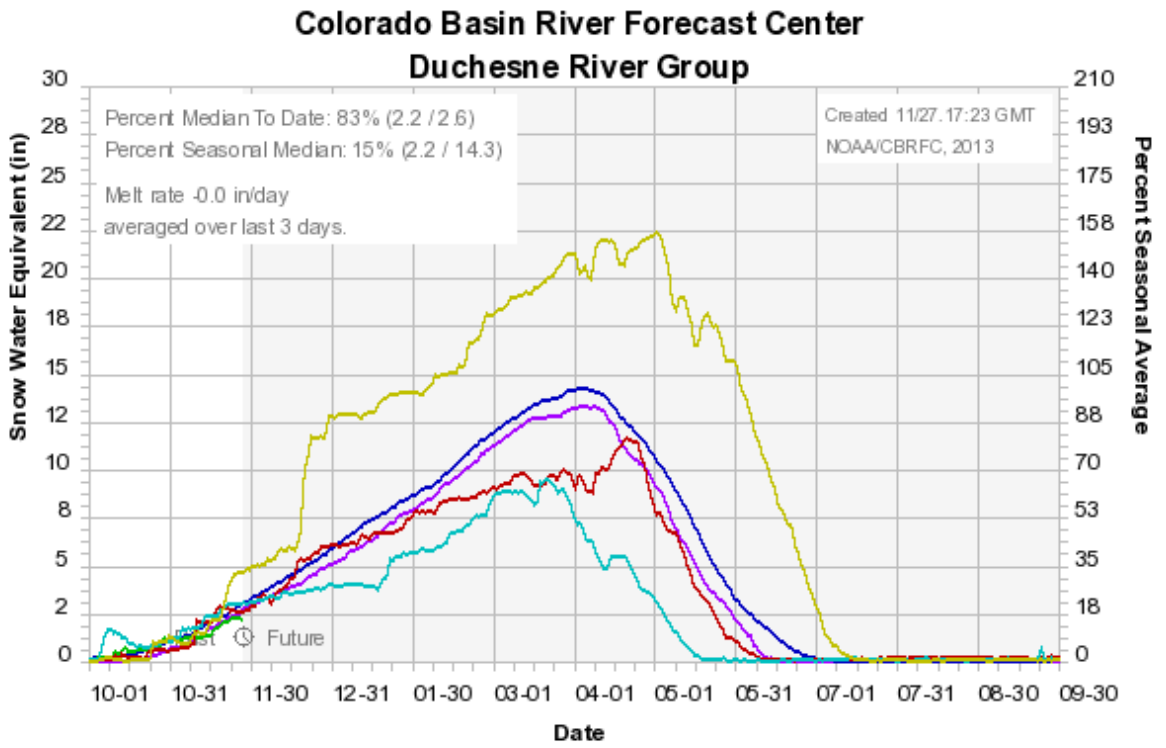




Web Reference: http://www.cbrfc.noaa.gov/station/sweplot/sweplot.cgi???open

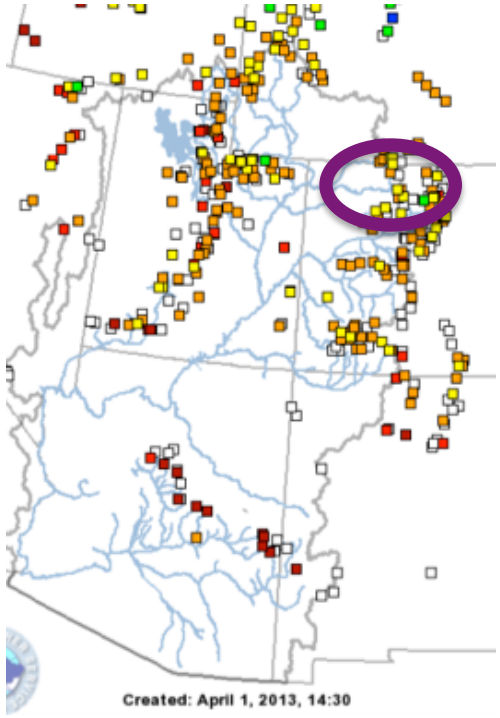
Snow: Duchesne Basin

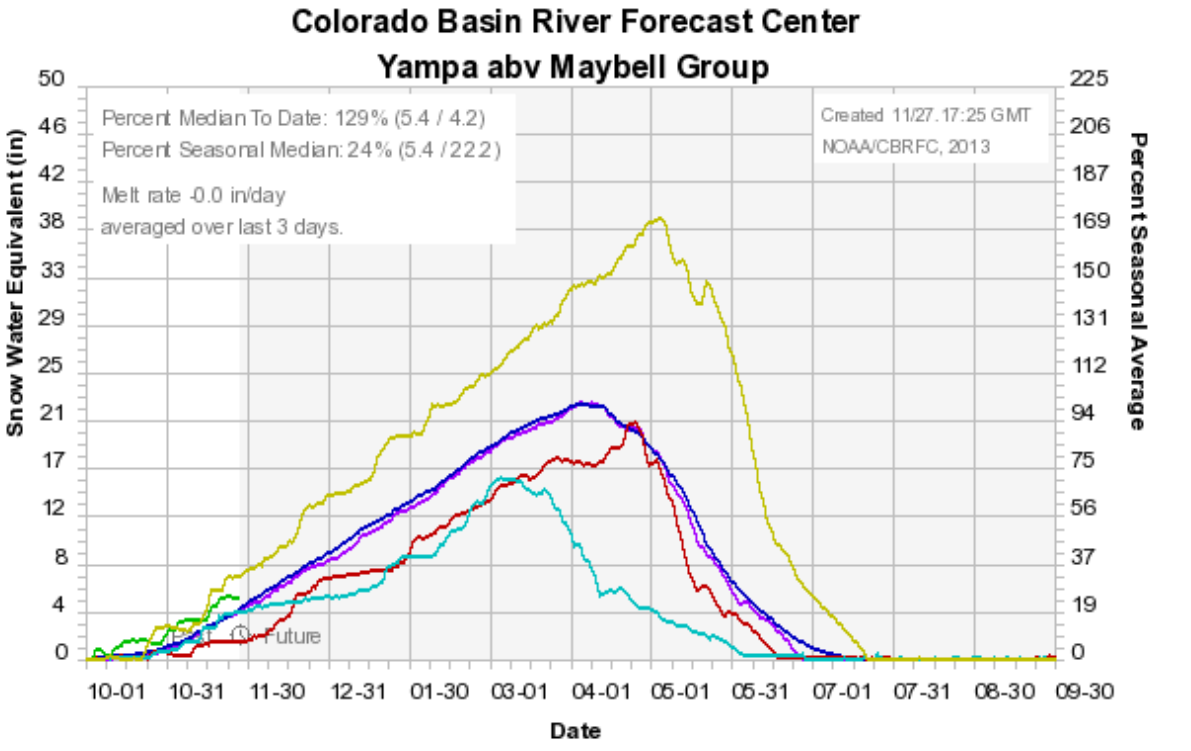




Web Reference: http://www.cbrfc.noaa.gov/station/sweplot/sweplot.cgi???open

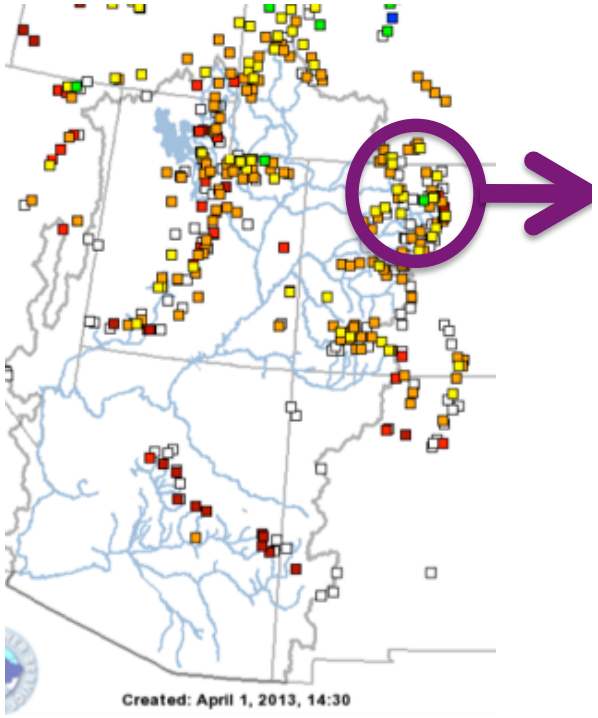
Snow: Yampa Basin

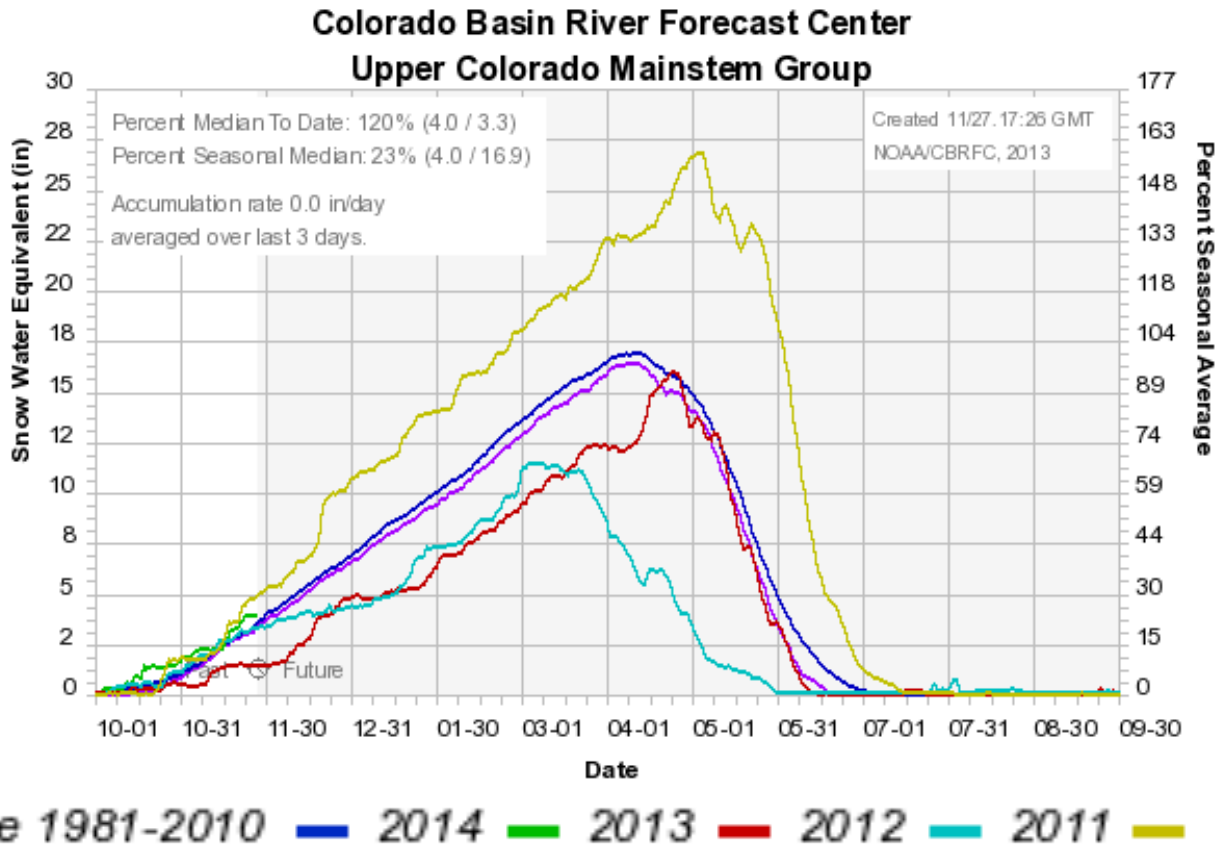




Web Reference: http://www.cbrfc.noaa.gov/station/sweplot/sweplot.cgi???open

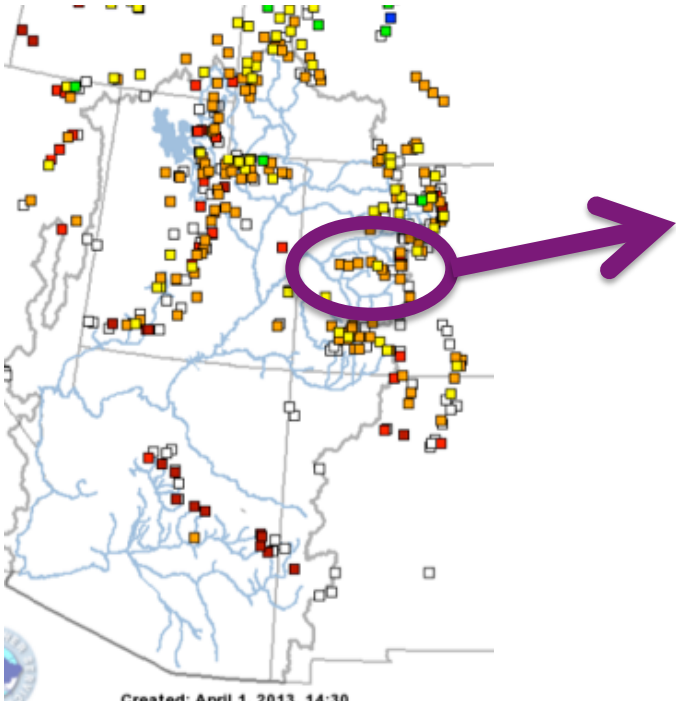
Snow:
Colorado Mainstem (above Cameo)

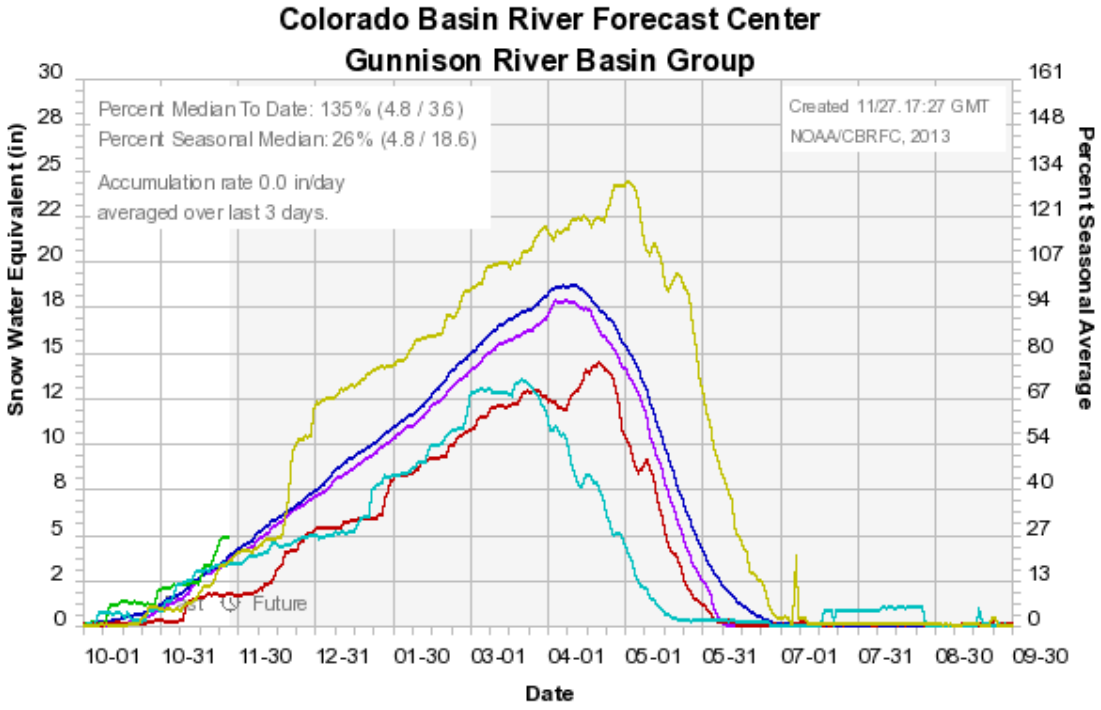




Web Reference: http://www.cbrfc.noaa.gov/station/sweplot/sweplot.cgi???open

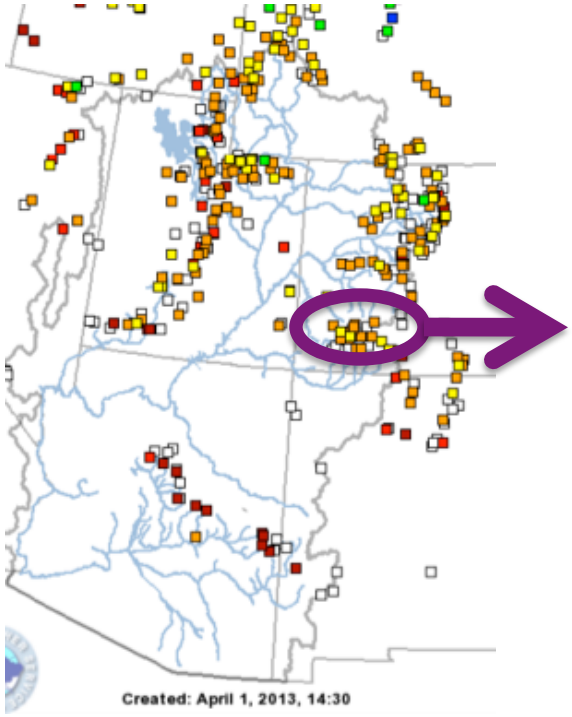
Snow:
Gunnison Basin

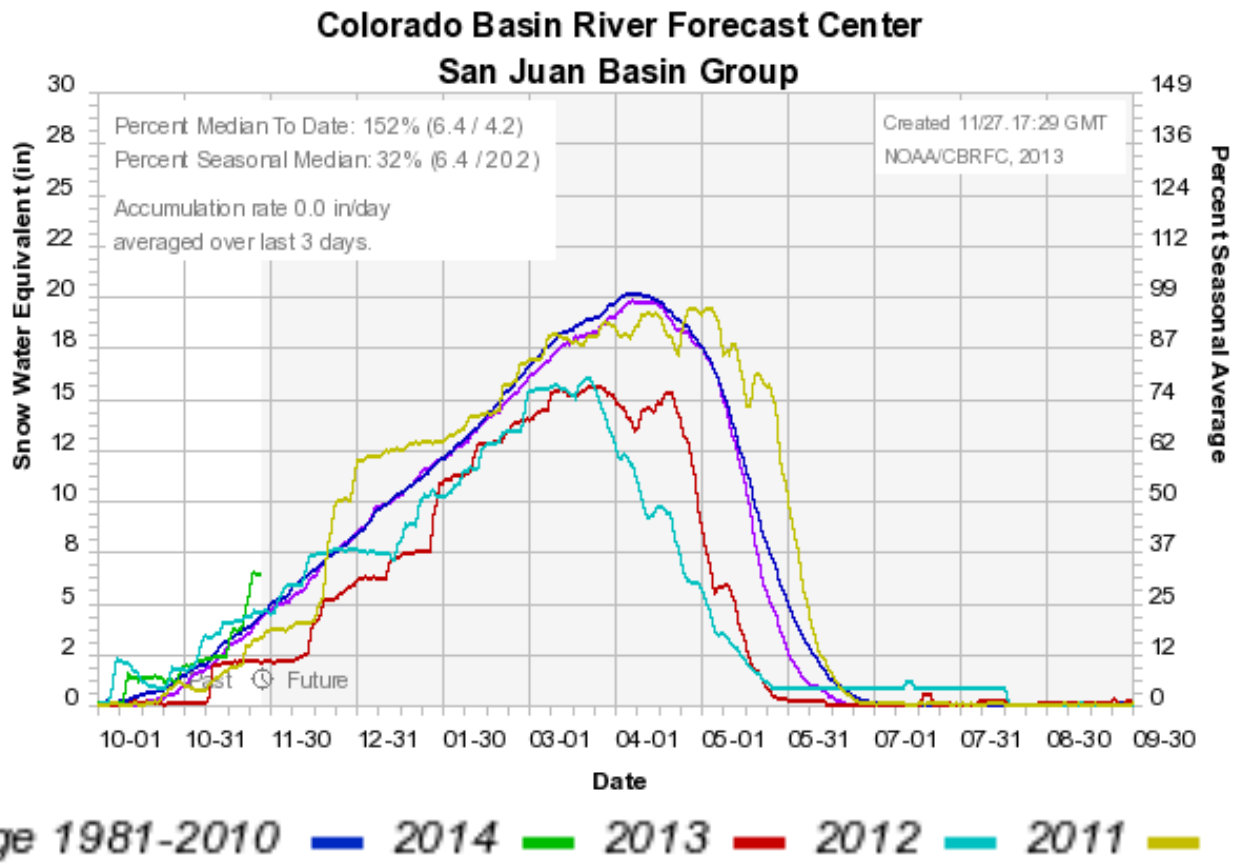




Web Reference: http://www.cbrfc.noaa.gov/station/sweplot/sweplot.cgi???open

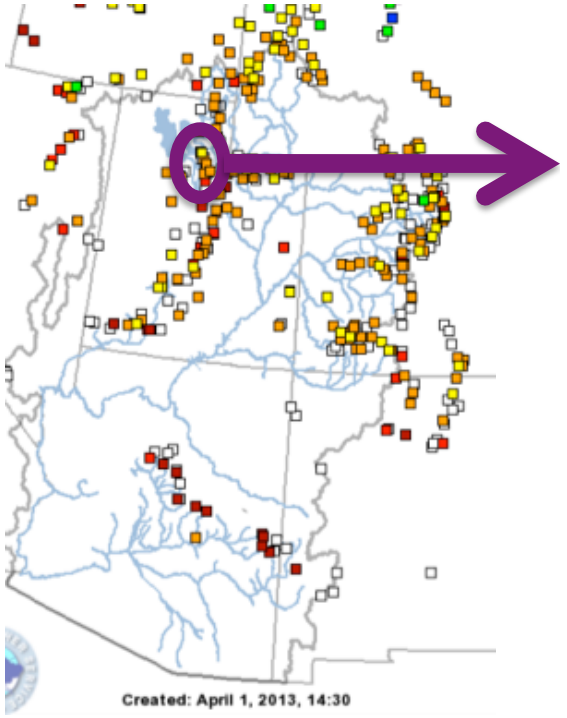
Snow:
San Juan Basin

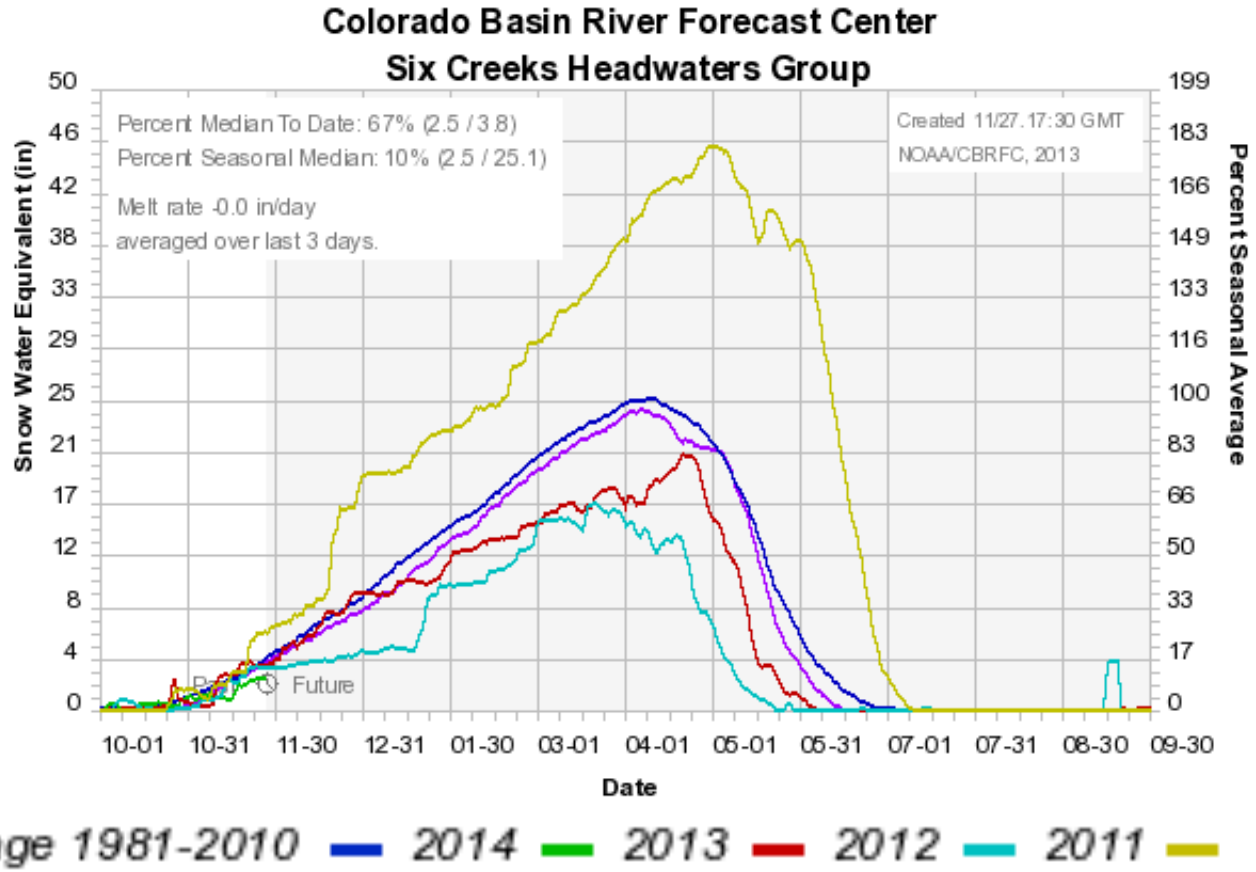




Web Reference: http://www.cbrfc.noaa.gov/station/sweplot/sweplot.cgi???open

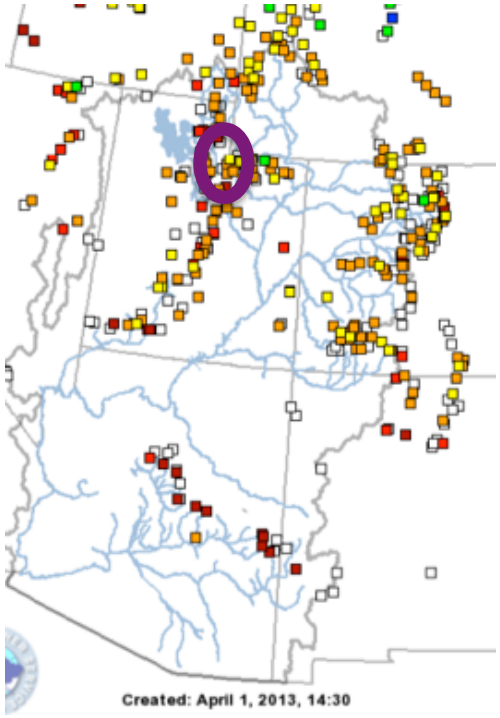
Snow:
Six Creeks in Salt Lake County

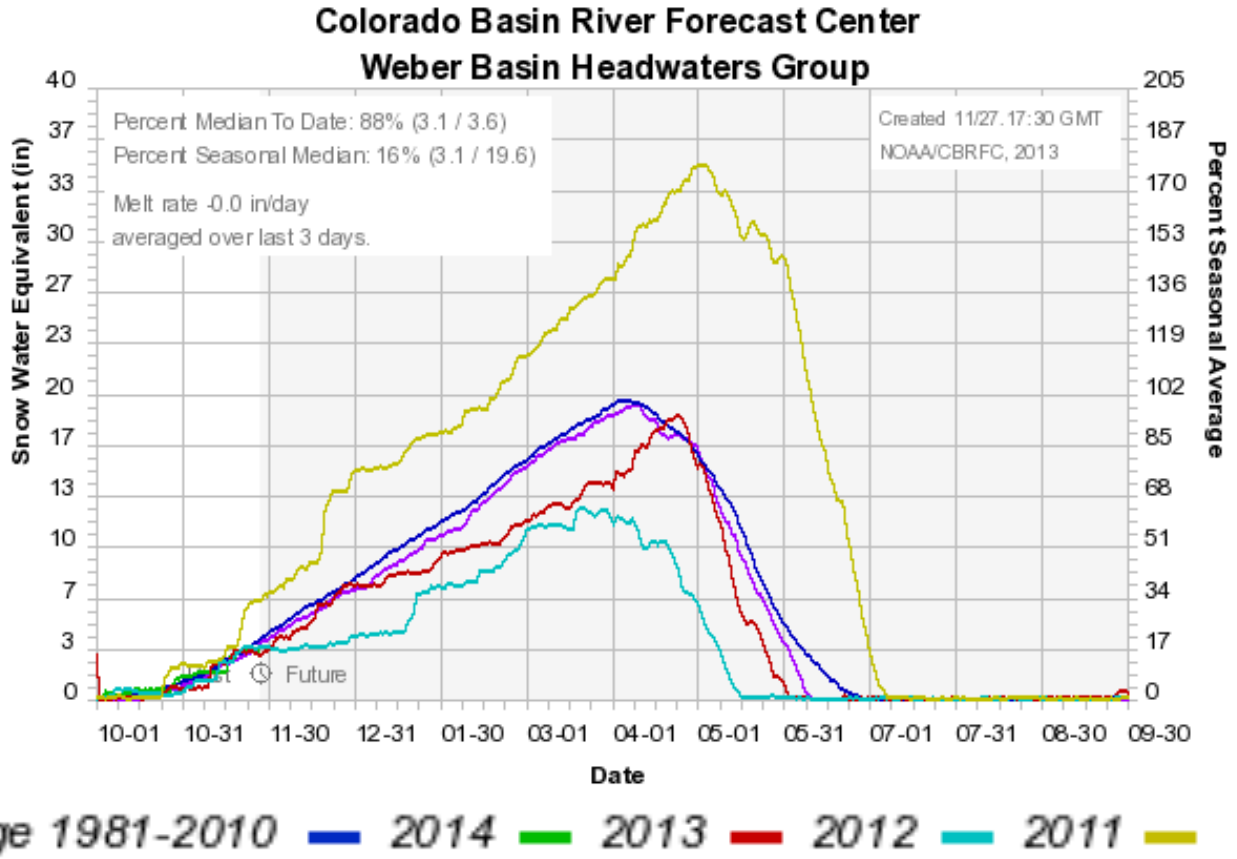




Web Reference: http://www.cbrfc.noaa.gov/station/sweplot/sweplot.cgi???open

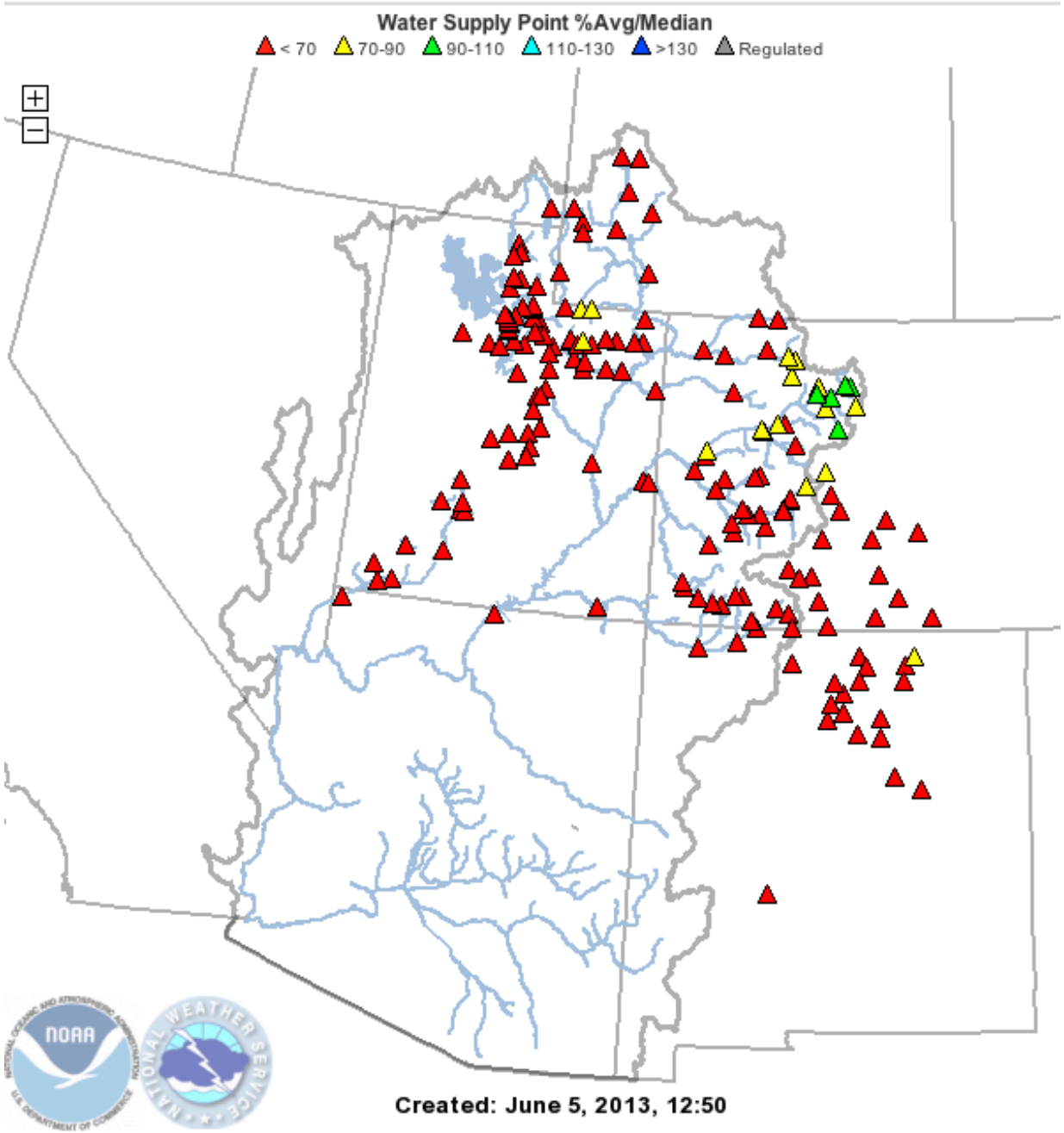
Snow:
Weber Basin



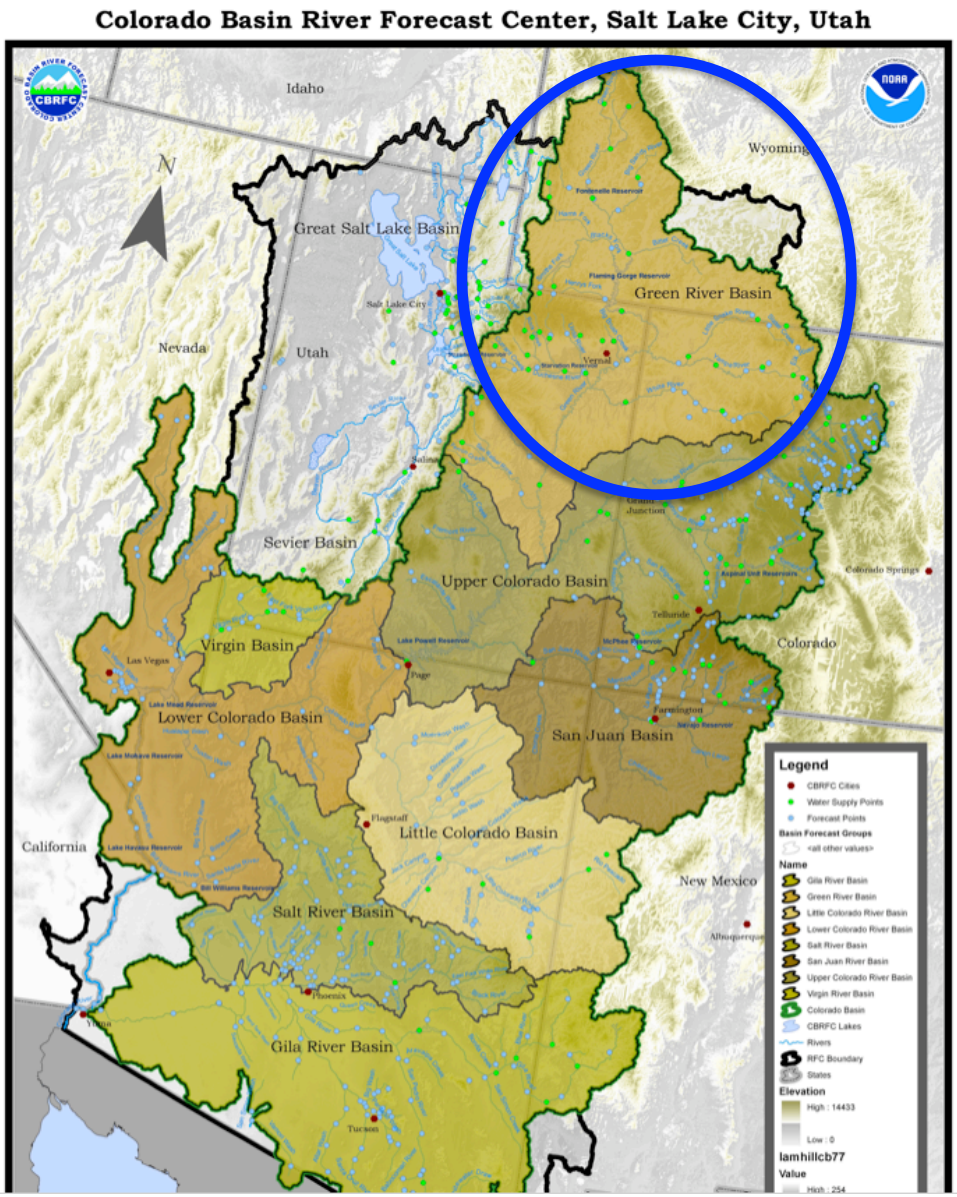


Web Reference: http://www.cbrfc.noaa.gov/station/sweplot/sweplot.cgi???open

2013 Water Supply Forecasts



Green River Basin



Upper Green

- Below Average Volumes: Bottom 5 of record
- Higher volumes from Blacks Fork and Smiths Fork
- Forecast error low at headwater locations
- Forecast error increased downstream points and Flaming Gorge Local

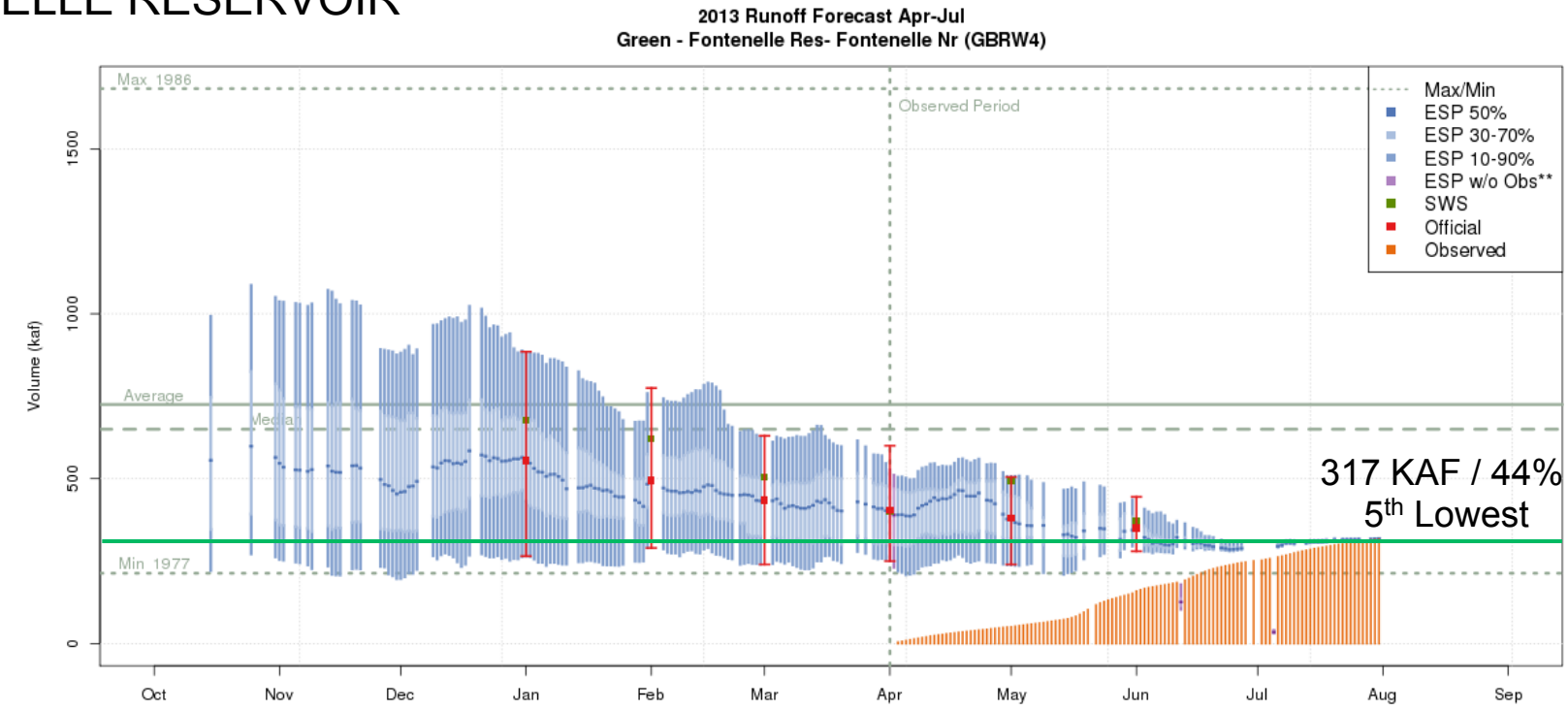
Yampa

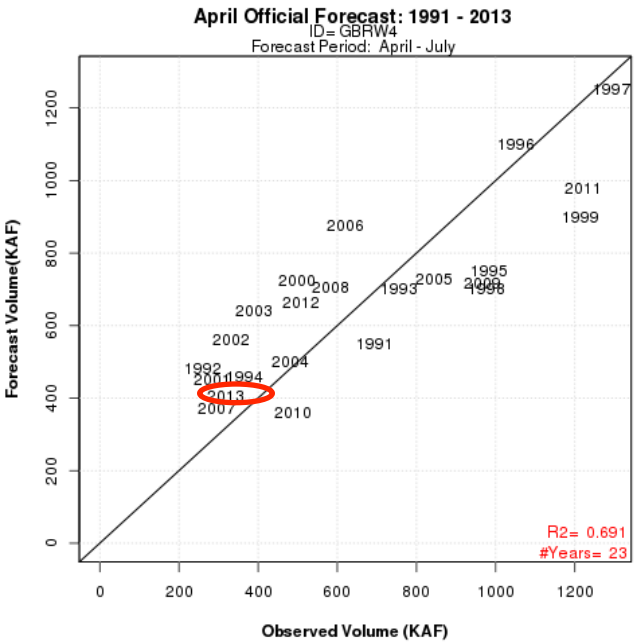
- Below average volumes
- Very dry with the exception of April
- Increase in May forecasts as a result of wet April

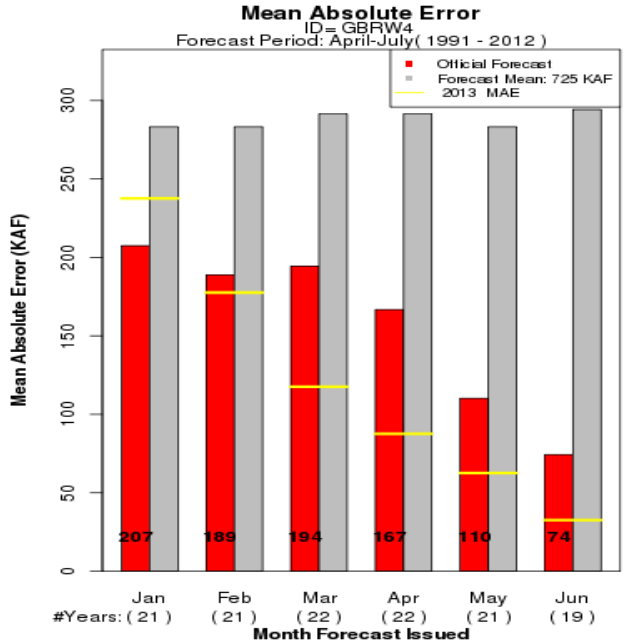
Duchesne

- Below average volumes
- Record low Jan-Mar precipitation
- Wet April increased many May forecasts
- Increased forecasts were too high at most points

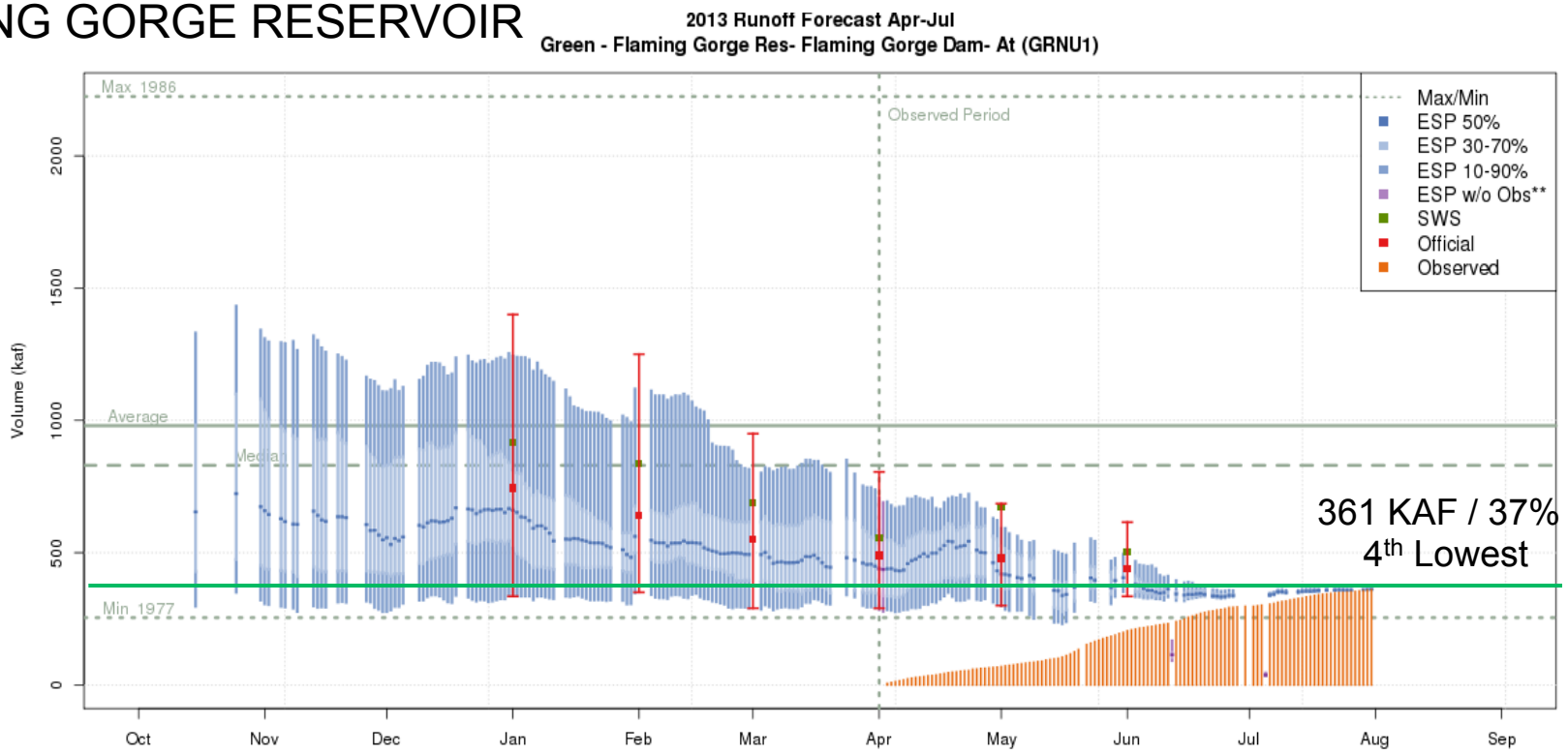
FONTENELLE RESERVOIR

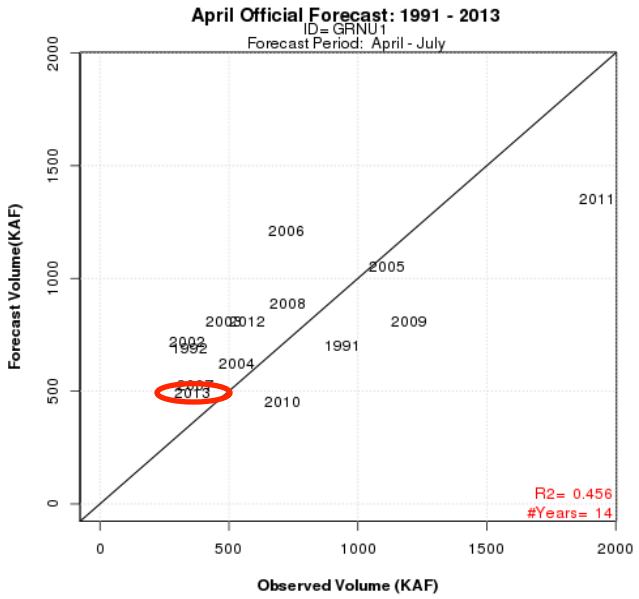


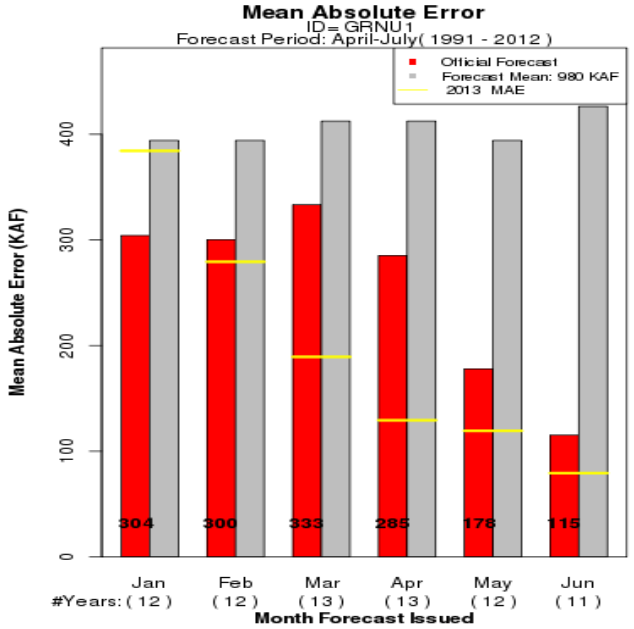




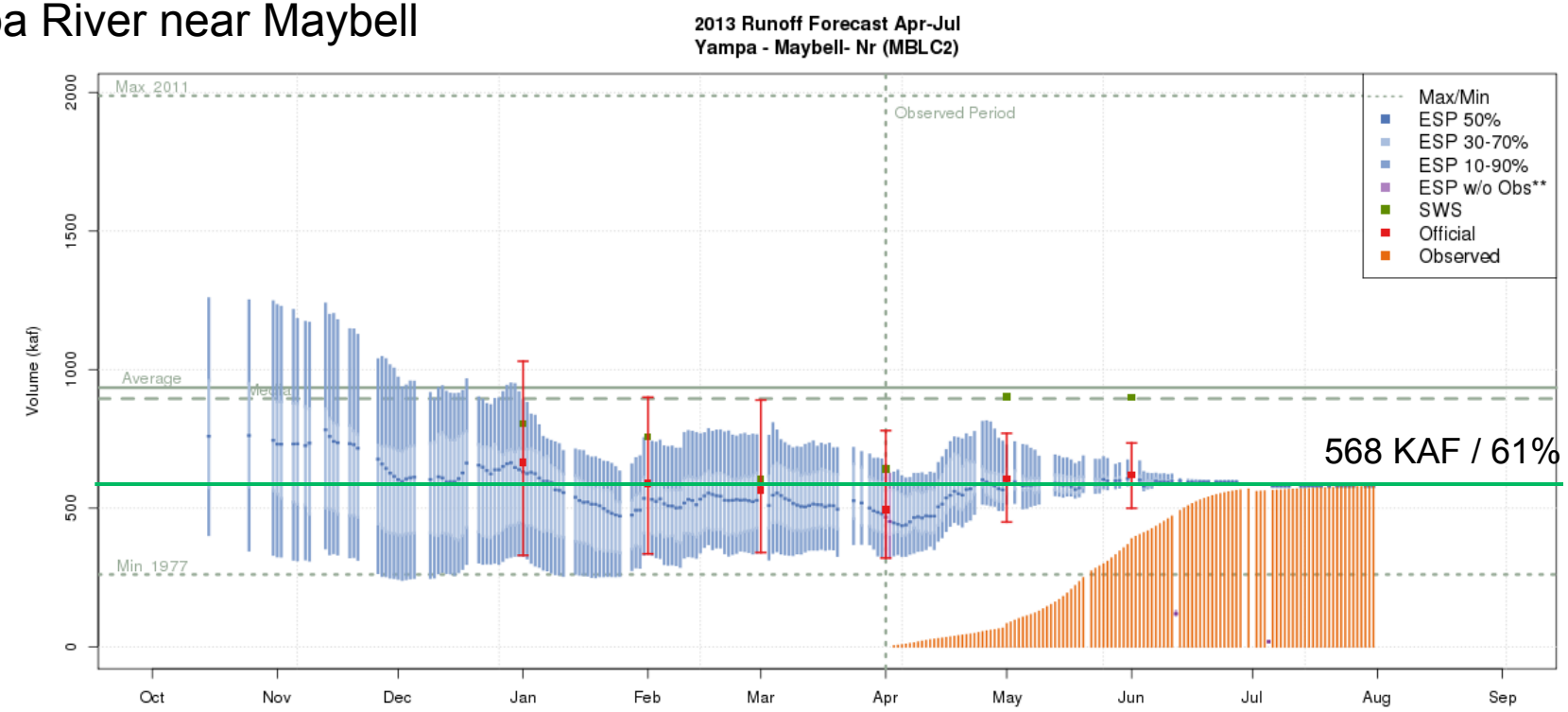
FLAMING GORGE RESERVOIR

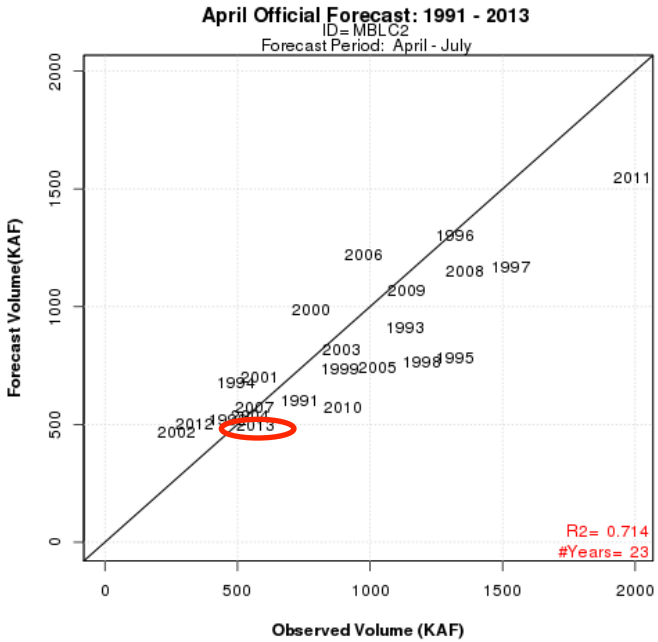


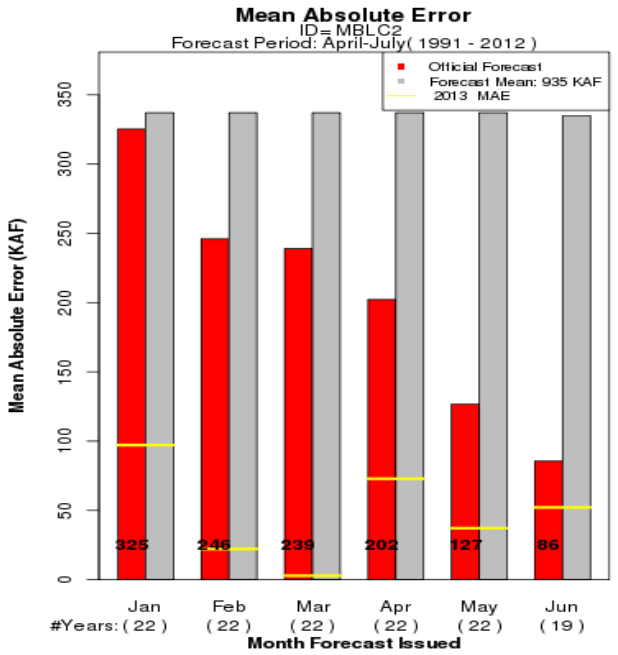




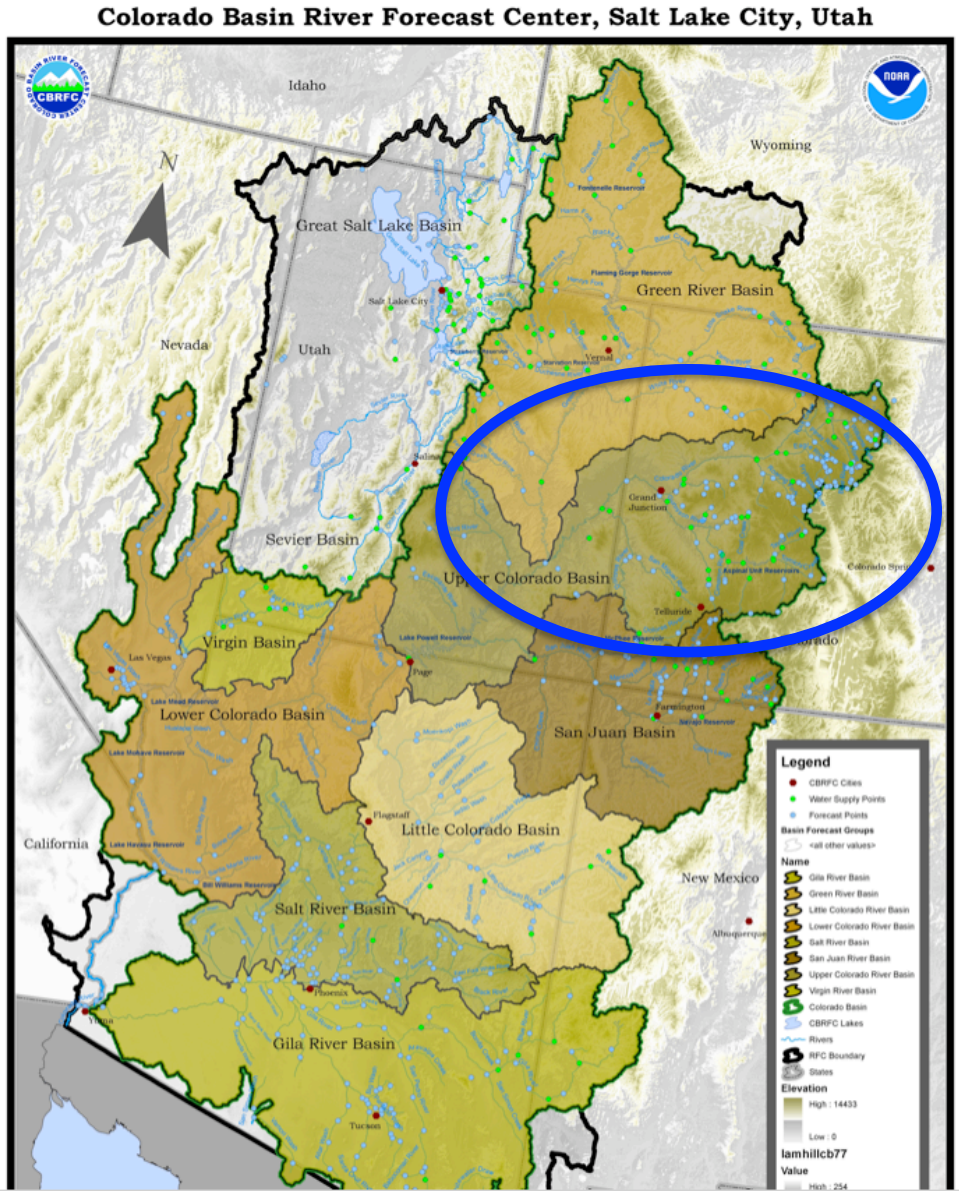
Yampa River near Maybell





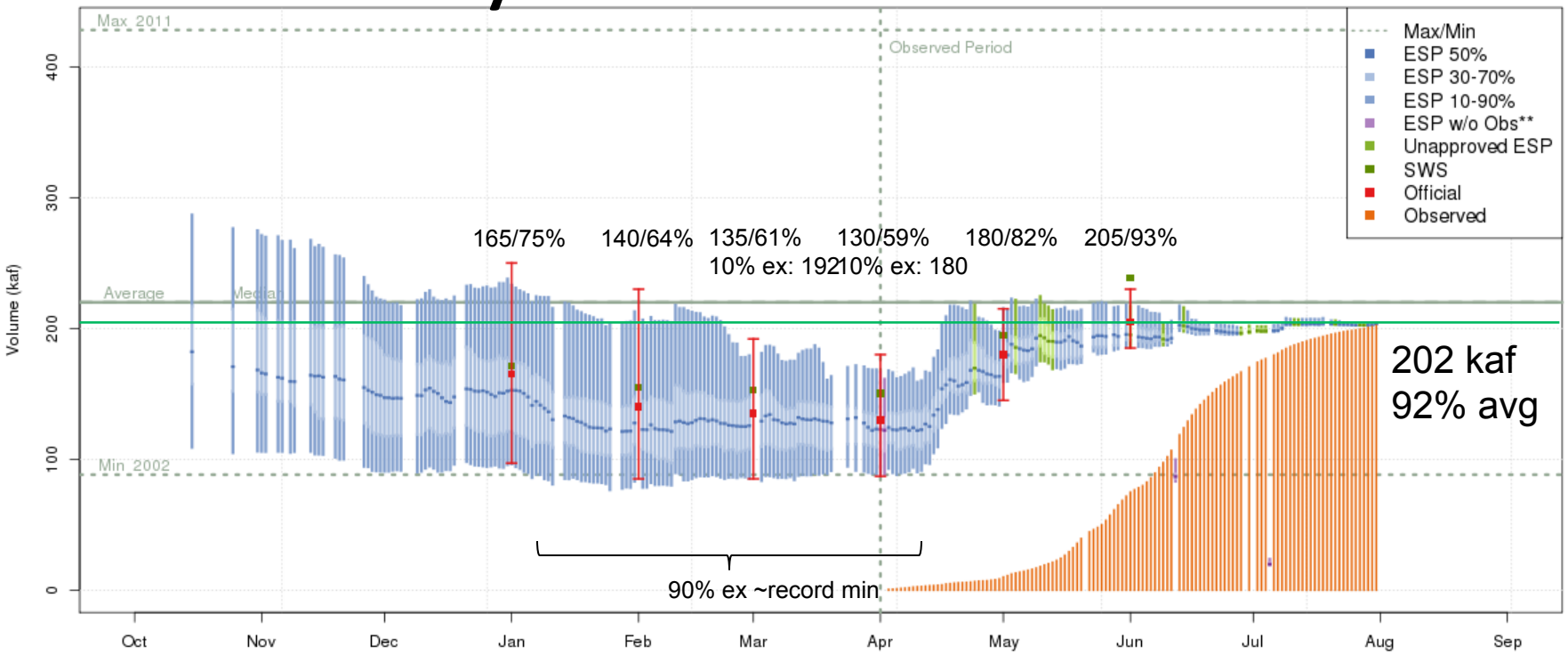


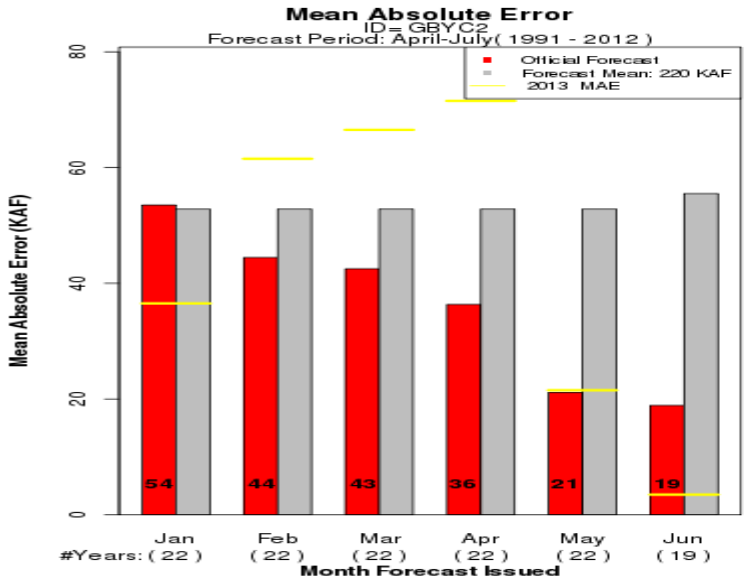
Upper Colorado Mainstem Basin

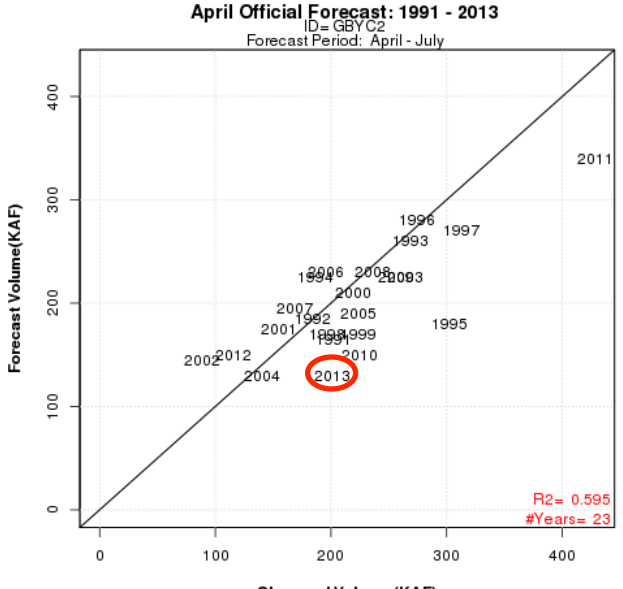


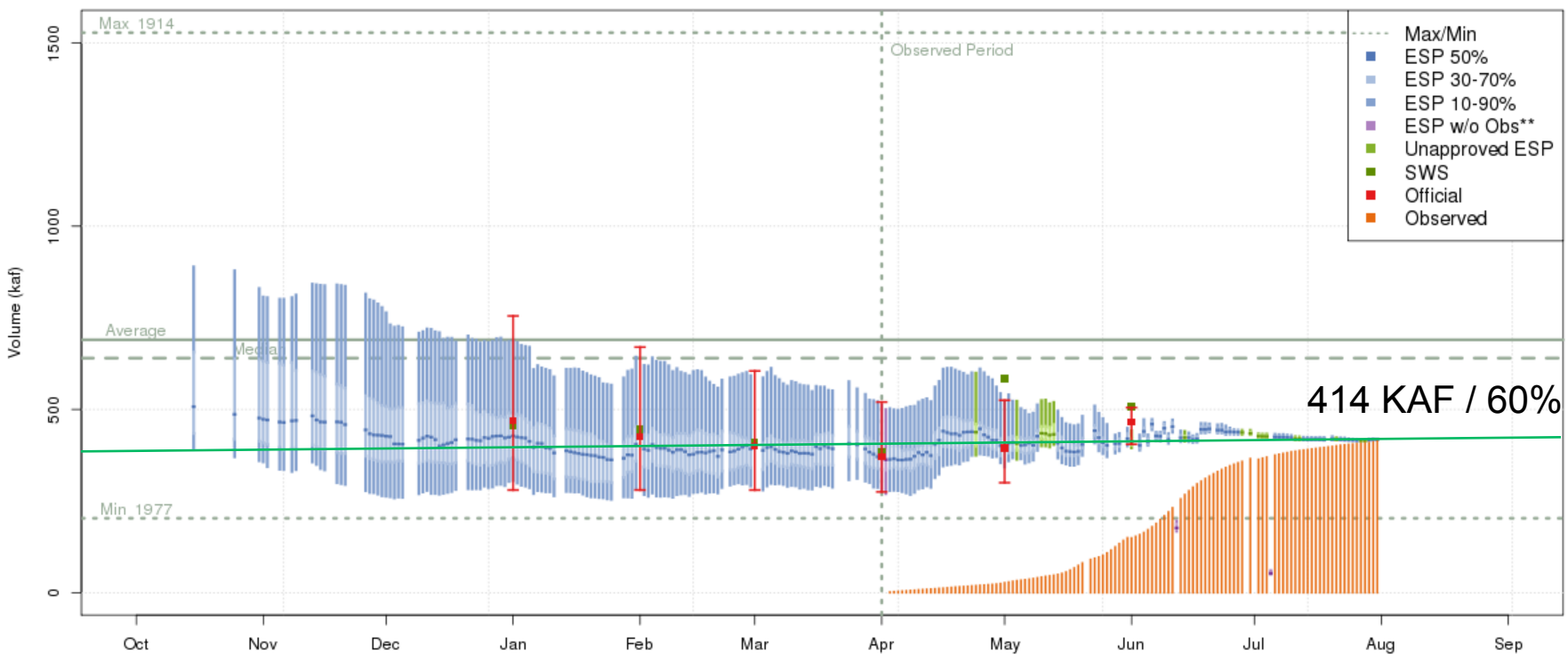
- Mainstem:
  - Good late season precipitation helped.
  - Big jumps in the water supply forecasts May 1 and June 1.
- Gunnison:
  - Missed out on the Jan precipitation seen in southern Colorado and much of the Apr-May precipitation seen in northern Colorado.
  - Water supply forecasts were consistent through the season and had a good handle on things right from the start.
- Dolores:
  - Good Dec-Jan precipitation, but dried out after that.
  - Dolores River 4th lowest volume out of 98 years.

Lake Granby Forecasts

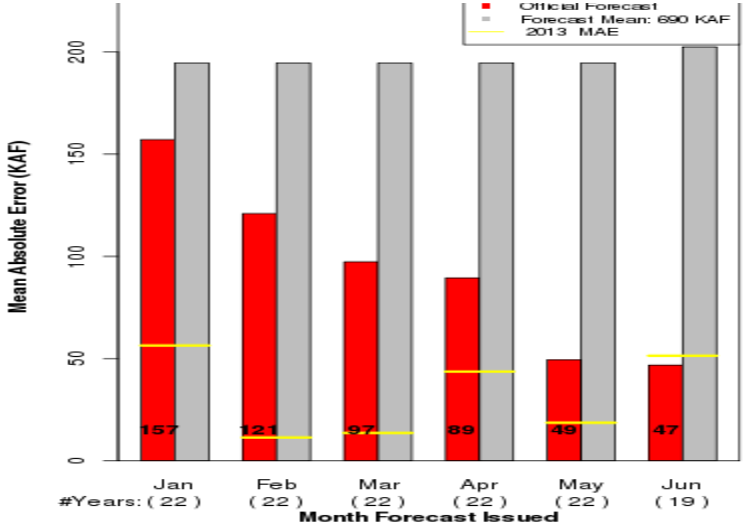


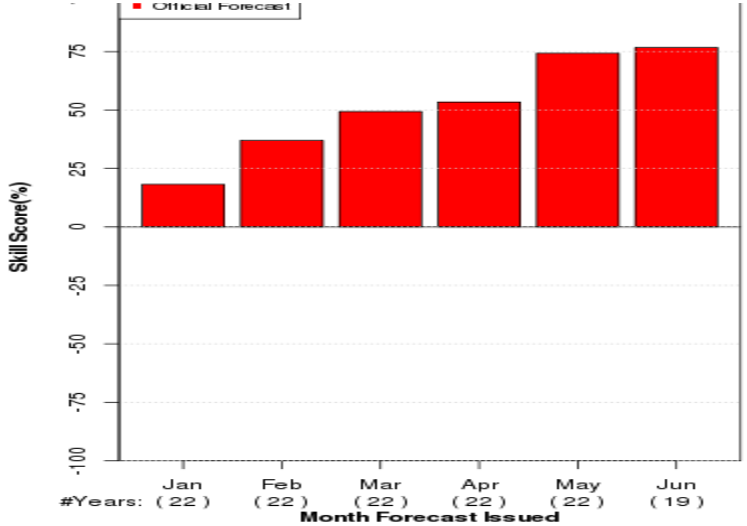




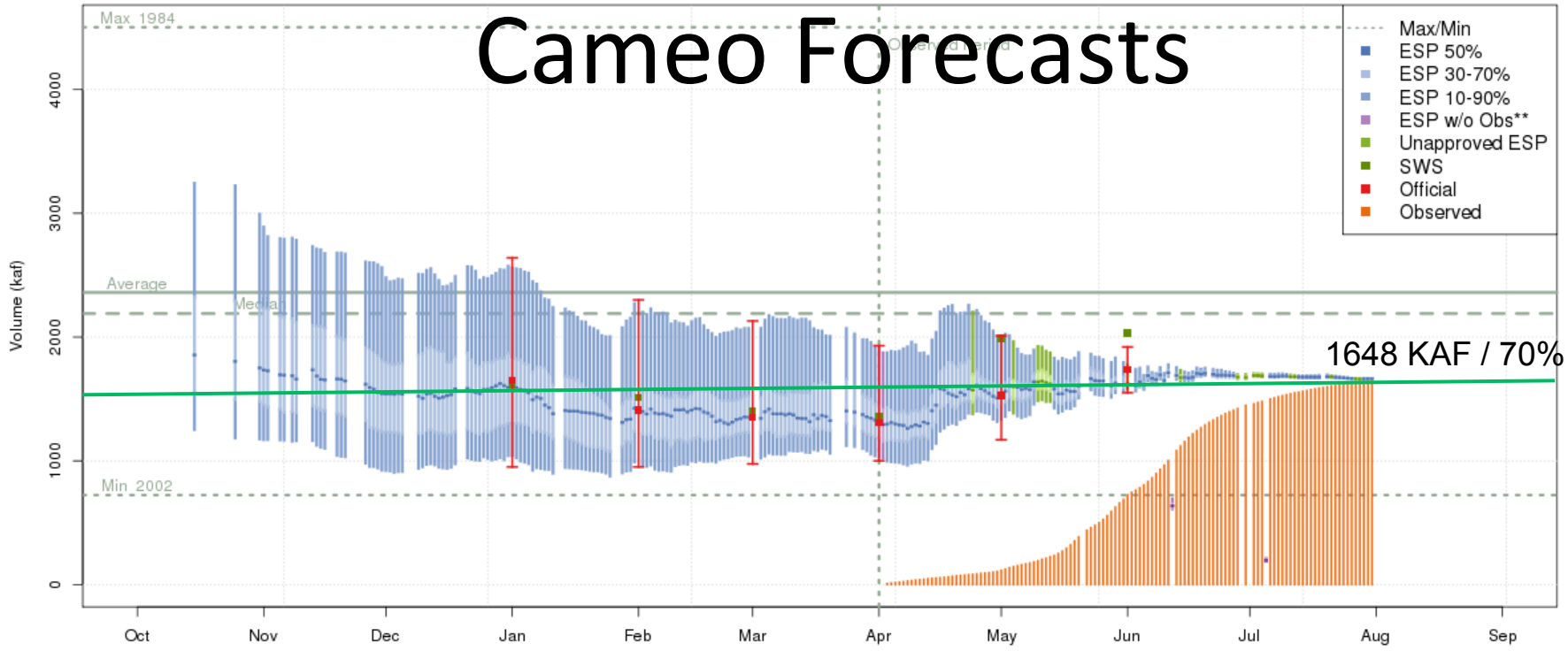


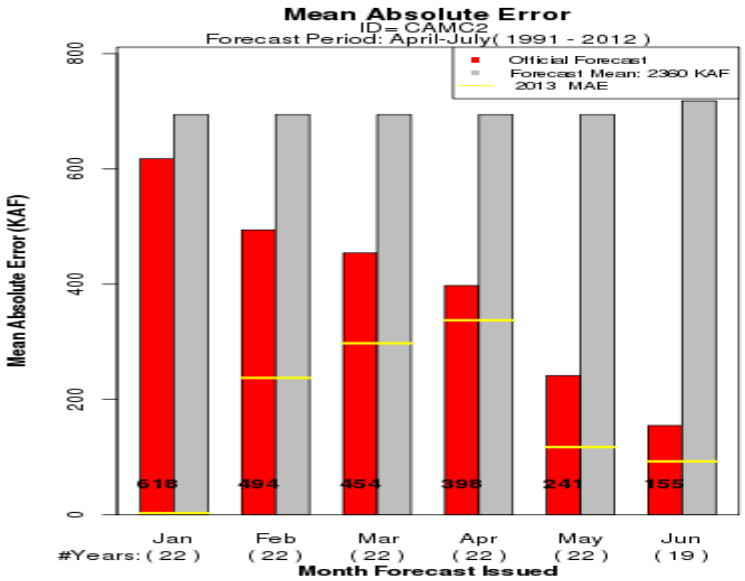
Plot Created 2013-10-22 13:02:08, Lastest ESP Run from 2013-09-30, CBRFC / NWS / NOAA
Maximum of 1528 in 1914, Minimum of 203 in 1977, Average/Median for 1981-2010.
**These ESP forecasts do not include observed and are not total runoff.

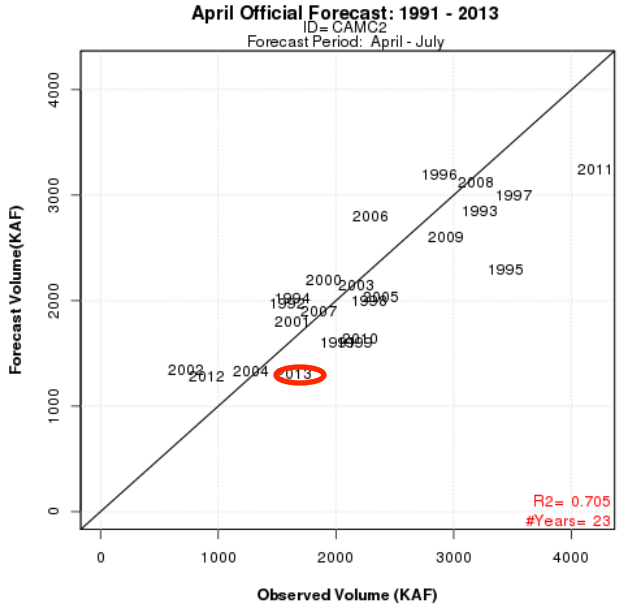




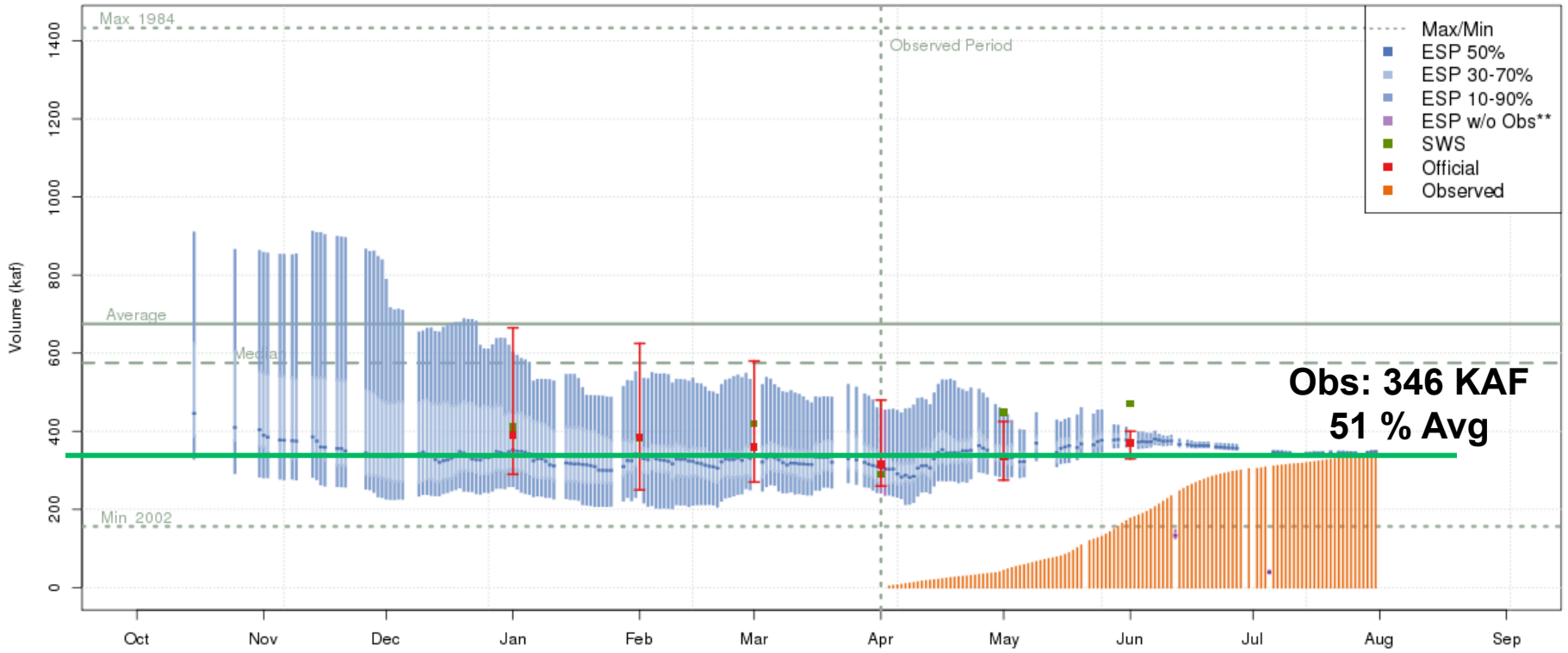
Cameo Forecasts

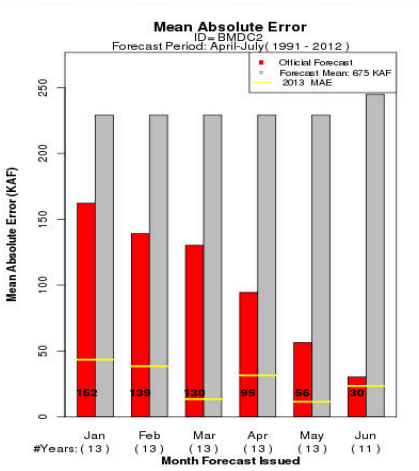


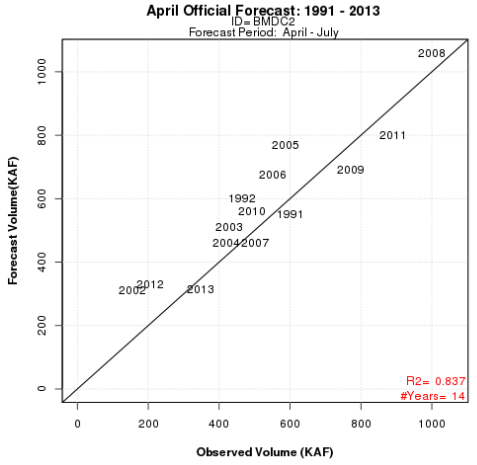




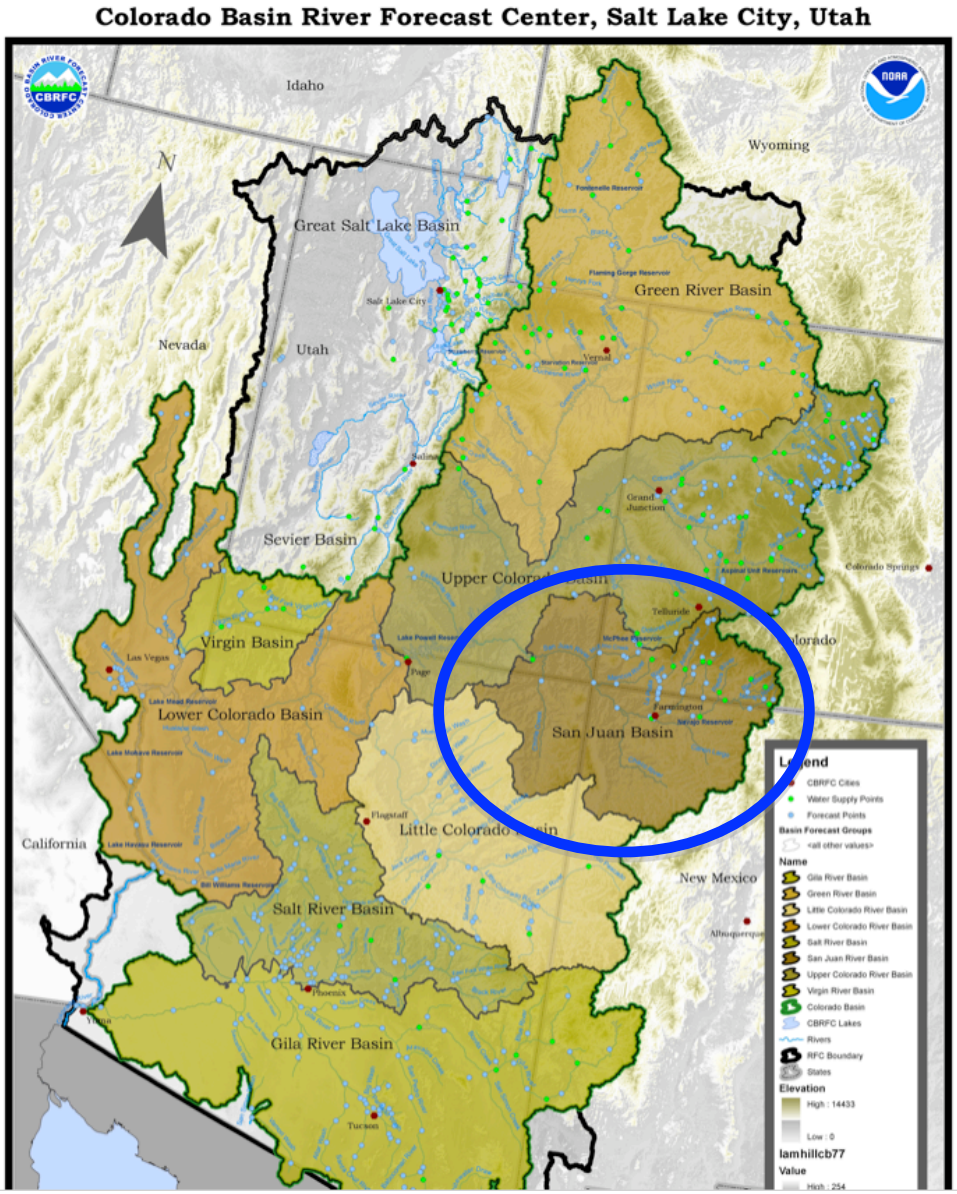
Gunnison – Blue Mesa





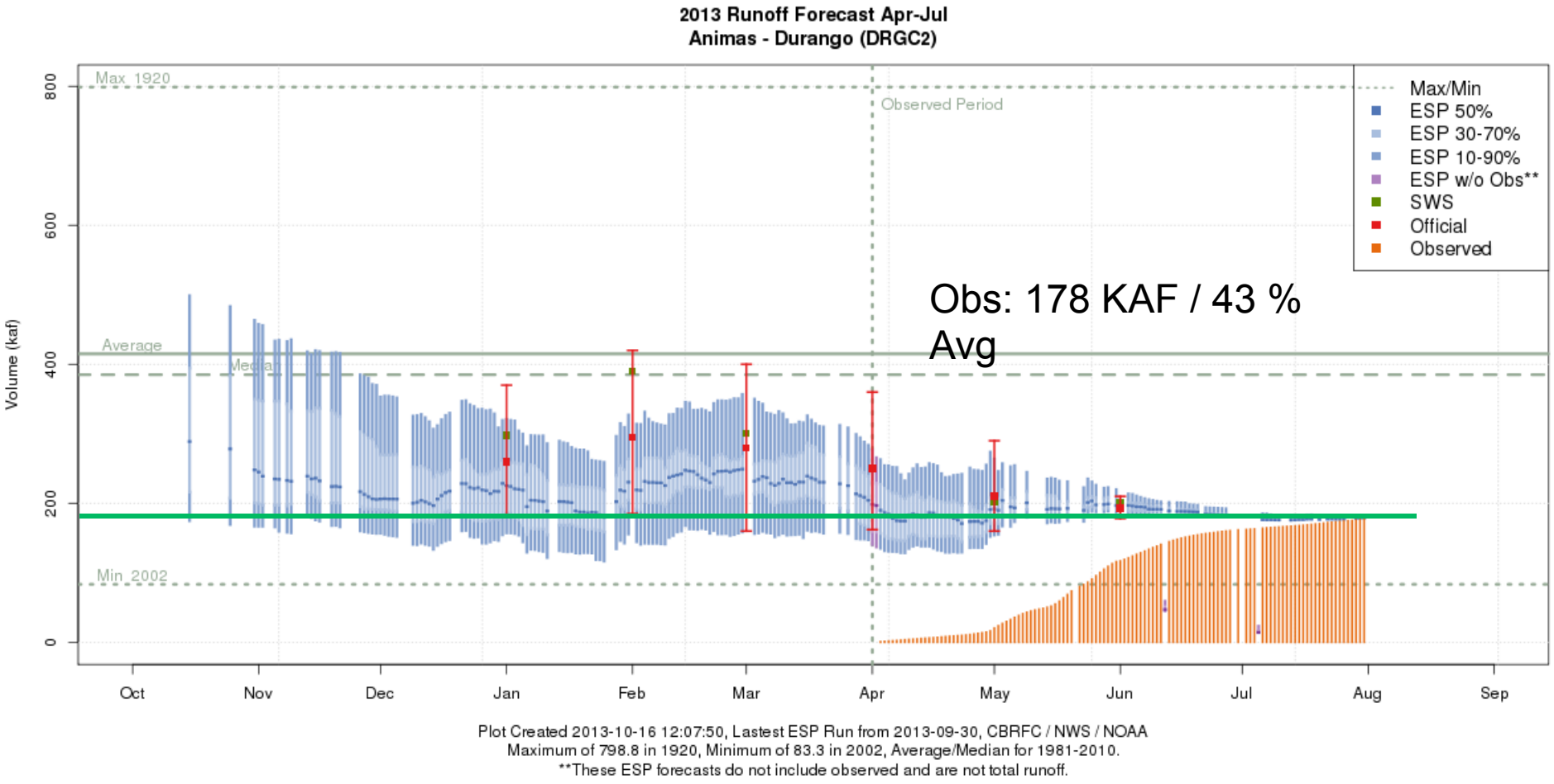


San Juan Basin

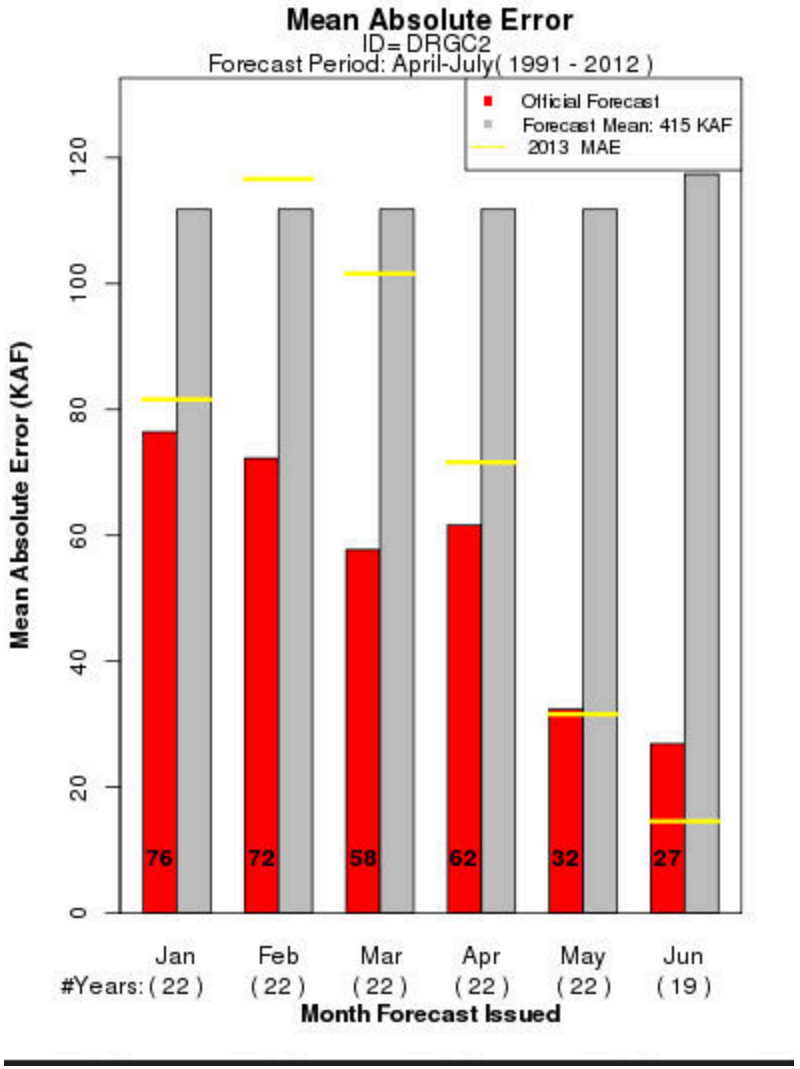


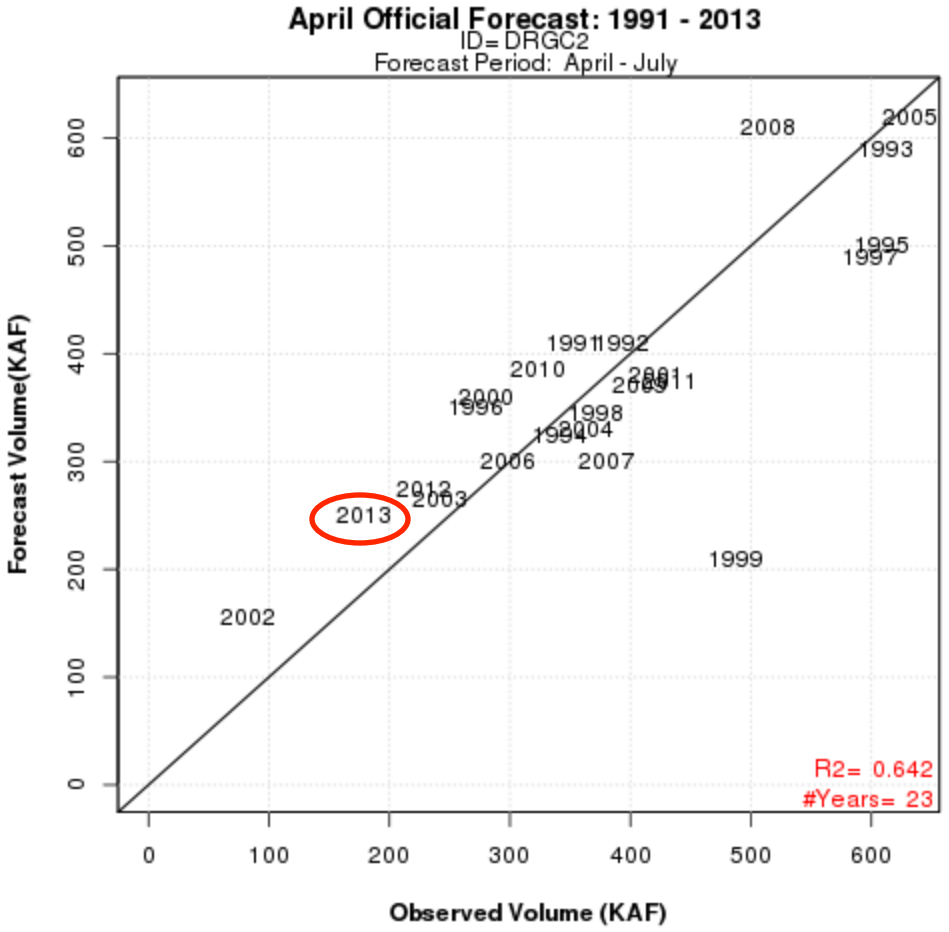
- Summary:
  - Very dry soil conditions entering the winter season
  - Good Dec and especially Jan precipitation amounts. Very dry conditions developed from February through May.
  - Snow Water Equivalent (SWE) while below average all season, did show some improvement during January. Beyond January snowpack conditions deteriorated.
  - Forecasts were too high, especially in Jan-Feb. It took until May before forecasts were more in line with resulting observations.

Animas - Durango

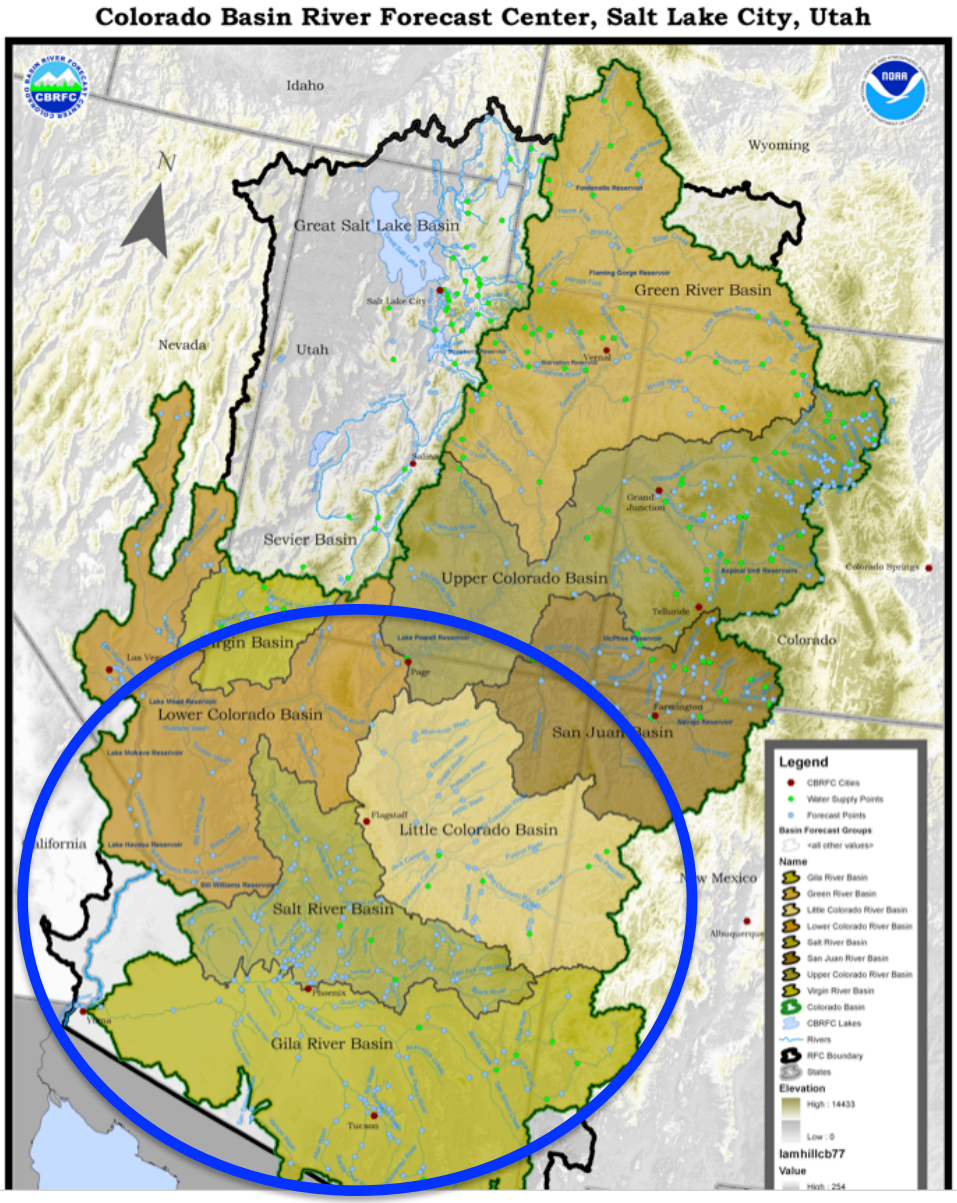


Animas - Durango





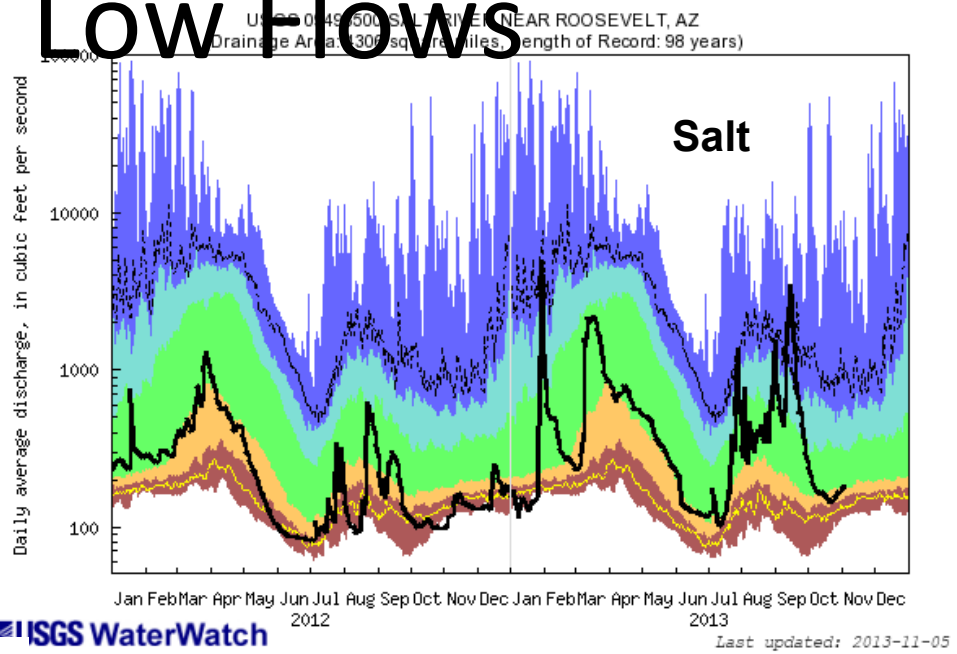
Lower Colorado Basin

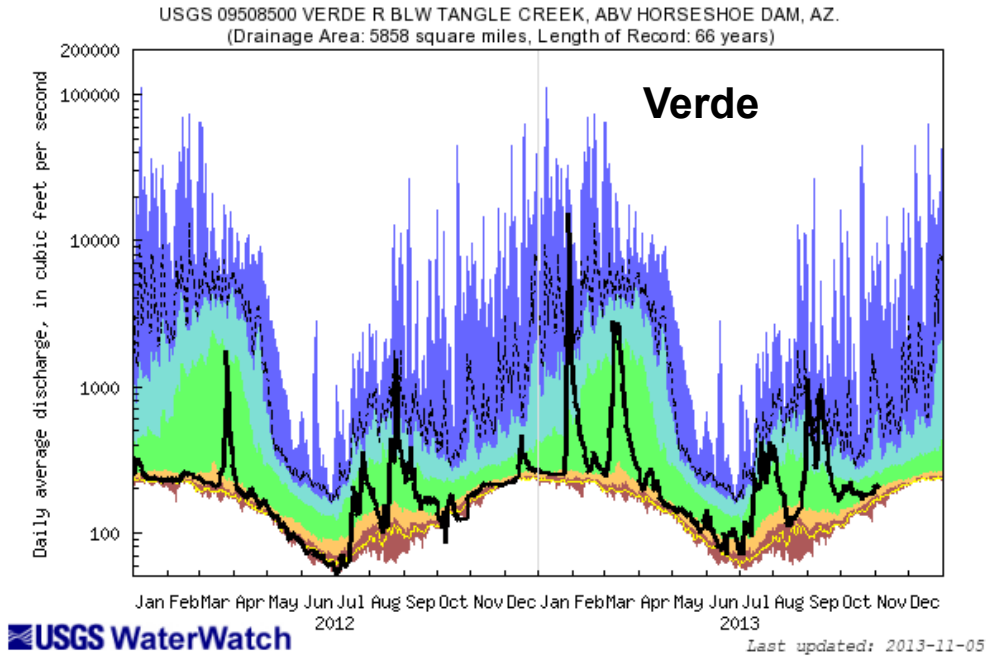


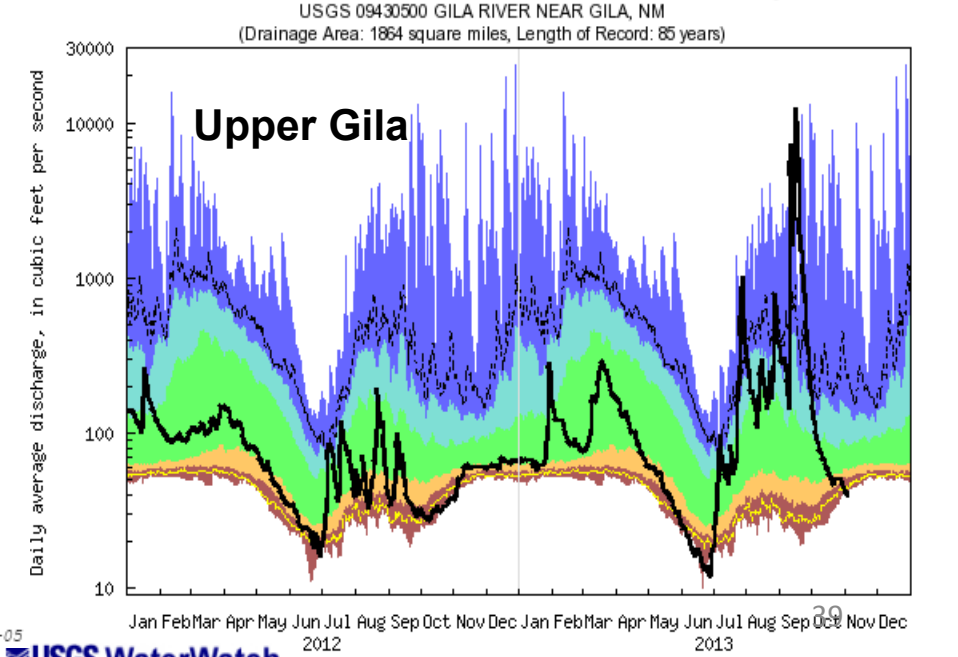
- Virgin:
  - Snowpack started well after wet Dec.
  - Below average precipitation Jan-Jun resulted in another dry year.
- Salt-Verde:
  - Generally dry for an extended period, particularly in Salt.
  - Verde Basin faired better with precipitation events.
  - Neutral conditions throughout the forecast period.
  - Dry soil conditions entering the season.
  - Early snowpack fizzled.

Drought and Low Flows

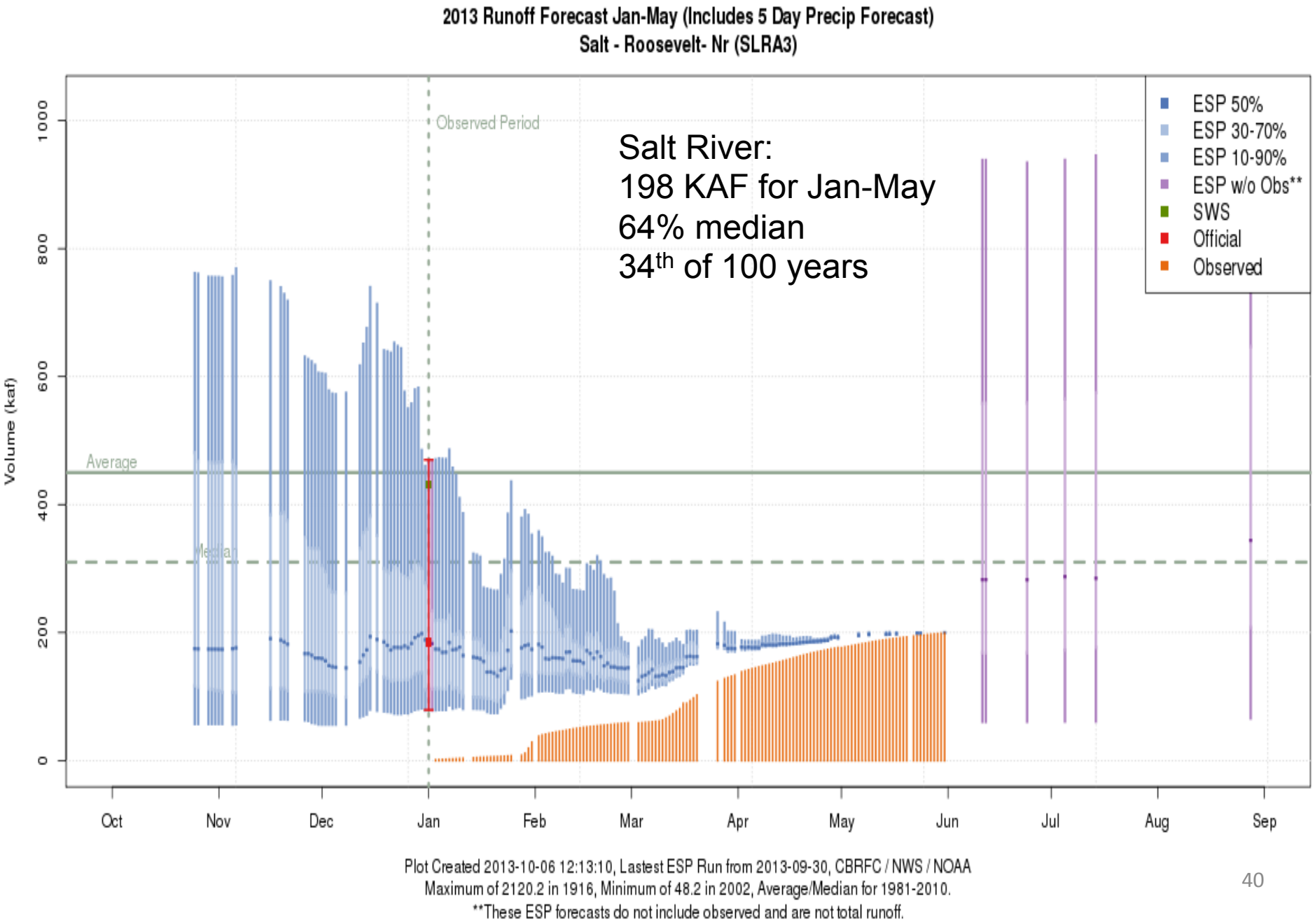
- Dry conditions throughout AZ
- Being so dry from last year definitely factored into this year's forecast
- Conditions improved this summer for next year's WS



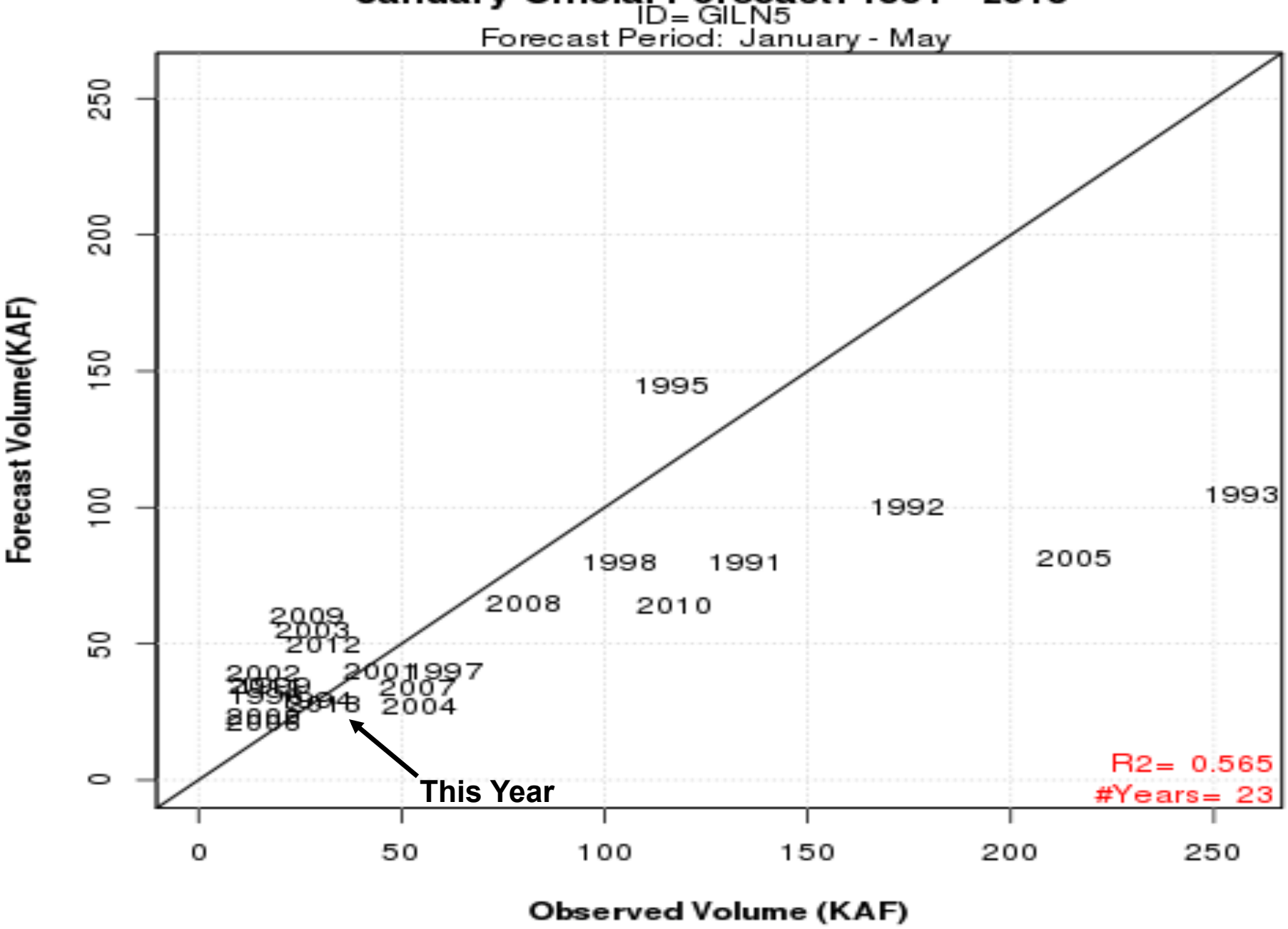




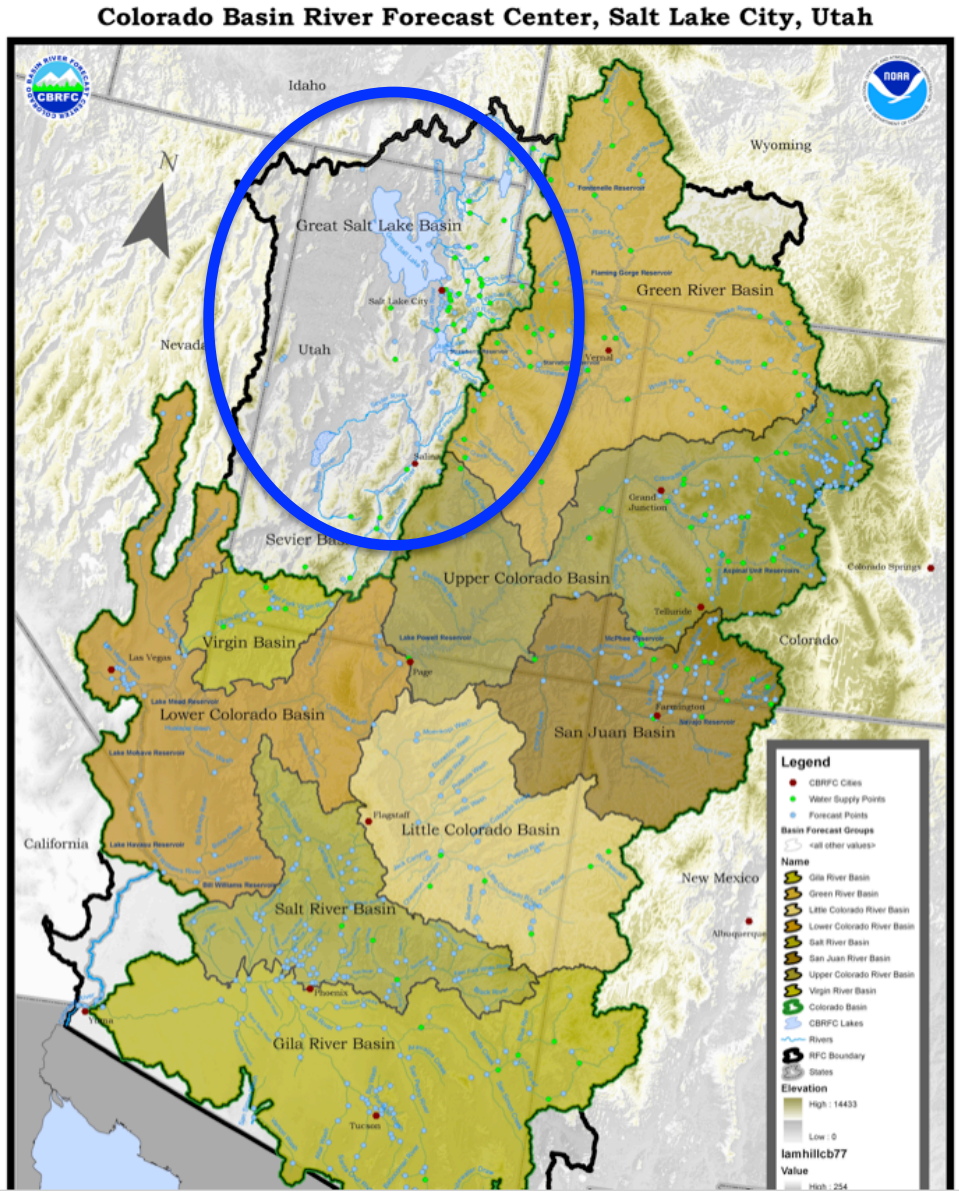
Salt


2013 Runoff Forecast Jan-May (Includes 5 Day Precip Forecast)
Salt - Roosevelt- Nr (SLRA3)
Observed Period
Salt River:
198 KAF for Jan-May
64% median
34th of 100 years
ESP 50%
ESP 30-70%
ESP 10-90%
ESP w/o Obs**
SWS
Official
Observed
Average
Median
Volume (kaf)
0
200
400
600
800
1000
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Plot Created 2013-10-06 12:13:10, Lastest ESP Run from 2013-09-30, CBRFC / NWS / NOAA
Maximum of 2120.2 in 1916, Minimum of 48.2 in 2002, Average/Median for 1981-2010.
**These ESP forecasts do not include observed and are not total runoff.

GILA RIVER – Forecast Performance the Last 23 Yrs

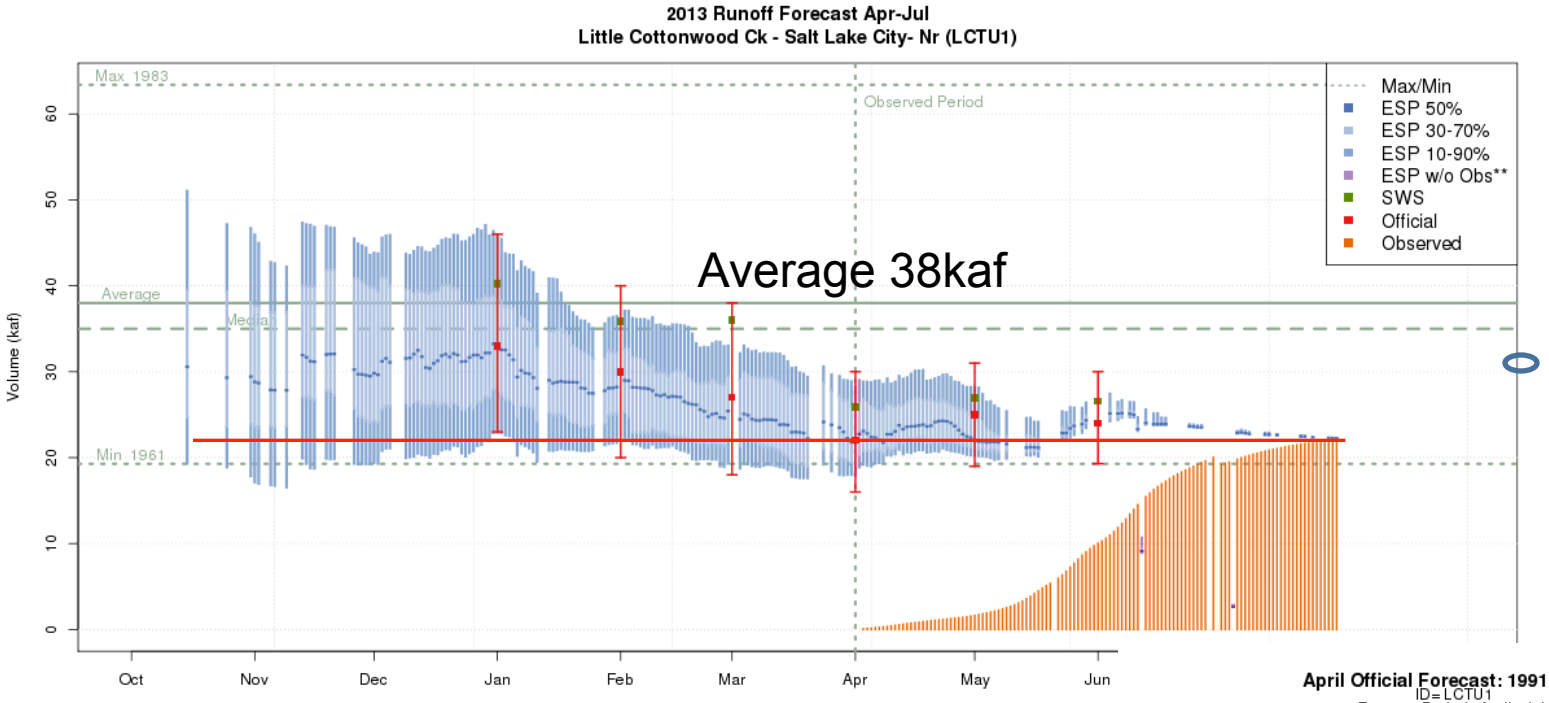


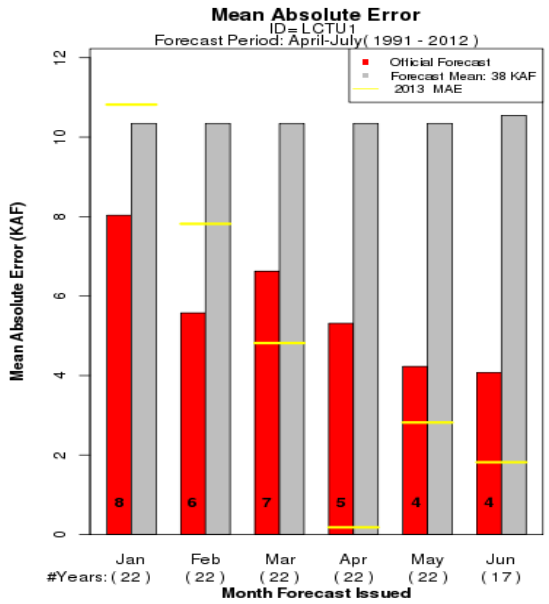
Great Basin

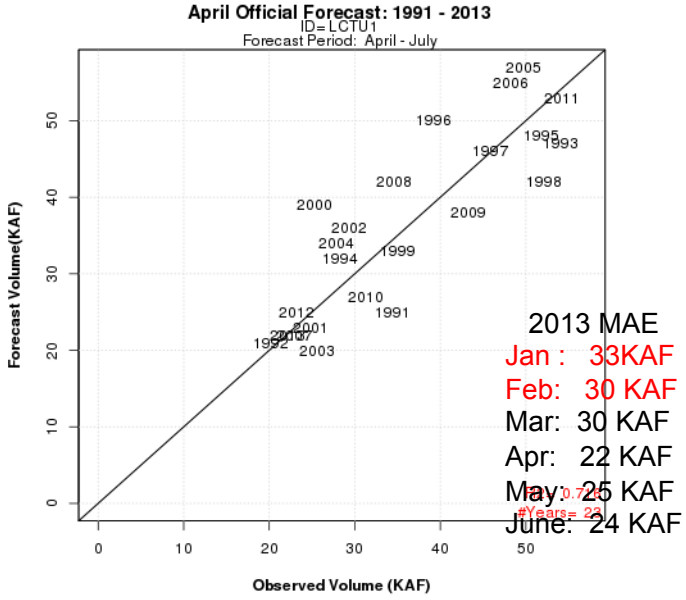


- Similar to Upper Colorado

Little Cottonwood Creek nr Salt lake City







2013 MAE
Jan : 33KAF
Feb: 30 KAF
Mar: 30 KAF
Apr: 22 KAF
May: 25 KAF
June: 24 KAF

2013 Summary

- Generally dry basin wide. Key exceptions:
  - Wet summer (JAS) -> good for antecedent conditions for WY14
  - December 2012 was wet but largely balanced out by dry preceding months leading to below average forecasts
  - April 2013 was wet in the upper basin. Low pressure moved through southern Utah to northern Colorado producing disparate impacts for precipitation within basin
- CBRFC debuted daily ESP forecast updates and continued legacy forecast products but without formal NRCS coordination
- Early season forecasts were generally higher than observed volumes particularly for points with very low volumes. Late season forecasts generally very good. Outlier basins with near average volumes were an exception – forecasts for these were in some cases underdone.

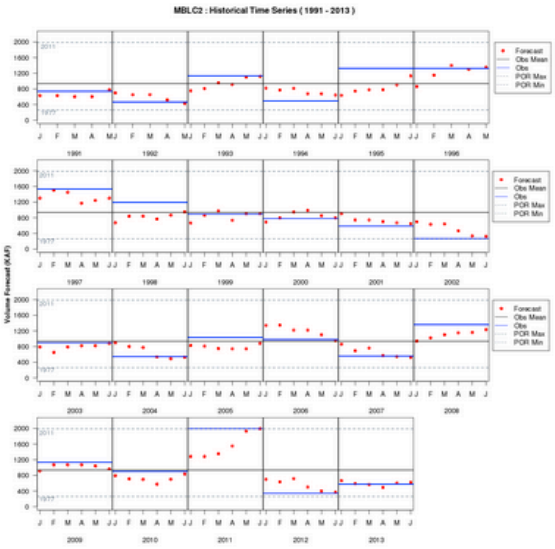
Additional Verification Resources

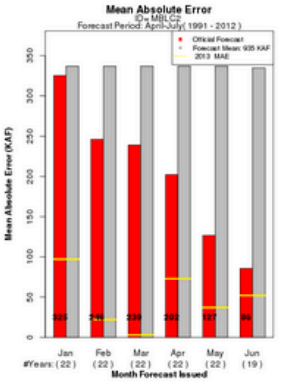
- Verification plots used in the presentation are available for all CBRFC forecast points
- CBRFC has generated 30 years of reforecasts to assess skill of current tools (e.g. ESP and SWS). Plots assessing their skill and reliability are available from individual forecast point websites

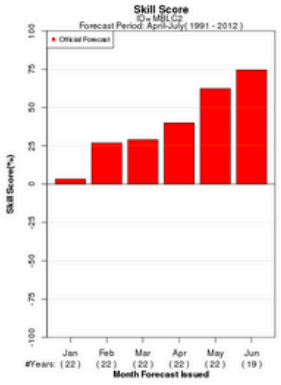
News: CBRFC website improvements coming soon.

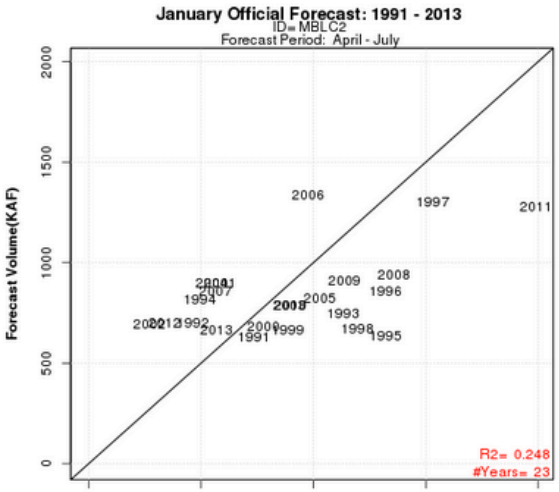
ESP runoff forecasts scheduled to resume in November.

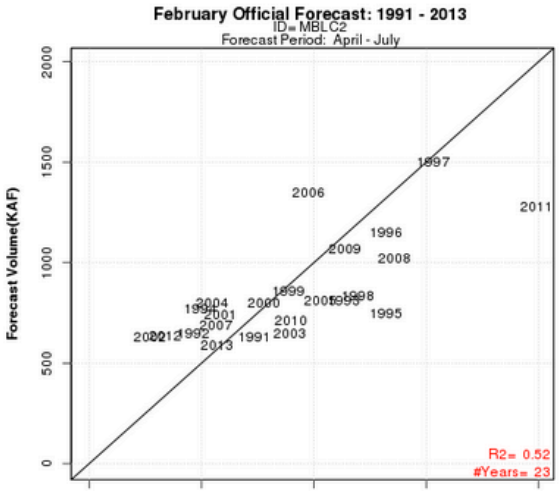
MBLC2 Water Supply Forecasts

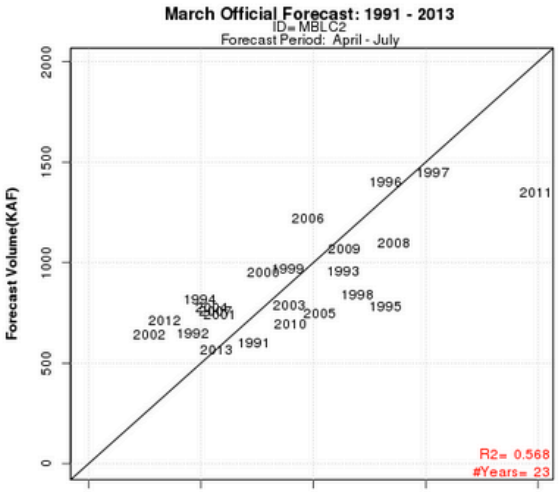










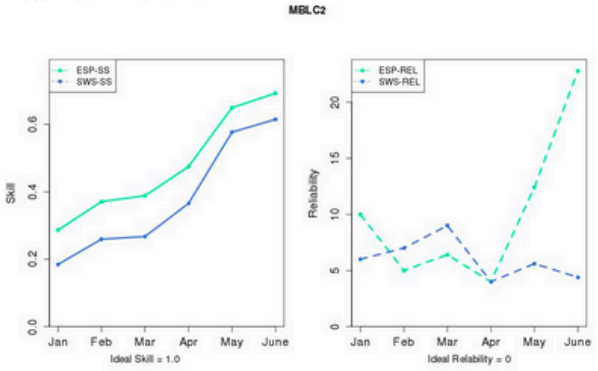


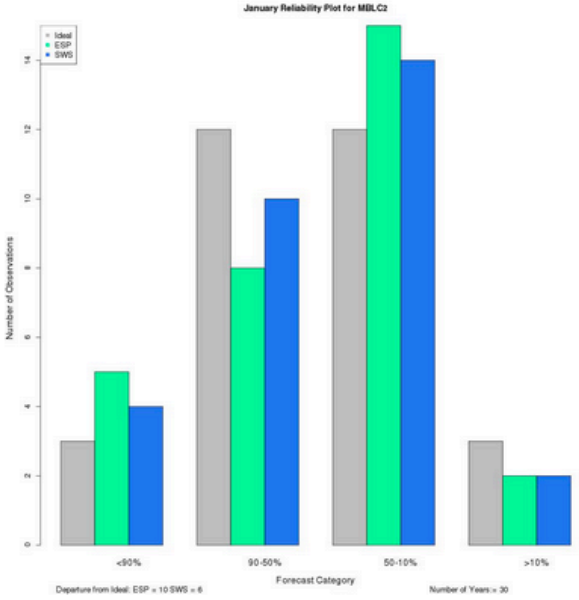
ESP runoff forecasts scheduled to resume in November.

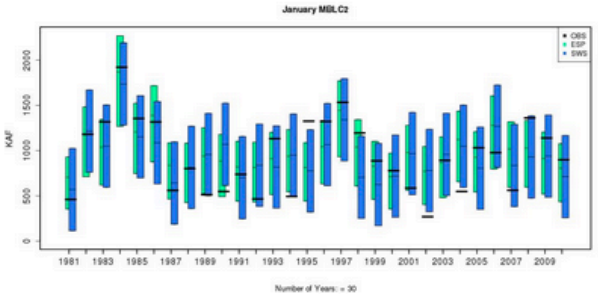
MBLC2 Water Supply Forecasts

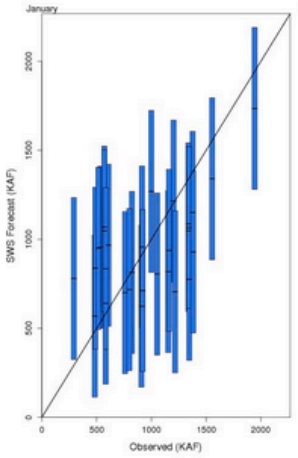
Plot Forecasts Observations Historical Annual/Official Verification Reforcast Verification

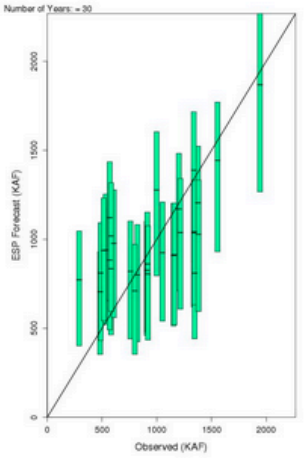
Water Year: 2013 2014







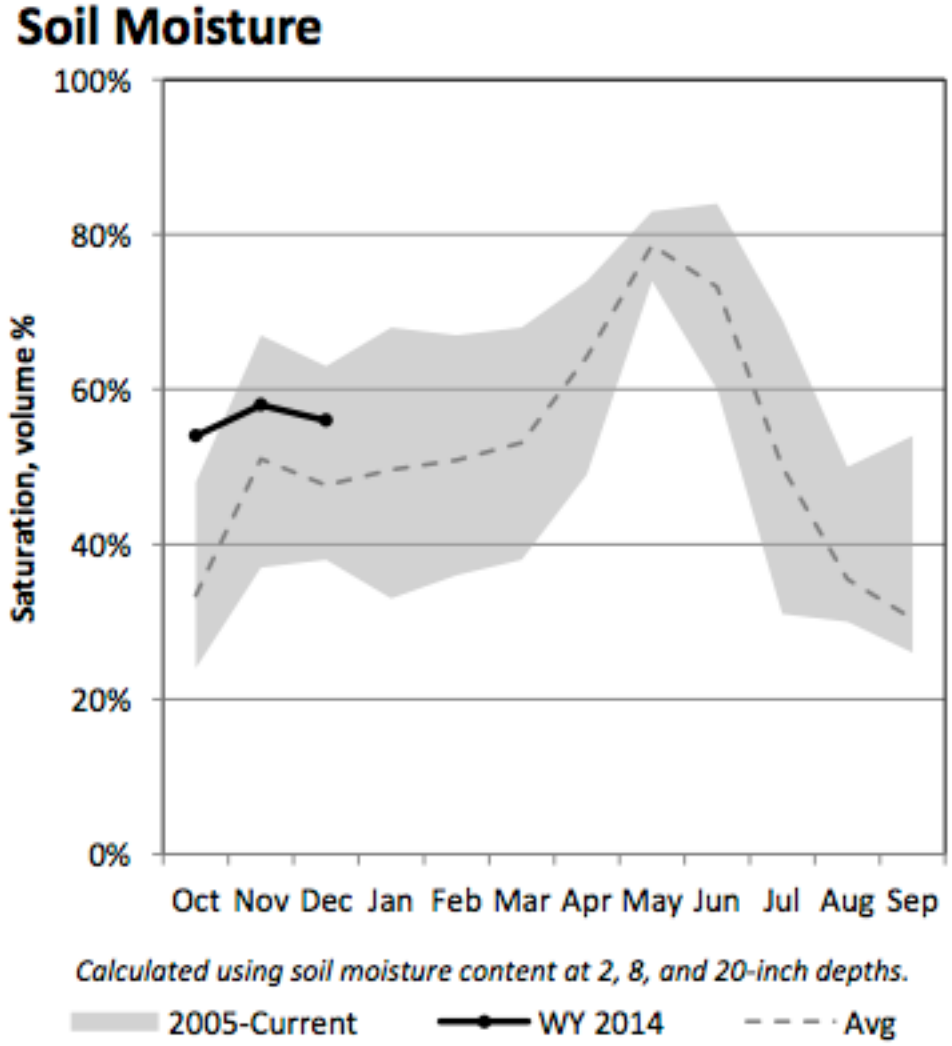




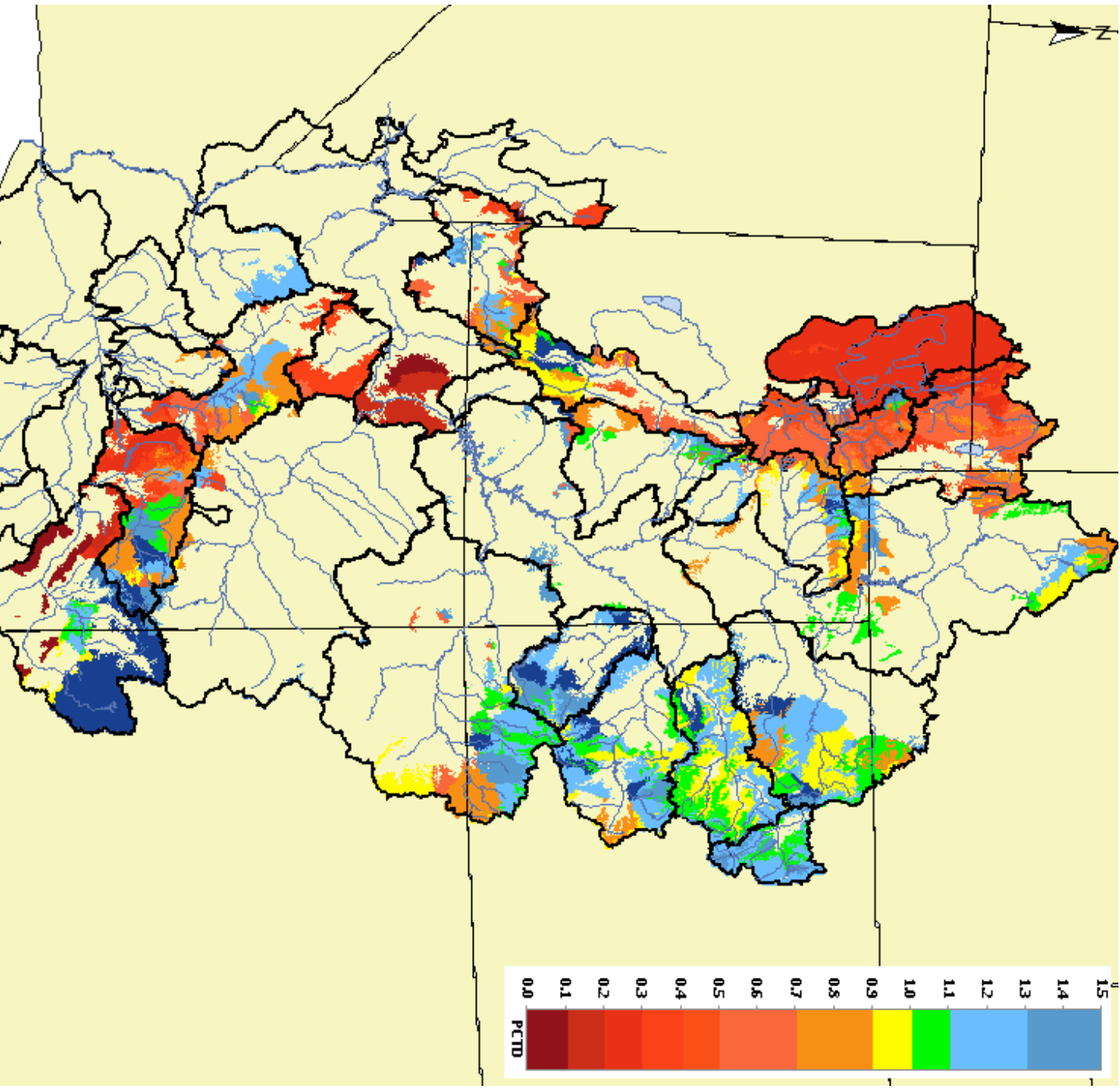
2014 Look Ahead

- Outlook and current situation:
  - Good antecedent conditions
  - Climate Forecasts and ENSO
- CBRFC updates
  - Daily ESP
  - Webinars
  - Stakeholder Forum

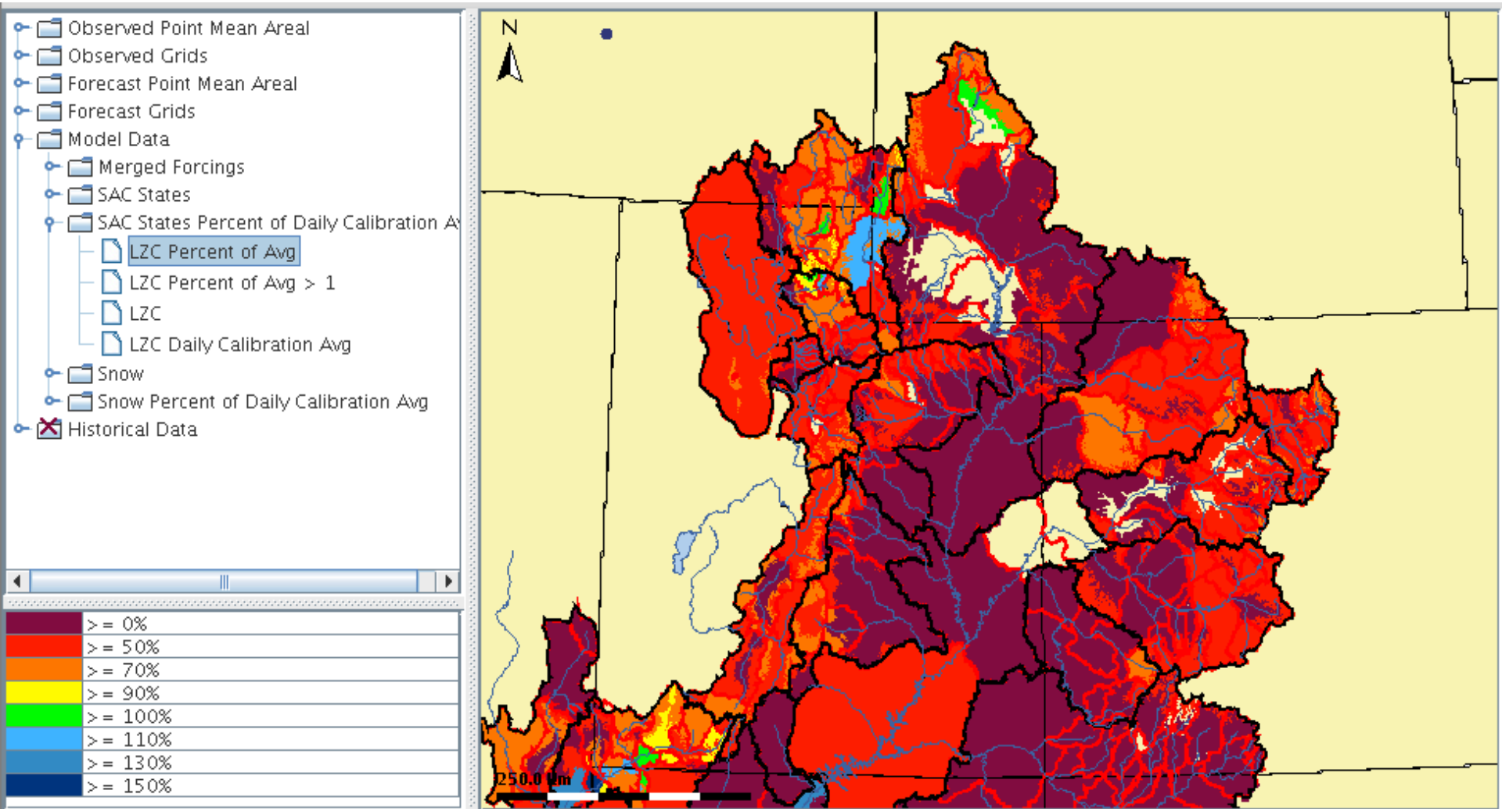
UT SNOTEL Soil Moisture



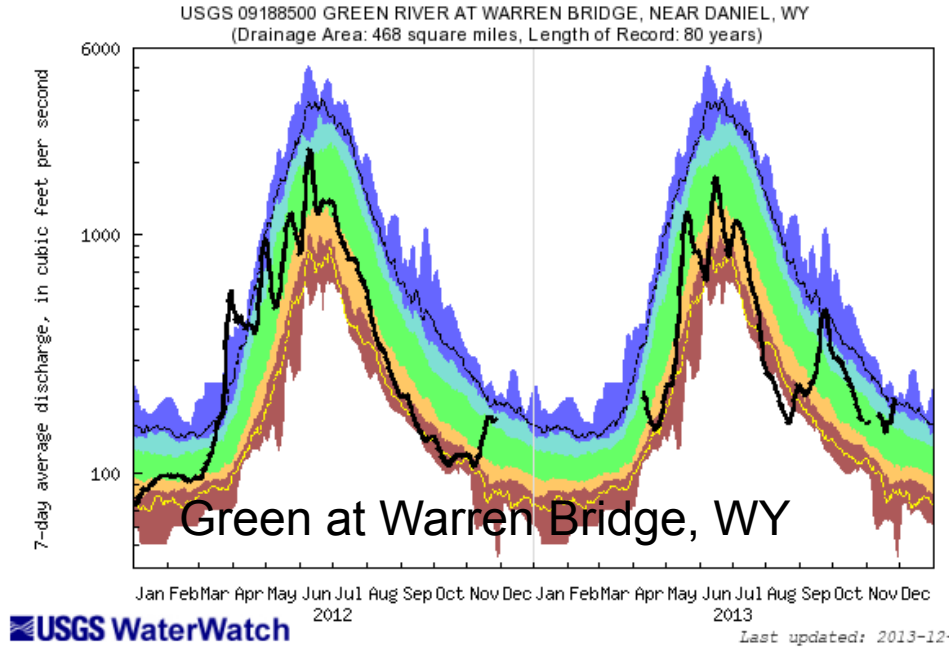
CBRFC Model Soil Moisture 11/1/2013

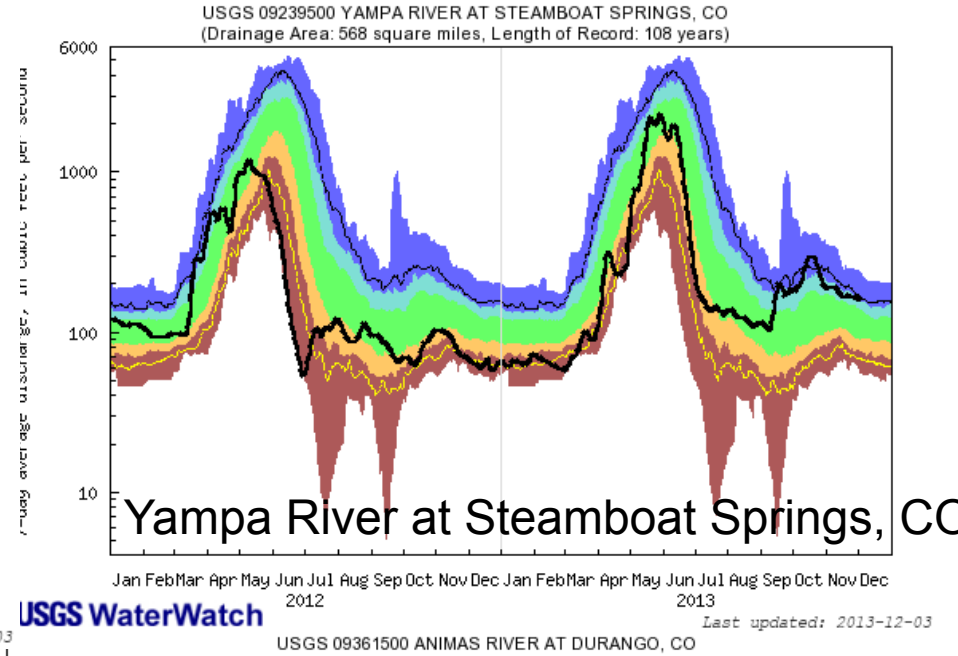


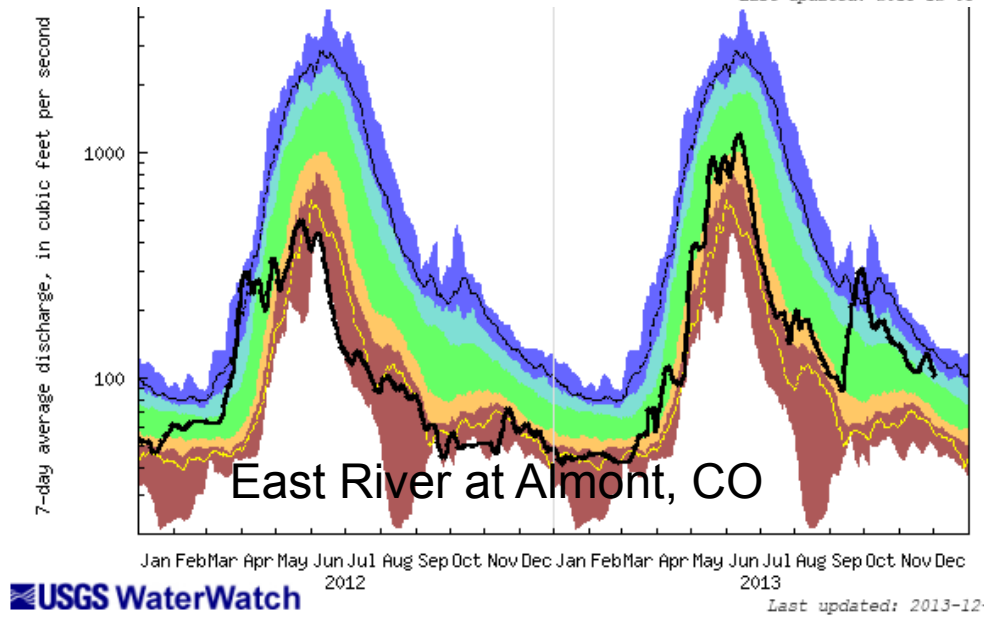
CBRFC Model Soil Moisture 11/1/12

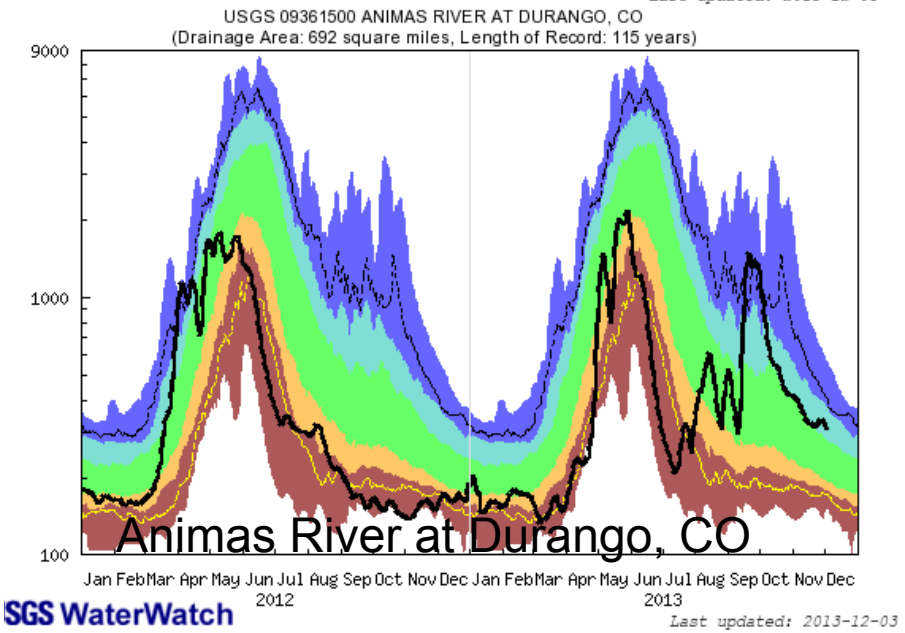


Base flows

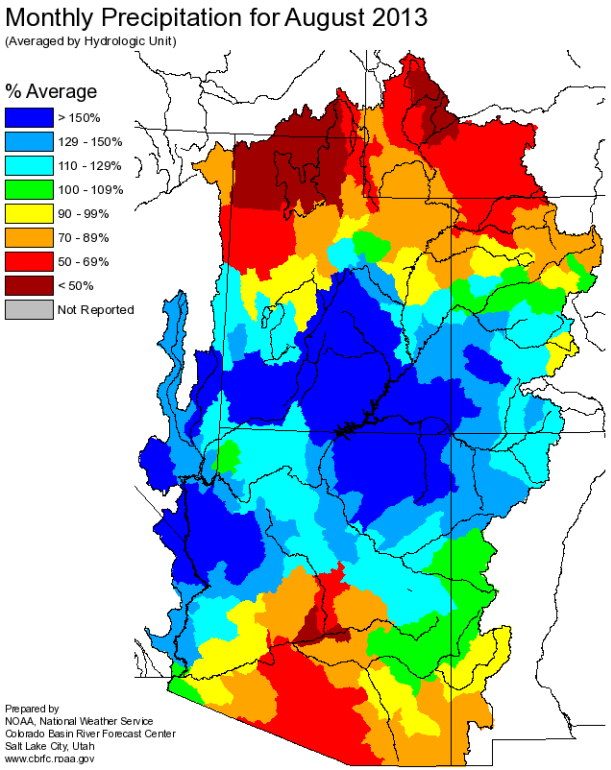

USGS 09188500 GREEN RIVER AT WARREN BRIDGE, NEAR DANIEL, WY
(Drainage Area: 468 square miles, Length of Record: 80 years)
7-day average discharge, in cubic feet per second
6000
1000
100
Green at Warren Bridge, WY
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2012
2013
USGS WaterWatch
Last updated: 2013-12-03

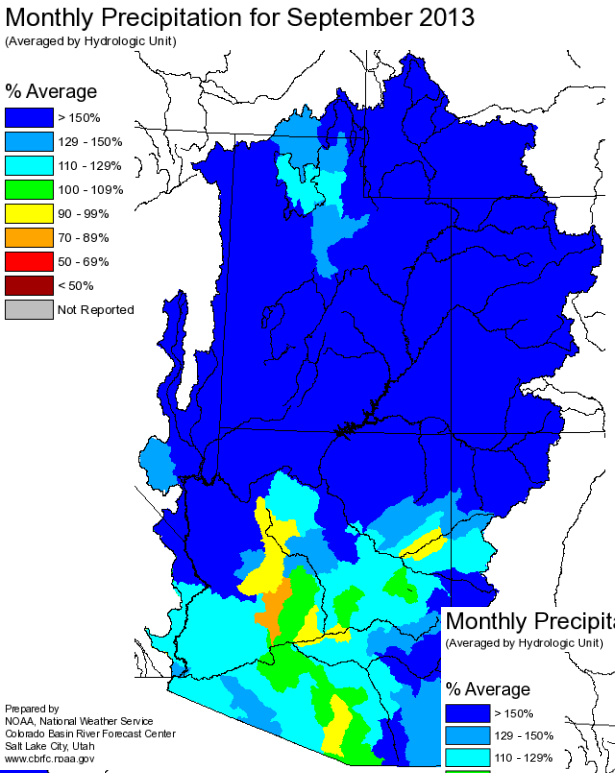

USGS 09239500 YAMPA RIVER AT STEAMBOAT SPRINGS, CO
(Drainage Area: 568 square miles, Length of Record: 108 years)
6000
1000
100
10
Yampa River at Steamboat Springs, CO
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2012
2013
USGS WaterWatch
Last updated: 2013-12-03

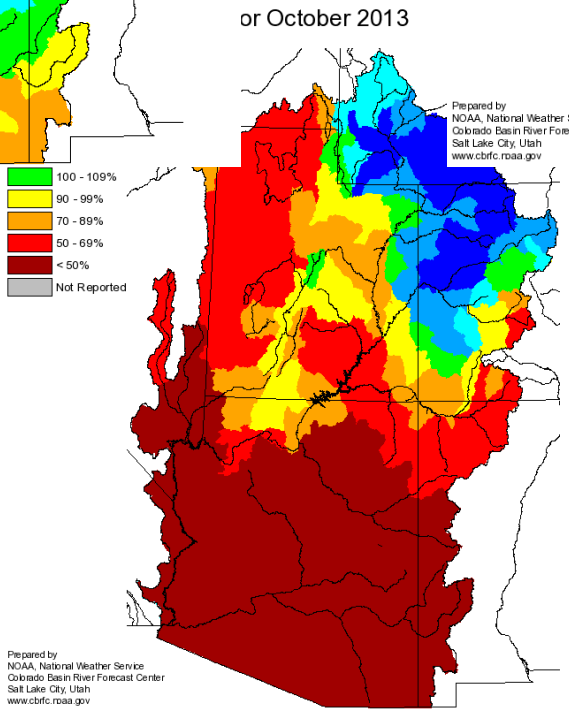

7-day average discharge, in cubic feet per second
1000
100
East River at Almont, CO
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2012
2013
USGS WaterWatch
Last updated: 2013-12-03

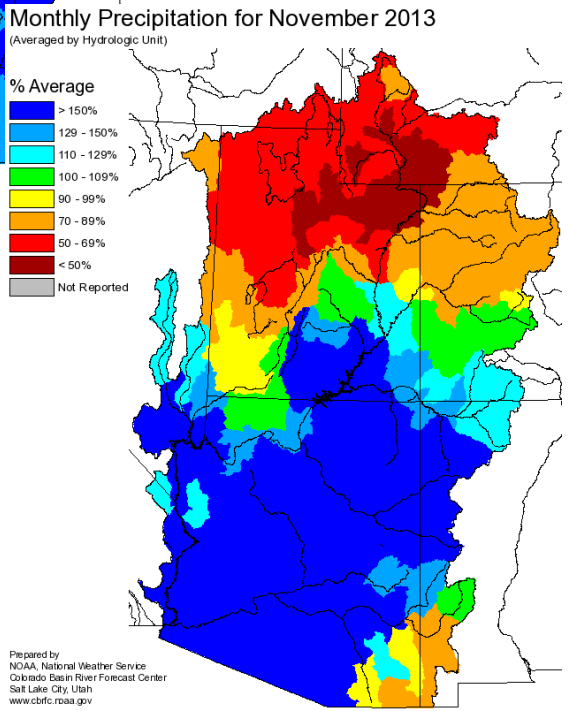

USGS 09361500 ANIMAS RIVER AT DURANGO, CO
(Drainage Area: 692 square miles, Length of Record: 115 years)
9000
1000
100
Animas River at Durango, CO
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2012
2013
USGS WaterWatch
Last updated: 2013-12-03

Summer/Fall Precipitation

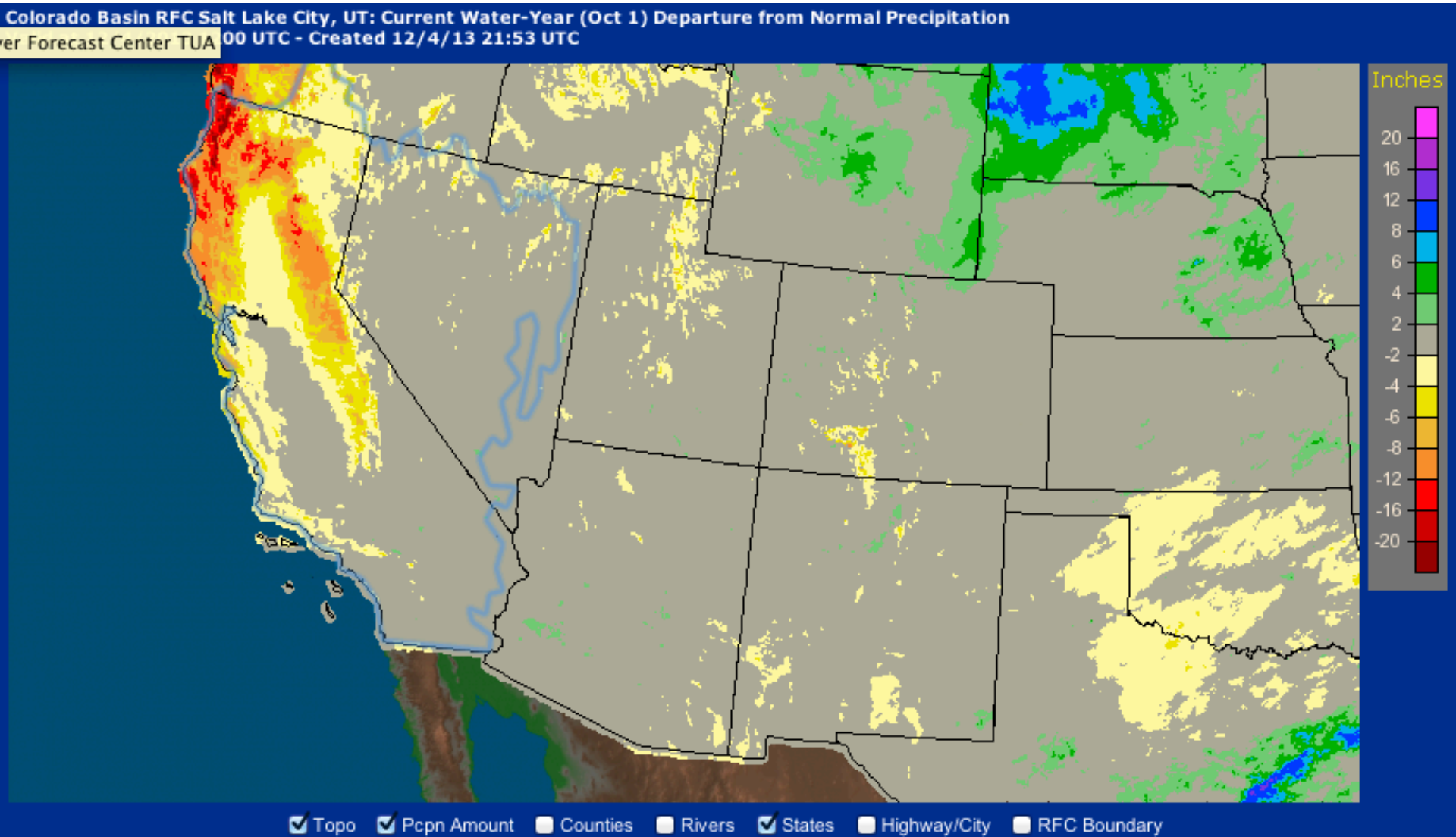




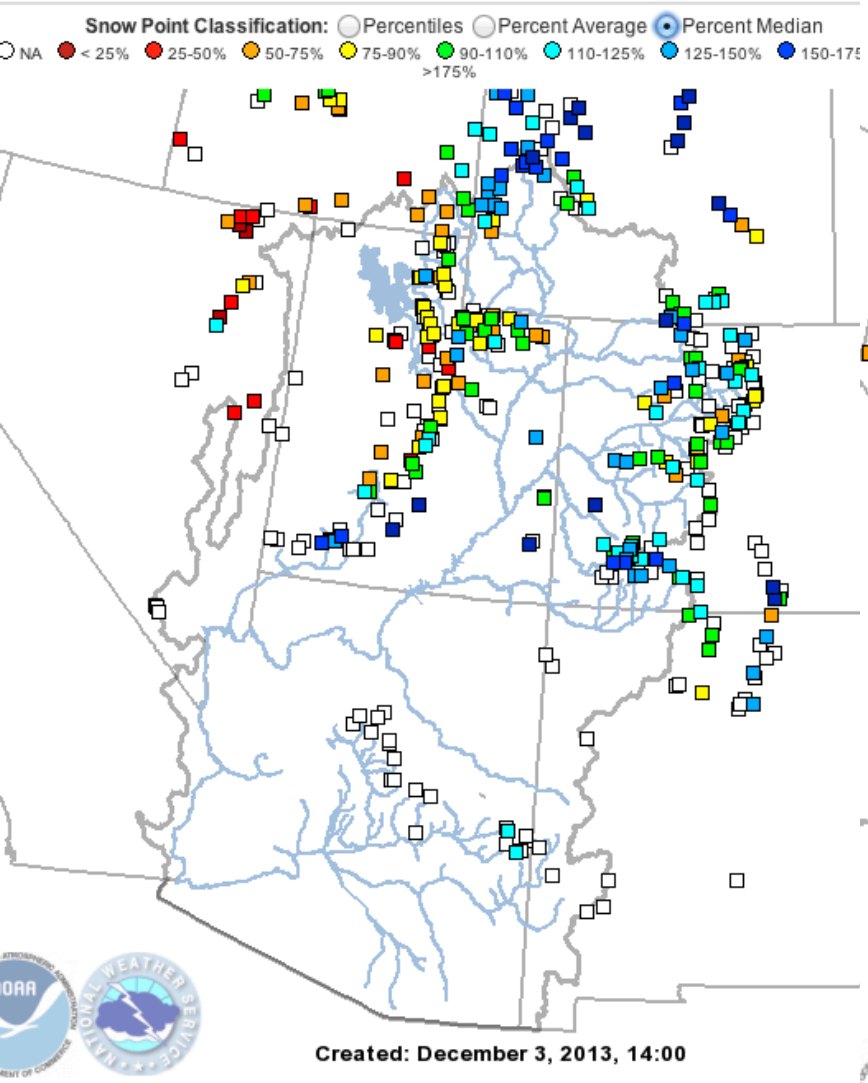


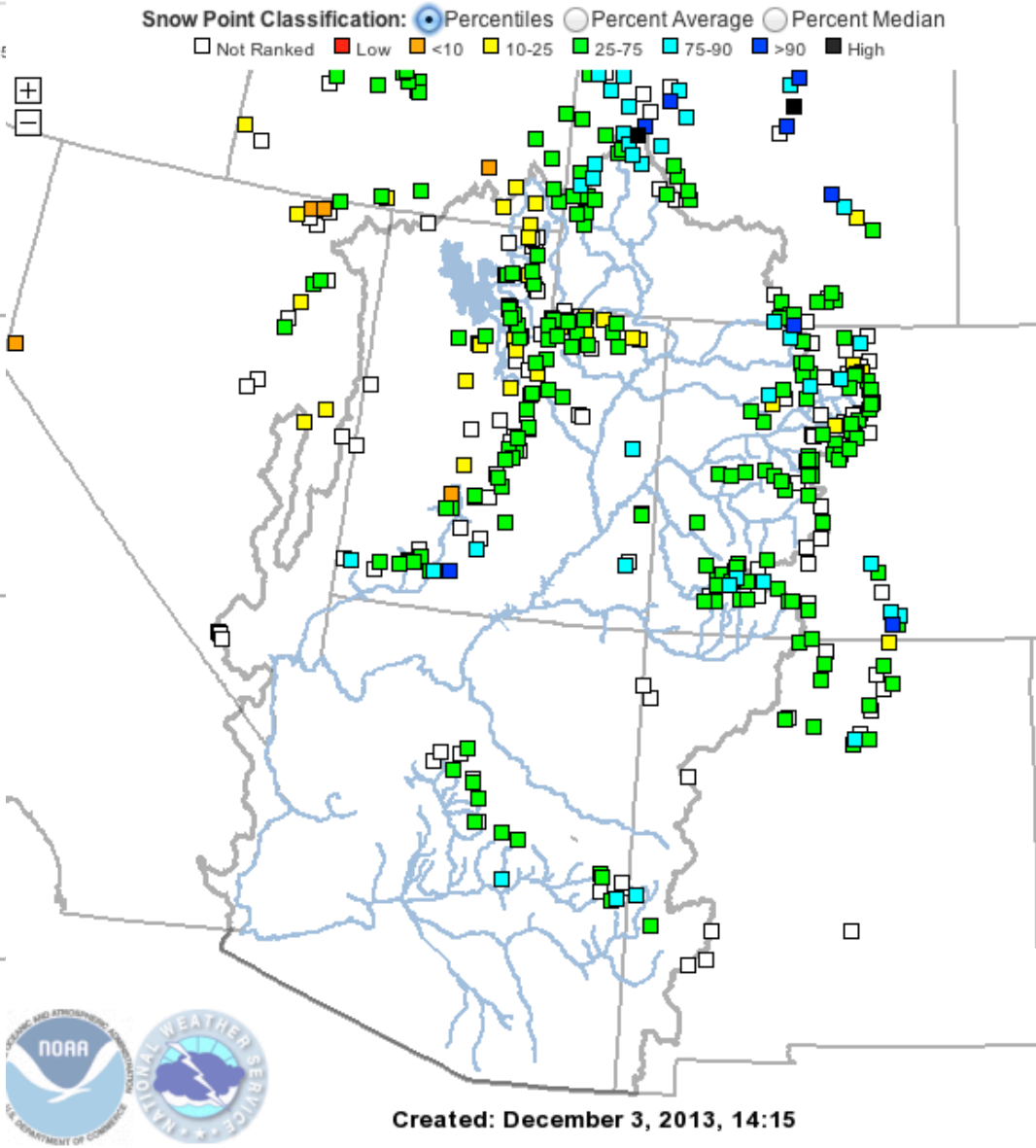


Water Year Precipitation to Date

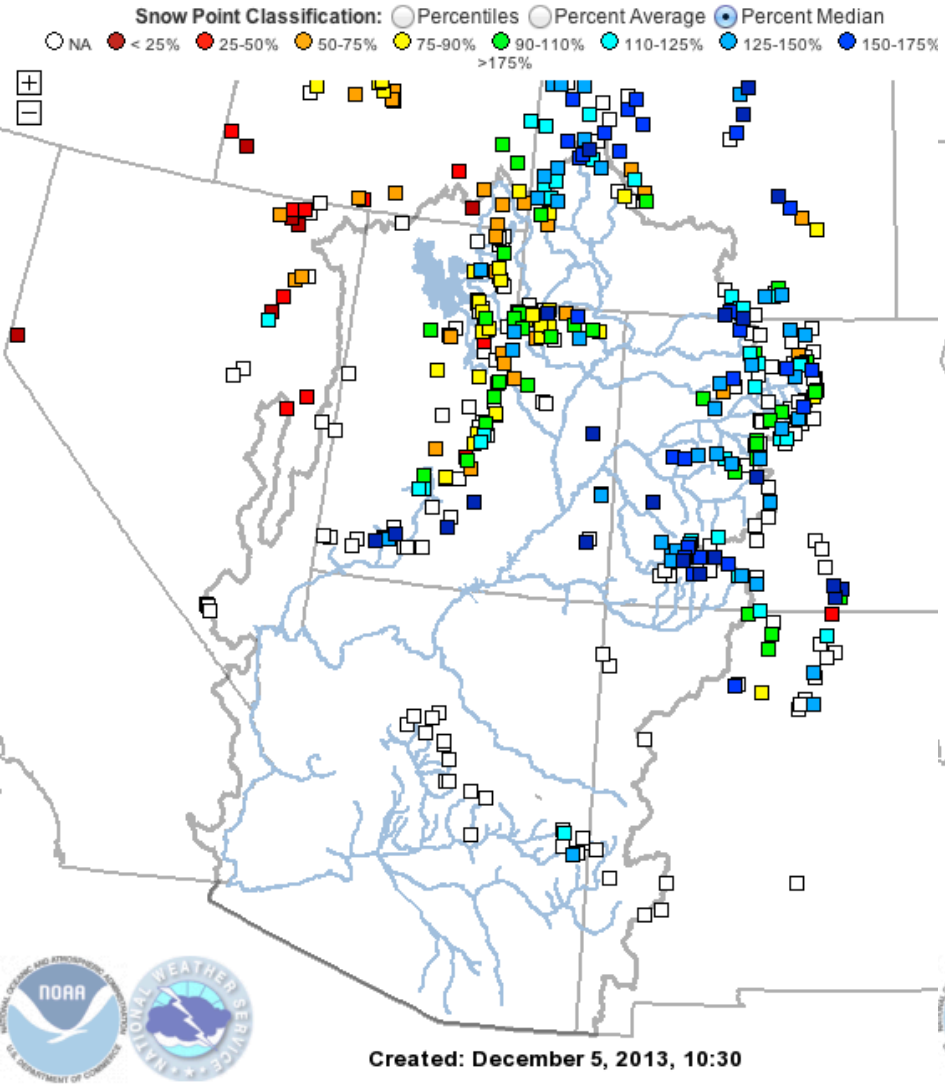


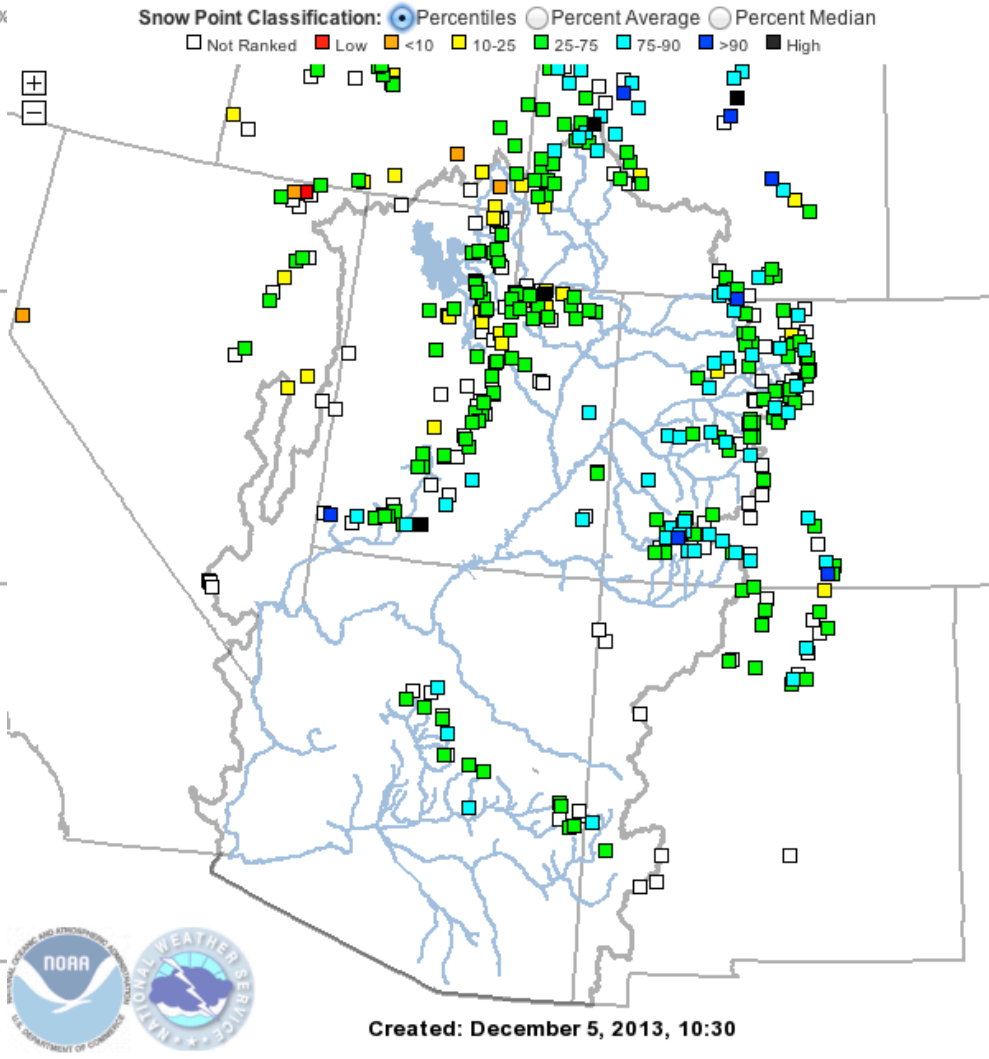
Snow so far (Dec 3)

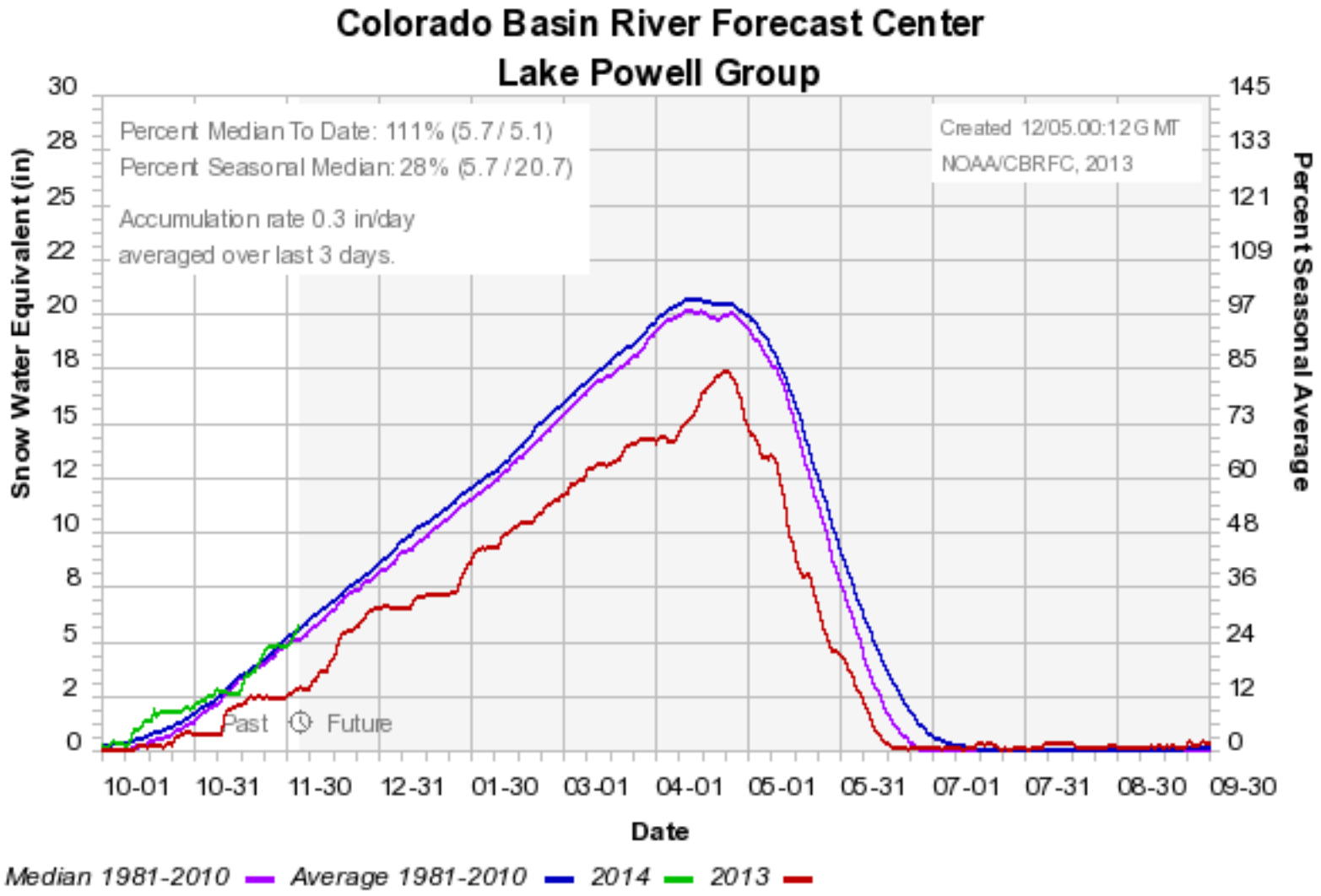




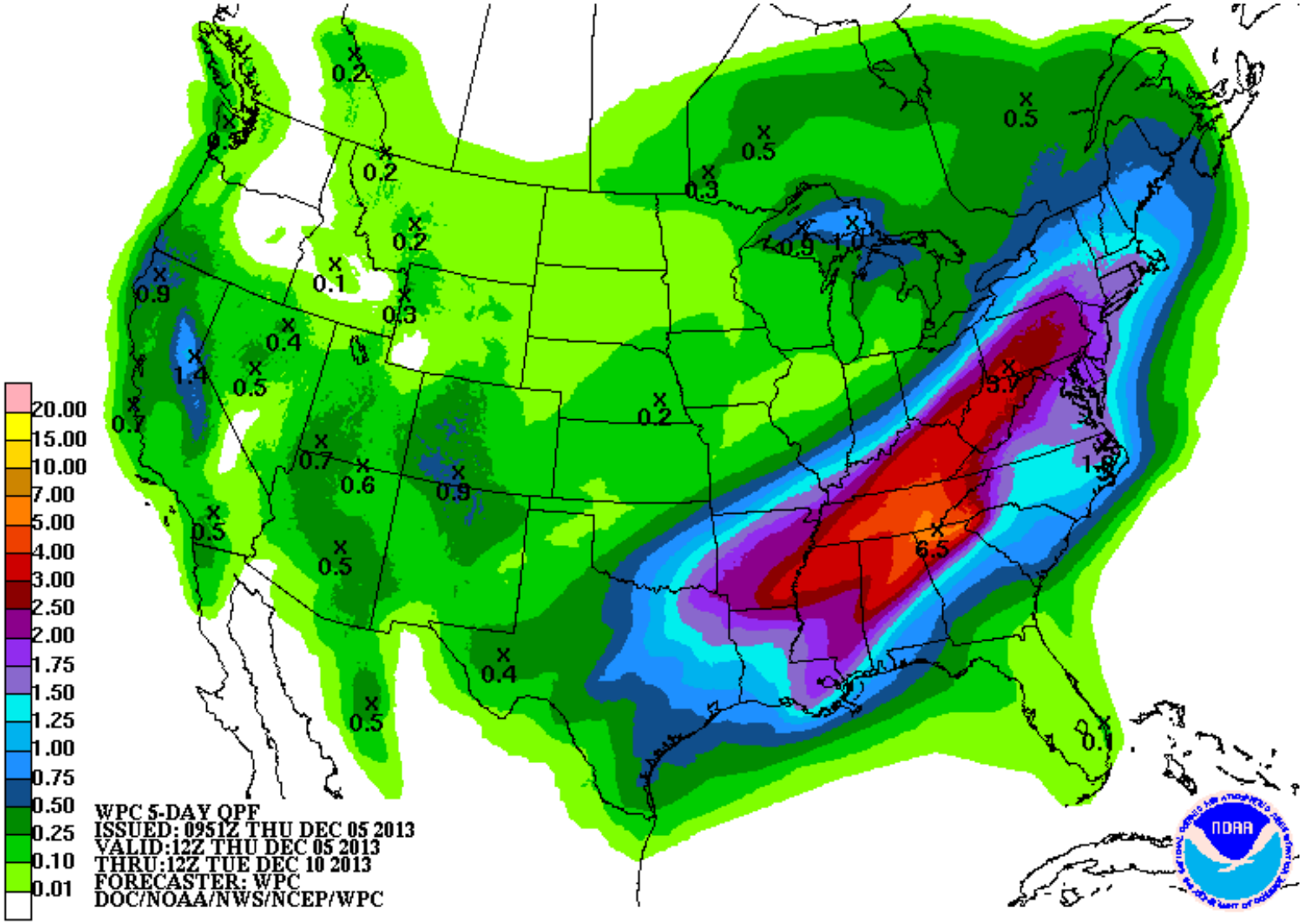
Snow so far (Dec 5)



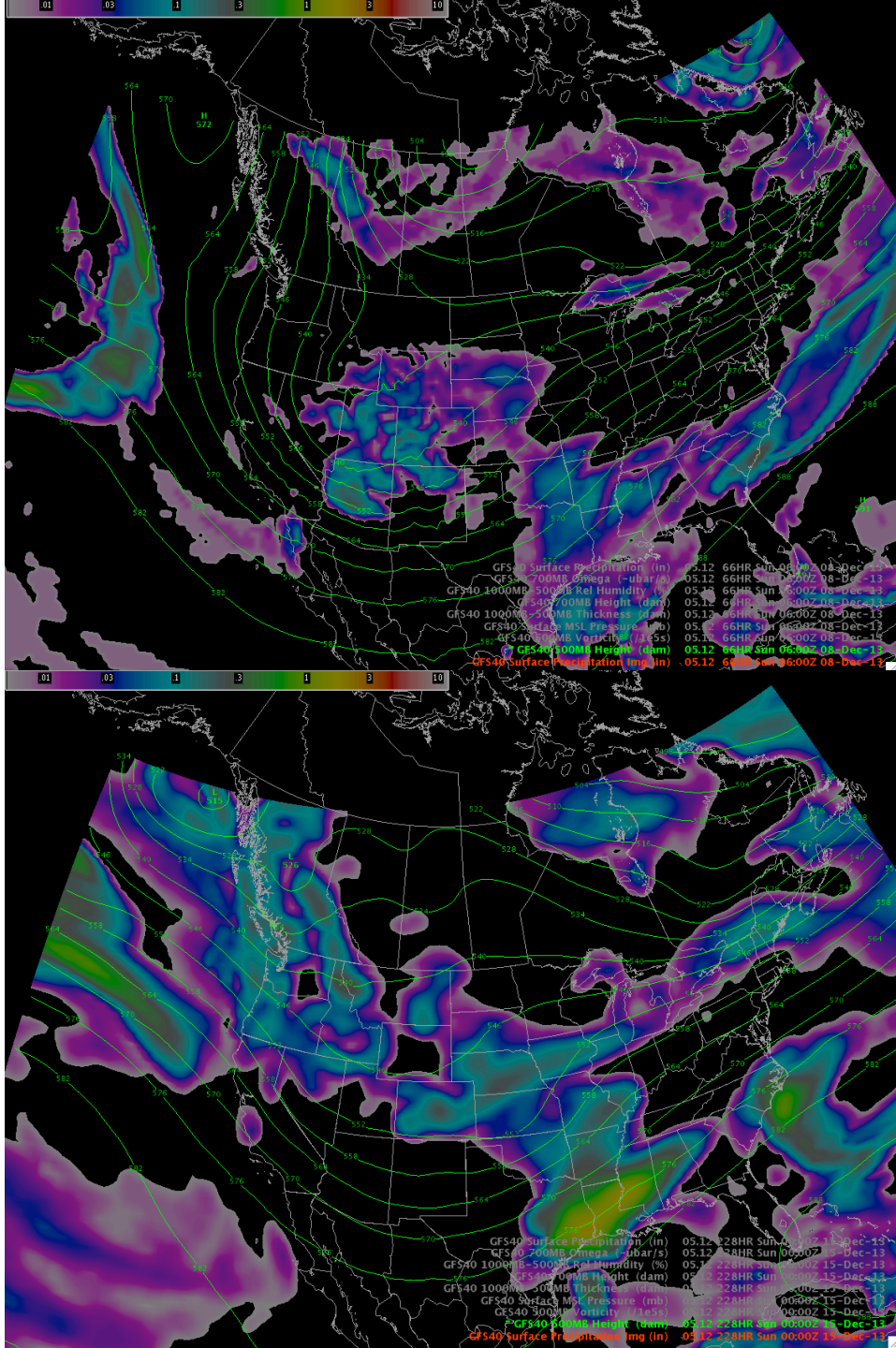



Colorado Basin River Forecast Center
Lake Powell Group
Percent Median To Date: 111% (5.7 / 5.1)
Percent Seasonal Median: 28% (5.7 / 20.7)
Accumulation rate 0.3 in/day
averaged over last 3 days.
Created 12/05.00:12 G MT
NOAA/CBRFC, 2013
Snow Water Equivalent (in)
Percent Seasonal Average
30
28
25
22
20
18
15
12
10
8
5
2
0
145
133
121
109
97
85
73
60
48
36
24
12
0
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
09-30
Date
Median 1981-2010
Average 1981-2010
2014
2013

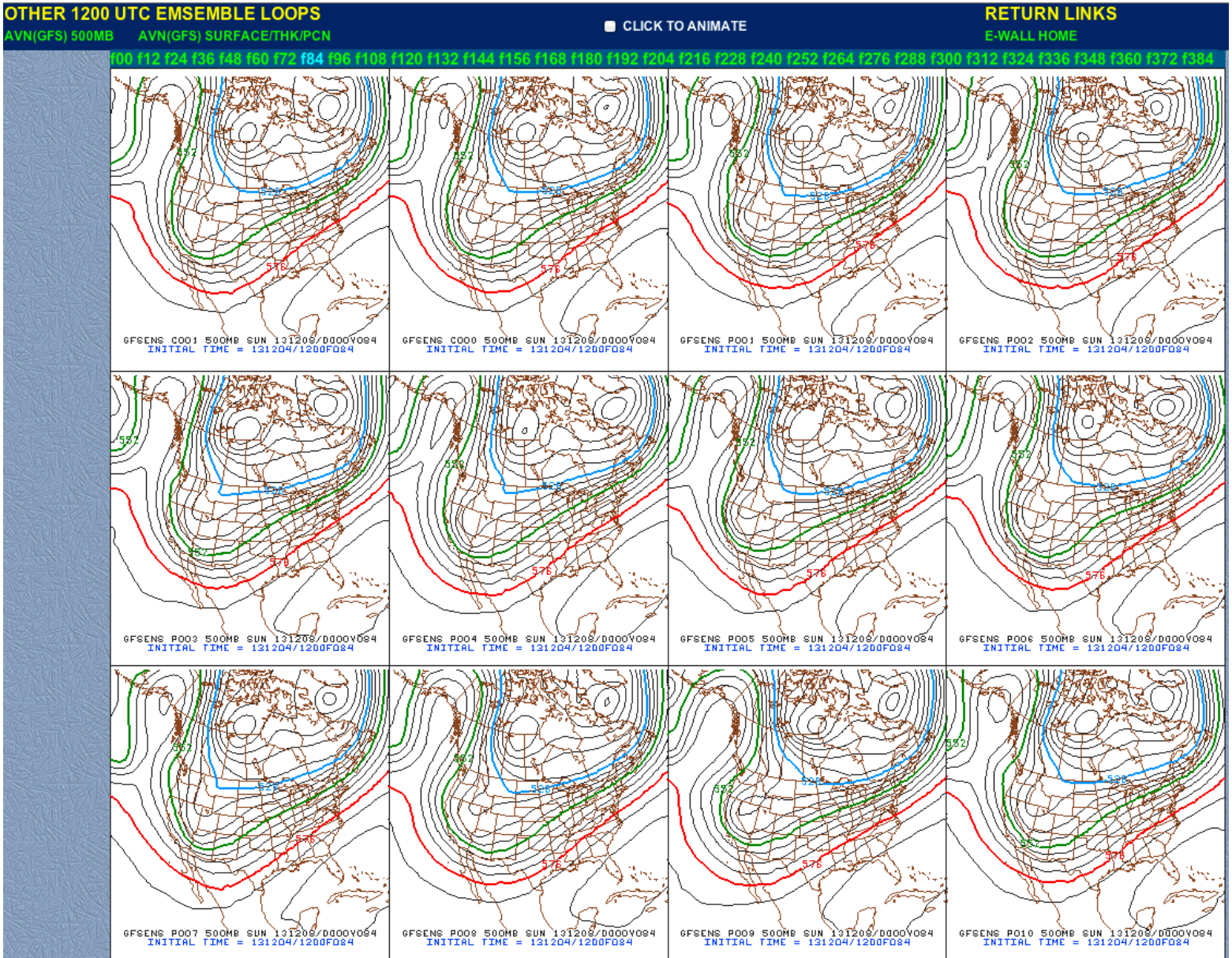
Weather Forecast: Active



- Series of two storms:
  - Storm #1
    - This weekend
    - Cold temperatures
    - ~1” SWE widespread
  - Storm #2
    - Late Next week
    - Warmer
    - Smaller precip amounts mostly to the south

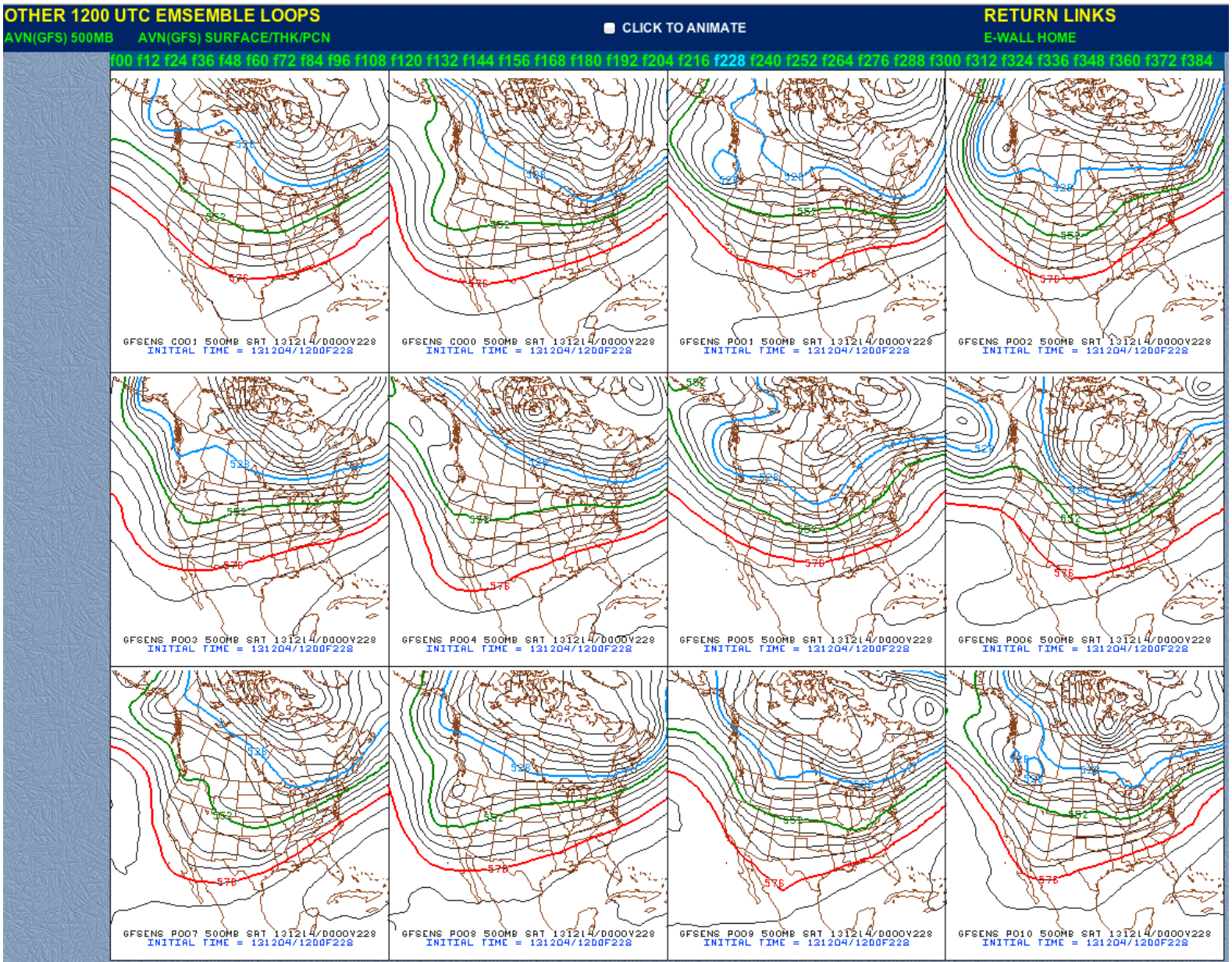


Weather forecasts become very uncertain further out in time



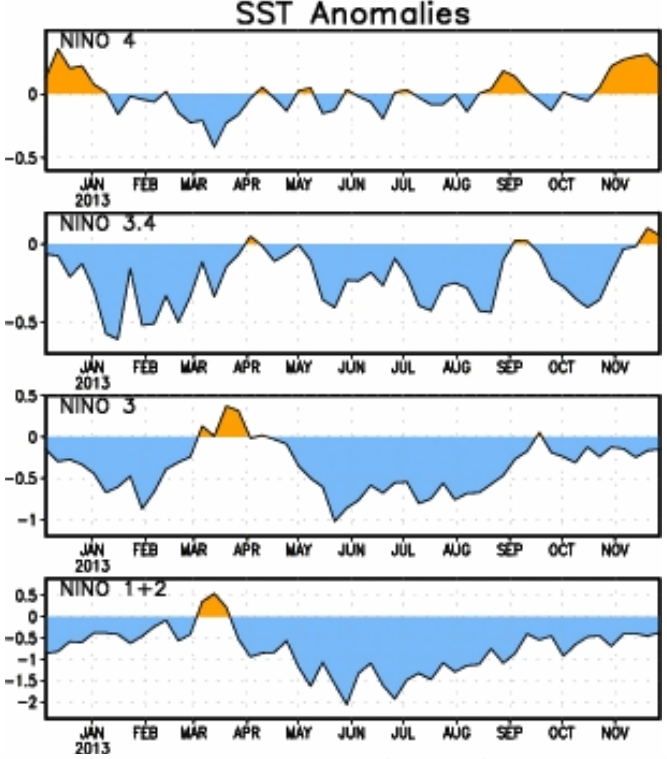
Source: www.meteo.psu.edu

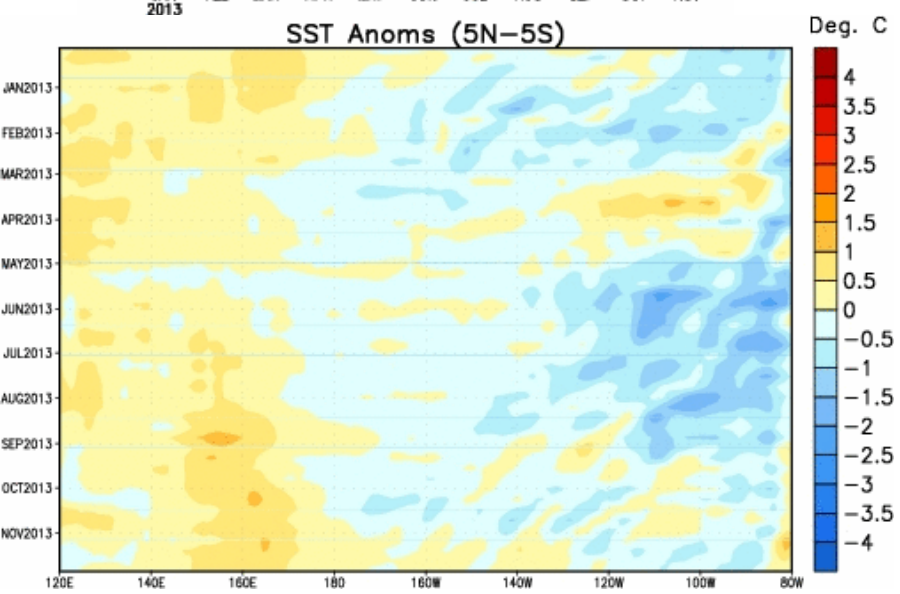
Weather forecasts become very uncertain further out in time

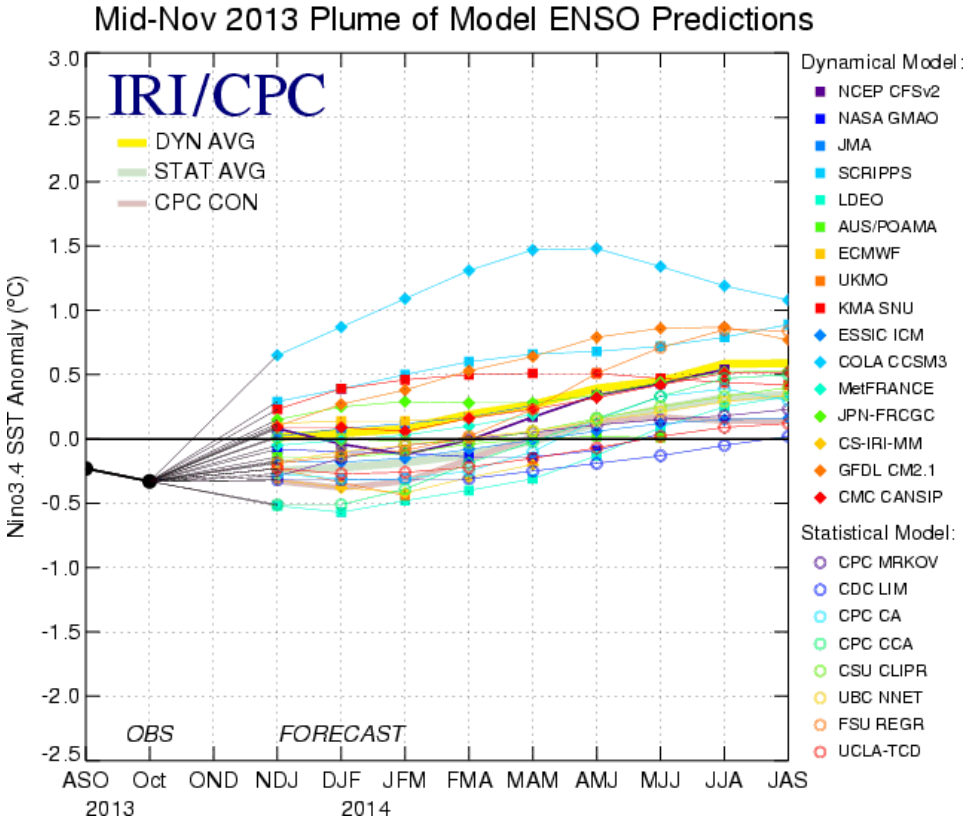


Source: www.meteo.psu.edu

ENSO Neutral (again)





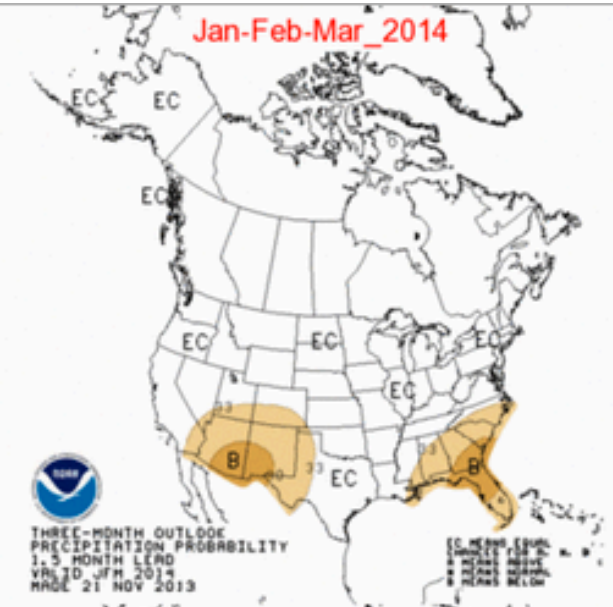


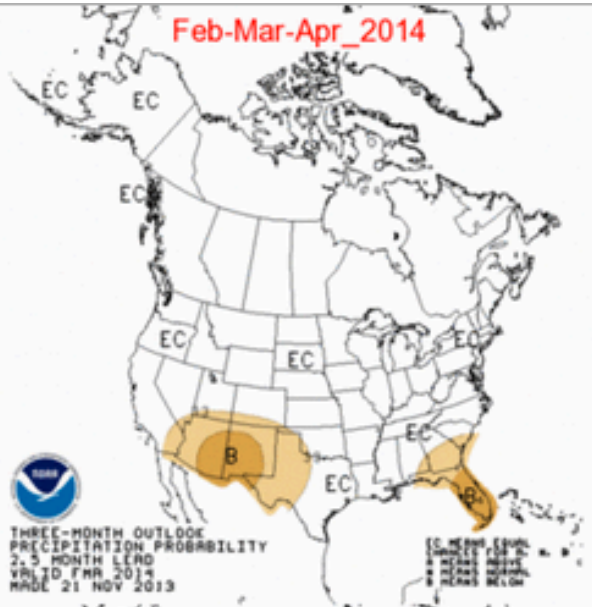
Sources: cpc.ncep.noaa.gov and iri.columbia.edu/climate/ENSO

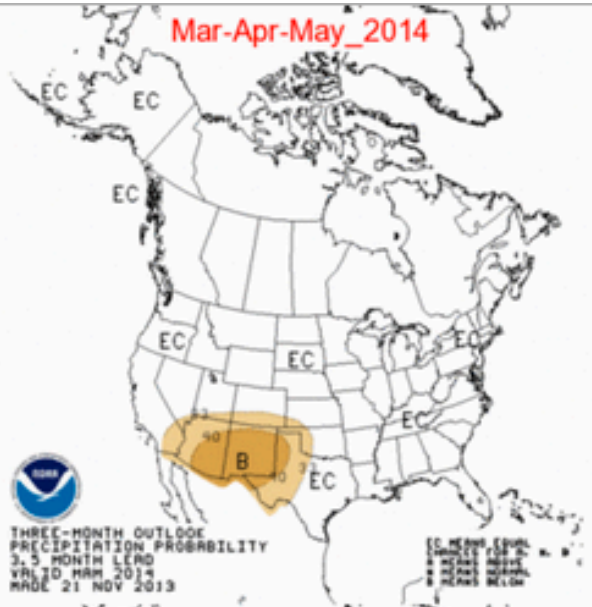
Historical Observed Apr-Jul Volumes (kaf)
1970-2010 (winter ENSO status)

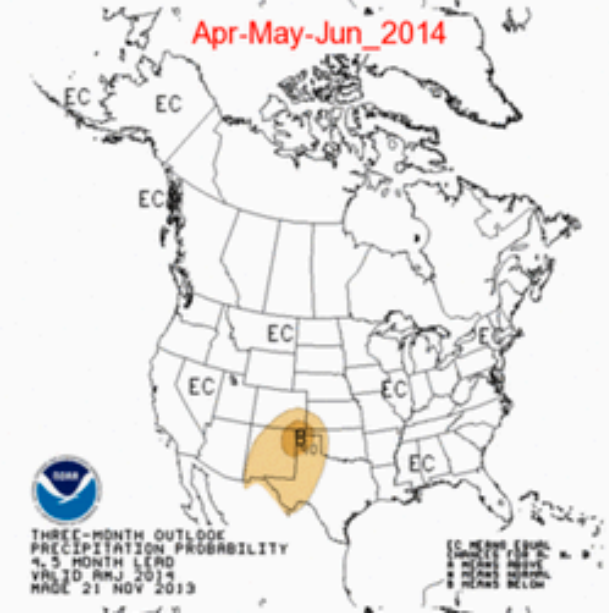
(1) -	1984 -	15406.41	(neutral)
(2) -	1983 -	14838.93	(el nino)
(3) -	1986 -	12601.21	(neutral)
(4) -	1995 -	11833.18	(el nino)
(5) -	1985 -	11701.11	(la nina)
(6) -	1997 -	11320.89	(neutral)
(7) -	1973 -	11262.74	(el nino)
(8) -	1979 -	11104.25	(neutral)
(9) -	1980 -	10606.60	(neutral)
(10) -	1993 -	9984.42	(neutral)
(11) -	1975 -	9953.16	(la nina 2)
(12) -	2008 -	8908.50	(la nina)
(13) -	2005 -	8844.02	(el nino)
(14) -	1978 -	8678.09	(el nino 2)
(15) -	1998 -	8510.14	(el nino)
(16) -	1982 -	8210.63	(neutral)
(17) -	1971 -	8180.35	(la nina)
(18) -	1970 -	8037.76	(neutral)
(19) -	2009 -	7806.72	(neutral)
(20) -	1999 -	7788.09	(la nina)
(21) -	1987 -	7758.54	(el nino)
(22) -	1996 -	7233.47	(la nina)
(23) -	1974 -	6915.13	(la nina)
(24) -	2010 -	5795.43	(el nino)
(25) -	1972 -	5494.26	(neutral)
(26) -	2006 -	5319.56	(neutral)
(27) -	1976 -	5297.75	(la nina 3)
(28) -	1991 -	5159.33	(el nino)
(29) -	1988 -	4567.47	(el nino 2)
(30) -	2000 -	4367.05	(la nina 2)
(31) -	2001 -	4320.62	(la nina 3)
(32) -	1992 -	4124.42	(neutral)
(33) -	2007 -	4053.47	(el nino)
(34) -	2003 -	3910.17	(el nino)
(35) -	1994 -	3766.48	(neutral)
(36) -	2004 -	3542.00	(neutral)
(37) -	1989 -	3524.63	(la nina)
(38) -	1990 -	3228.85	(neutral)
(39) -	1981 -	3058.61	(neutral)
(40) -	1977 -	1277.39	(el nino)
(41) -	2002 -	1126.76	(neutral)

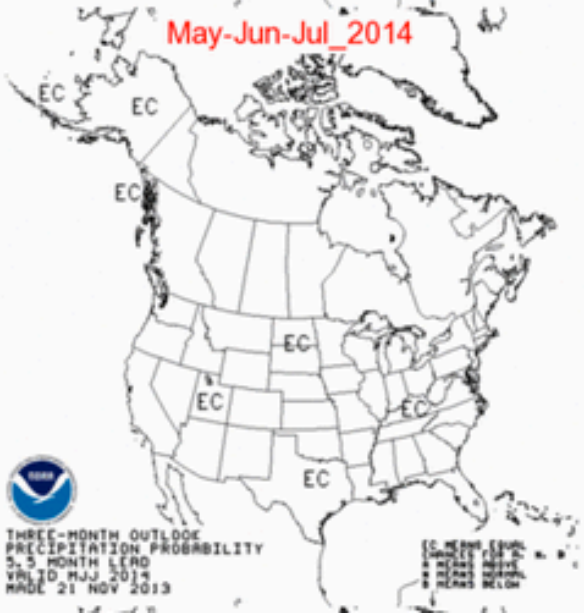
Climate Outlook

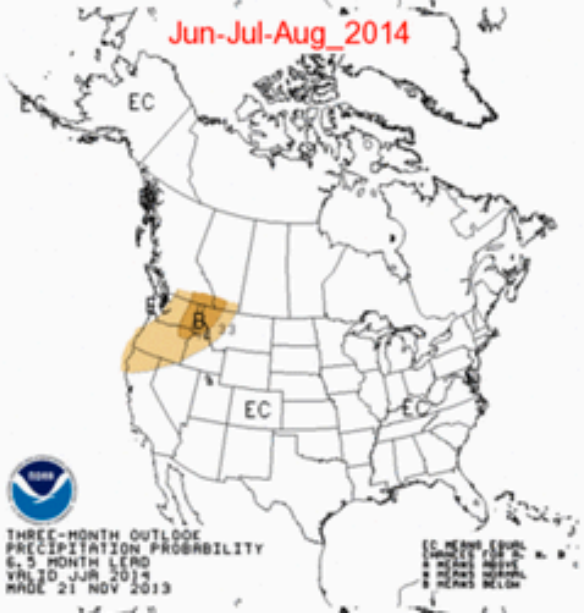




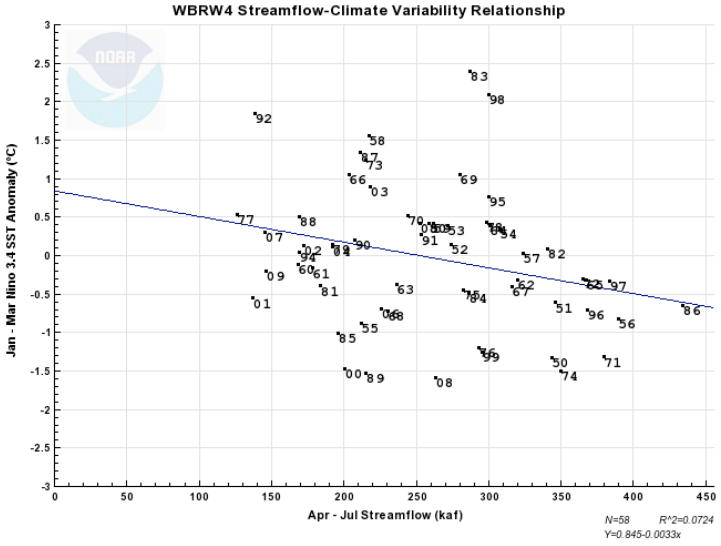


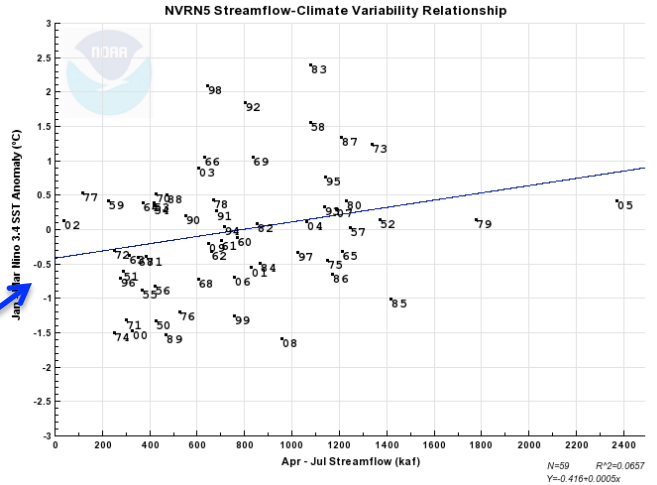


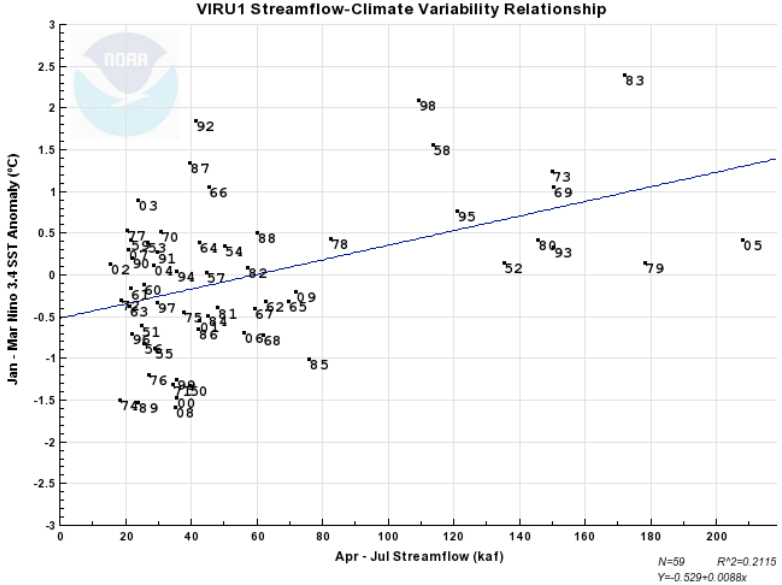


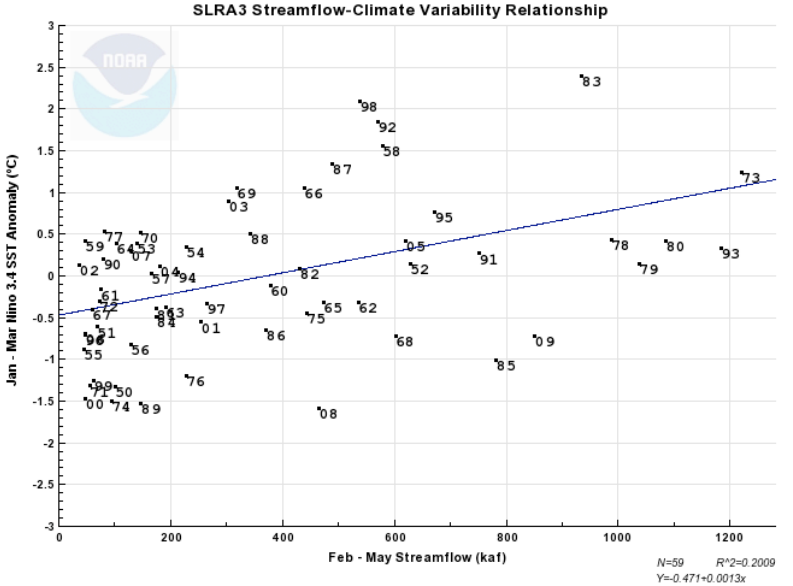


La Nina and Streamflow





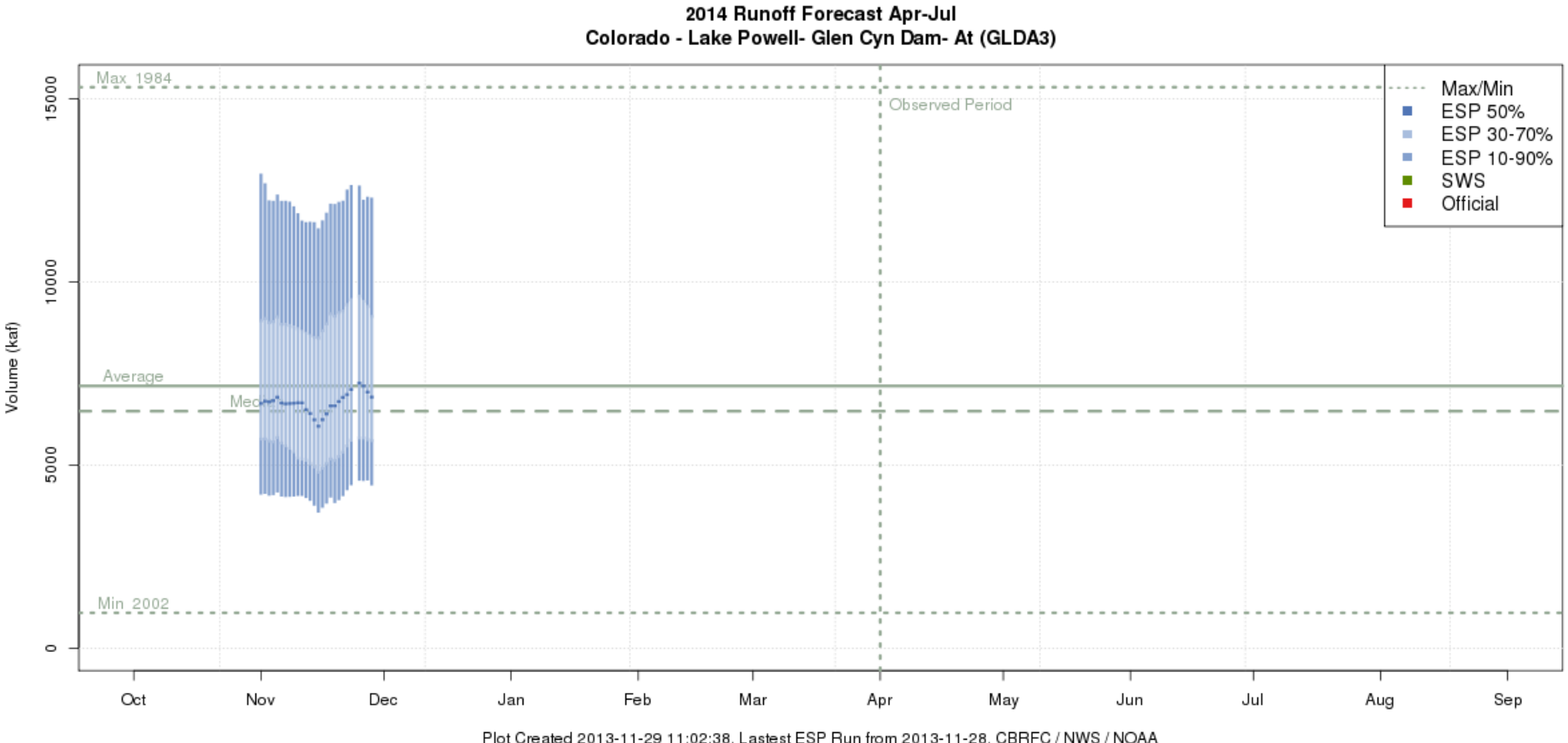




Early WY14 River Outlook…

- Excellent antecedent conditions
  - Aug/Sept precipitation
  - Soil moisture (less so in UT)
  - Streamflow
- Climate predictions
  - Dry for AZ, NM
  - No help for upper basin
- Weather
  - Active period
- Bottom line: Off to a promising start but long ways to go

Early WY14 River Outlook (con't)

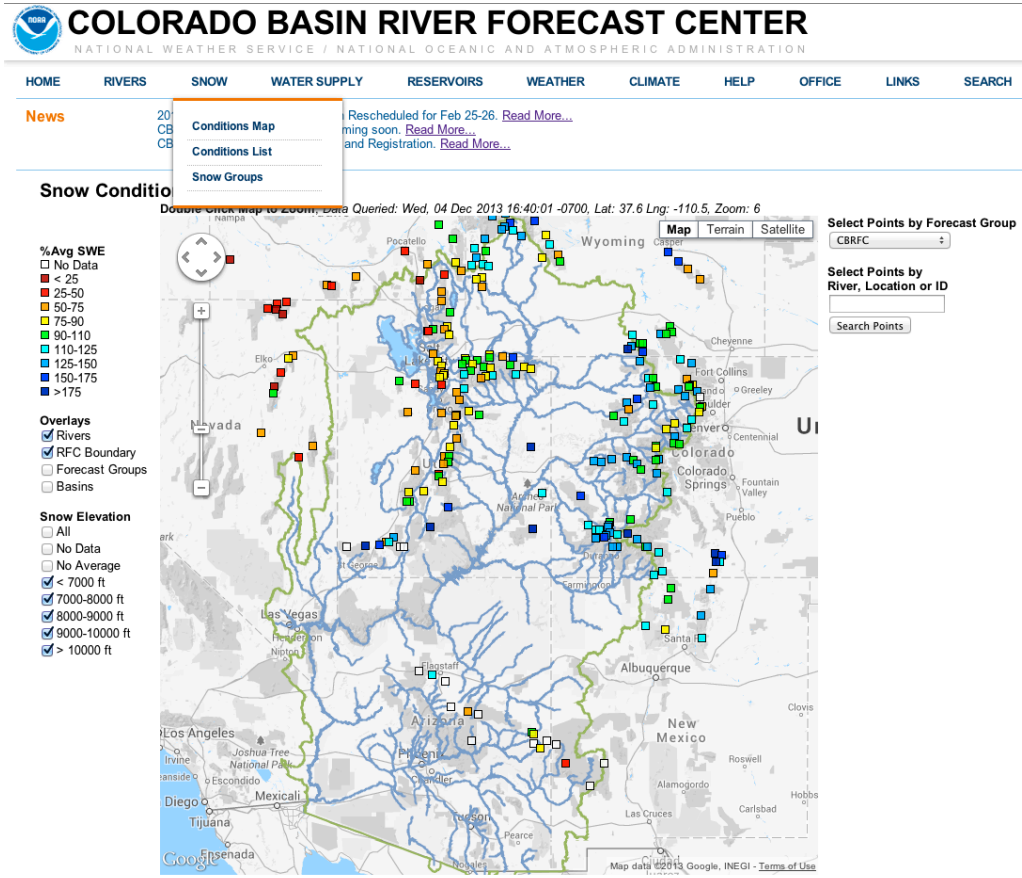


What's New at CBRFC

- Basin focal points / forecasters:
  - Brenda Alcorn (Upper Colorado)
  - Ashley Nielson (Green + Yampa / White)
  - Greg Smith (San Juan + Gunnison + Dolores)
  - Paul Miller (Great Basin)
  - Tracy Cox (Lower Colorado)
- Other key staff members:
  - Michelle Stokes (Hydrologist In Charge)
  - Kevin Werner (Service Coordination Hydrologist) – on detail Nov-Apr
  - John Lhotak (Development and Operations Hydrologist)
  - Craig Peterson (Calibrations, Operations lead, etc)
  - Cass Goodman (IT Support, web development, etc)
  - Stacie Bender (Hydrologist)
  - Brent Bernard (Hydrologist)

Webpage update

- Goals:
  - Improve performance
  - Search feature
  - Information accessibility
- Going live soon
- Comments welcome



http://www.cbrfc.noaa.gov/gmap/gmapbeta.php

2014 Forecast Webinar Schedule

January 7 at 1pm MT
February 6 at 1pm MT
March 6 at 1pm MT
April 7 at 1pm MT
May 6 at 1pm MT
June 5 at 1pm MT

Registration available:
www.cbrfc.noaa.gov/news/wswebinar2014.html

-

2014 Fourth Annual Colorado Basin River Forecast Center Stakeholder Forum

Dates: February 25-26 2014

Location: Colorado Basin River Forecast Center, 2242 West North Temple, Salt Lake City, UT 84116

Theme: Forecast Products, Delivery, Interpretation, and Application

Goals:

(1) Open discussion between CBRFC personnel and stakeholders regarding CBRFC products and services, with an emphasis on recently released products and their interpretation.

(2) Critical discussion on Colorado River and Great Basins products and their interpretation, practical application of these products, and delivery of these products through the CBRFC website and other methods.

(3) Opportunities for improvement of and collaboration over CBRFC products and services.

Registration:

Registration is free. To register, please contact Valerie Offutt at Valerie.Offutt@noaa.gov at 801.524.5130. You may also contact Greg Smith at Greg.Smith@noaa.gov or Paul Miller at Paul.Miller@noaa.gov with questions or comments.

Background:

CBRFC's annual stakeholder forum is important to the CBRFC and its stakeholders for determining forecast and development priorities. The forum emphasizes interaction between participants and CBRFC decision-makers such that participants develop an in-depth understanding of the CBRFC's forecast process and its development activities while also providing a forum for participants to share their experiences, priorities, and questions with CBRFC staff and management. Past forums have helped guide CBRFC projects and product development paths as well as other activities in the NWS and NOAA. Reports and presentations from the forum will be made available online.

Please feel free to pass along any additional comments or suggestions with your answers as well. Please send your responses to Greg Smith at Greg.Smith@noaa.gov.

Agenda:

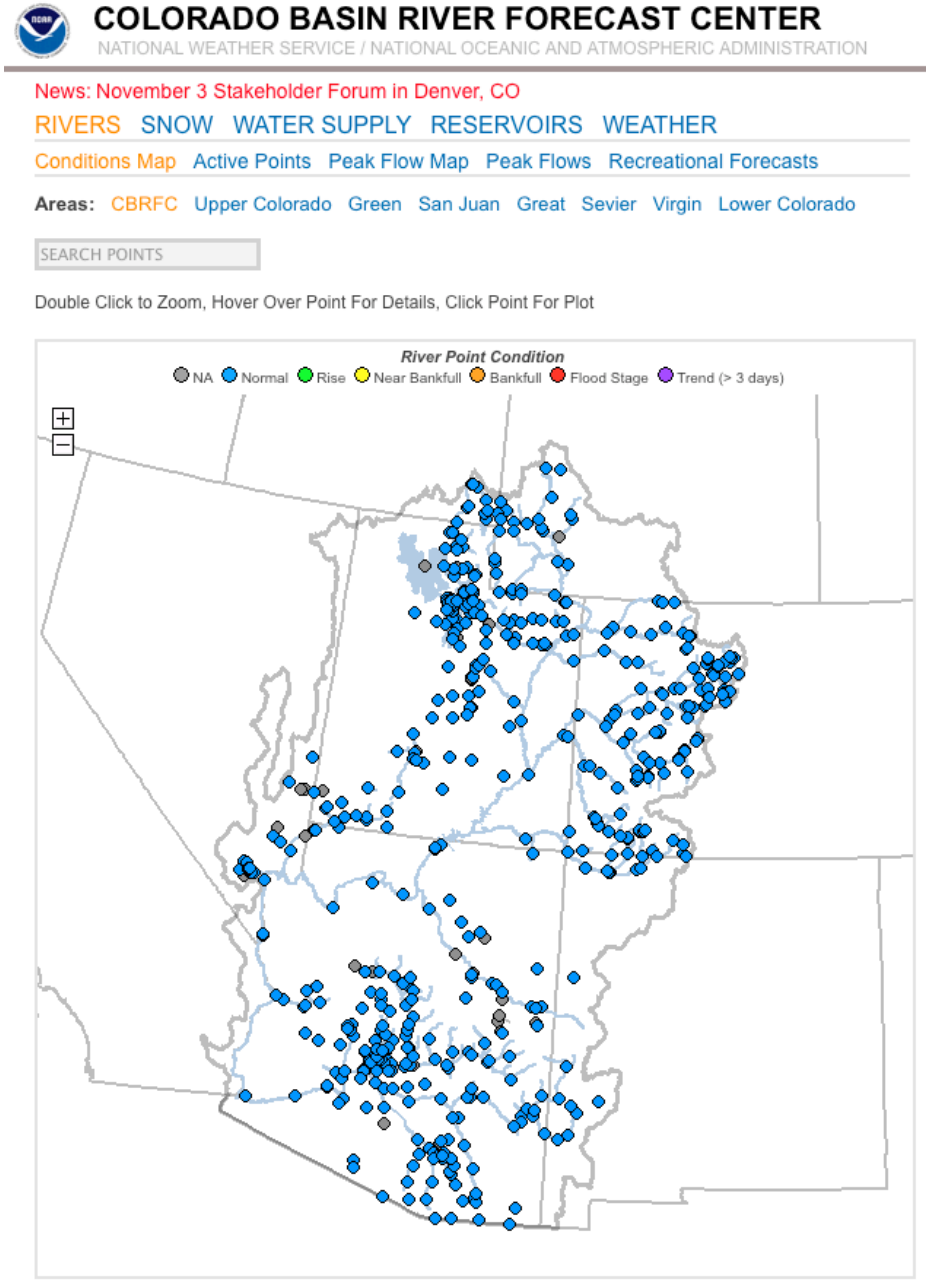
Draft agenda now available here. Please check back periodically for updates!

Email List

- Migrated to Google Groups
- Subscribed everyone who was subscribed last year
- You can add or change your email subscription by contacting us (kevin.werner@noaa.gov) or on your own here:
  - https://groups.google.com/forum/#!forum/cbrfc-email-list
- Blog style entries?

More Resources

www.cbrfc.noaa.gov



Forecasts

Verification

Soil moisture maps

Precipitation maps

Temperature maps

Presentations

These slides: http://www.cbrfc.noaa.gov/present/present2013.cgi

Feedback, Questions, Concerns always welcome….

Kevin Werner

CBRFC Service Coordination Hydrologist
Phone: 801.524.5130
Email: kevin.werner@noaa.gov