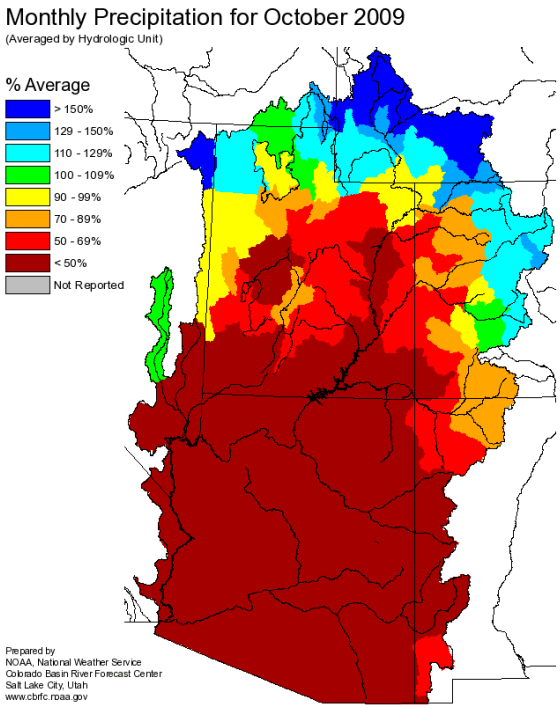
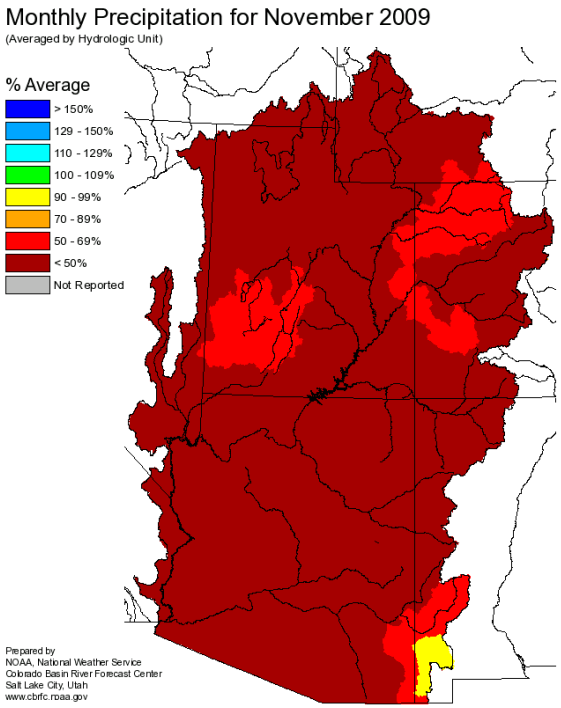
Water Year 2010 Review

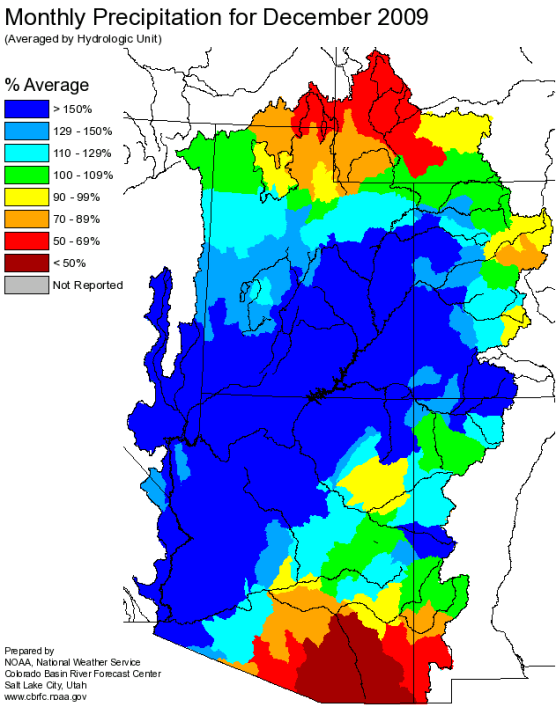
CBRFC Open House

August 17, 2010

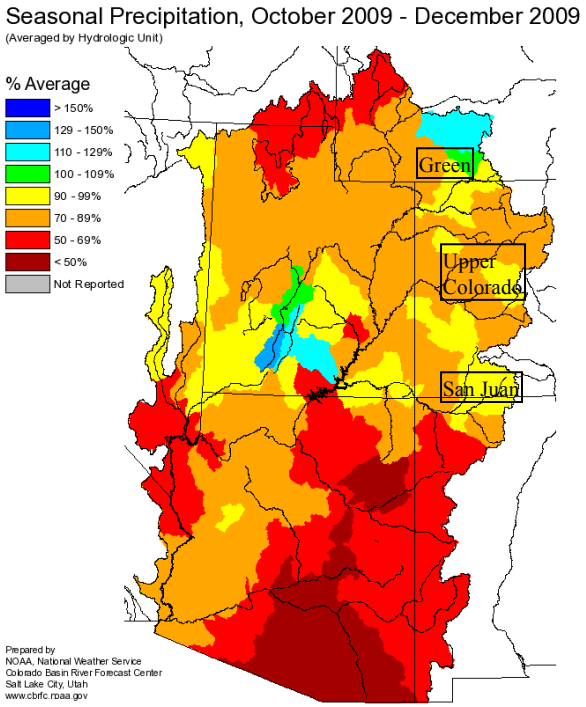
October – December Precipitation

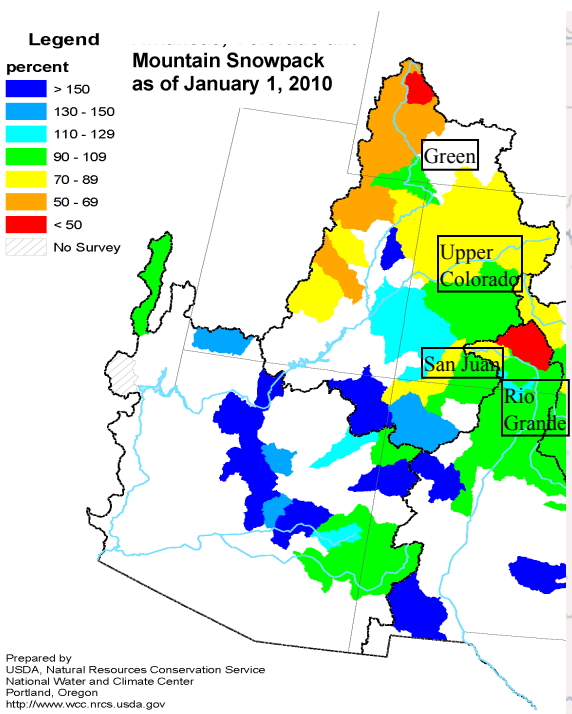


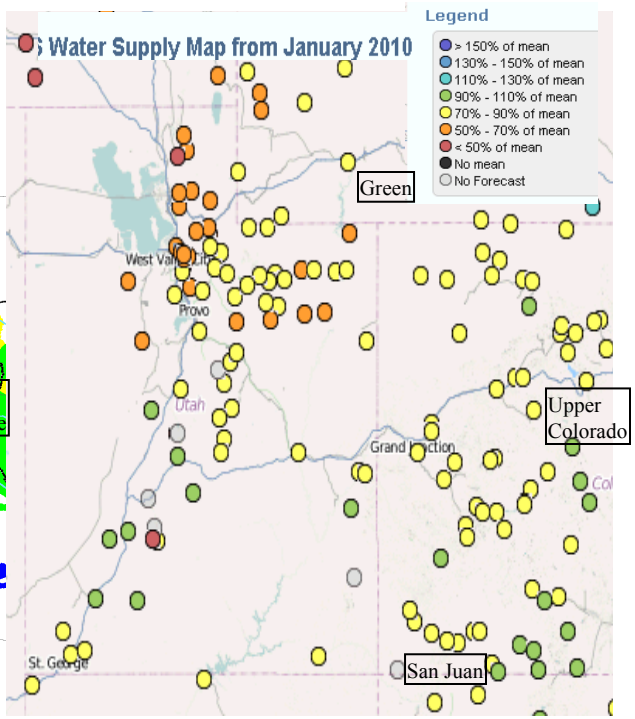




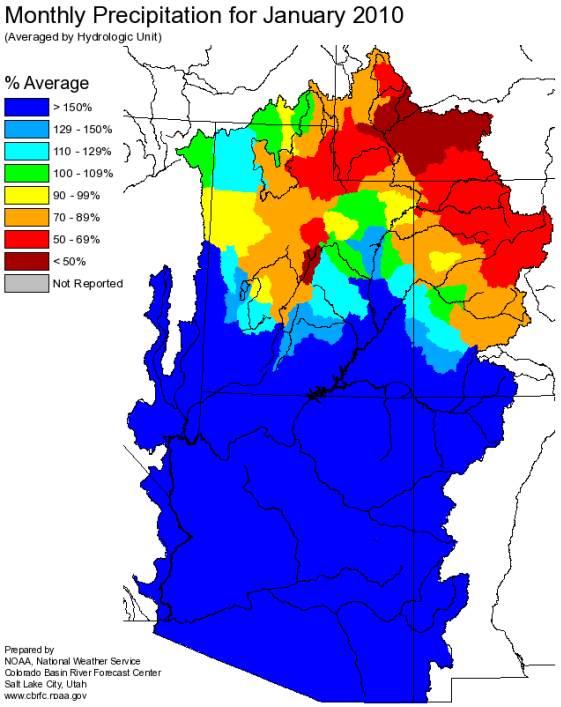
January 1, 2010

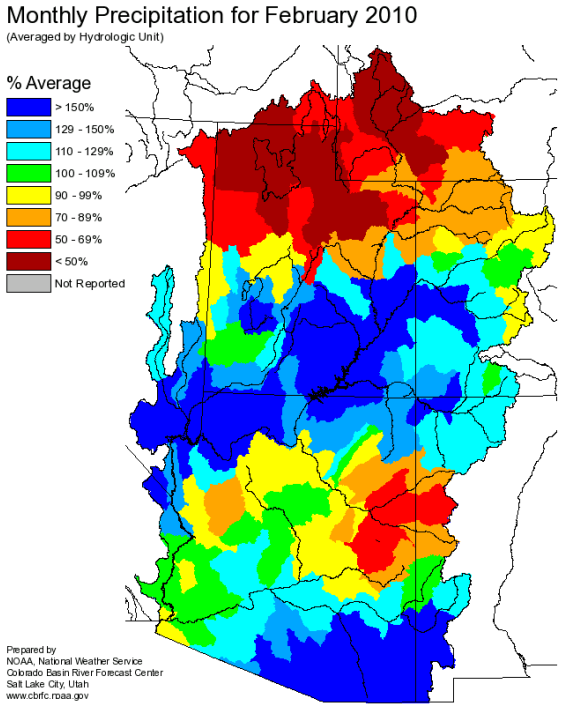


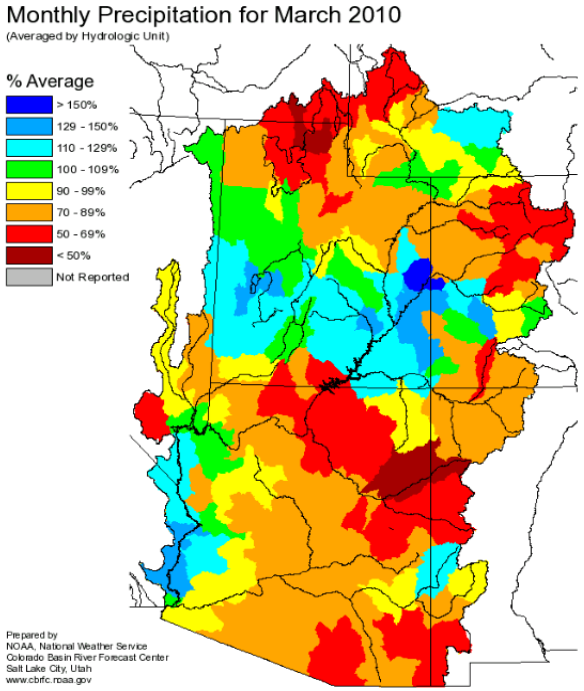




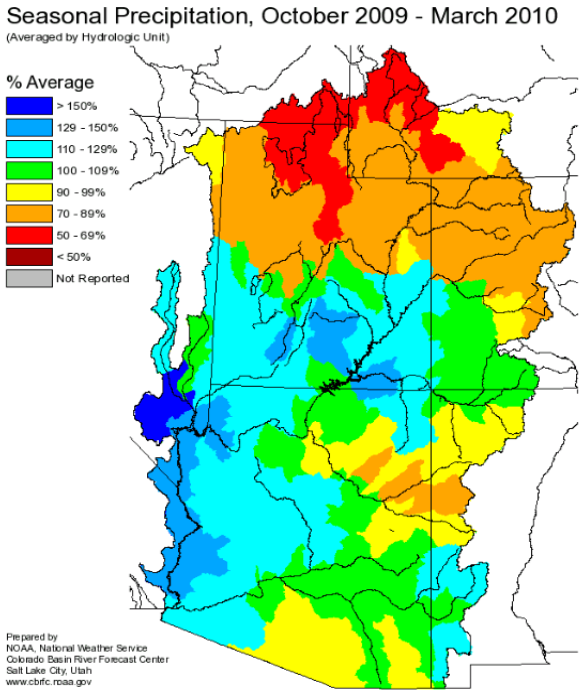
January – March Precipitation

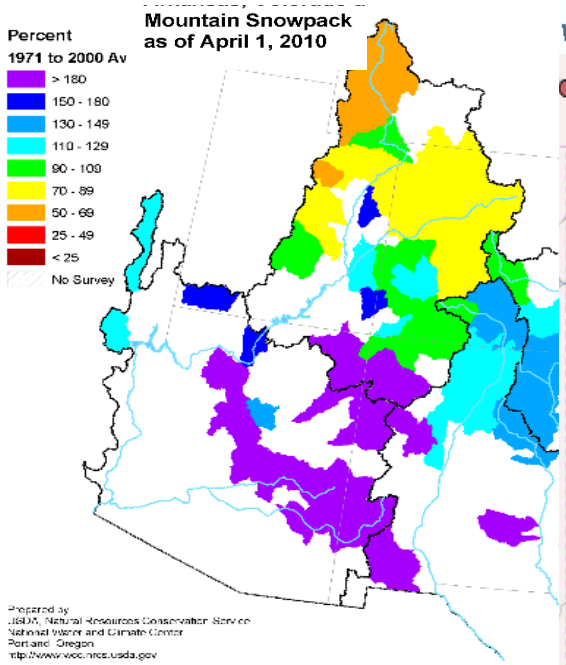


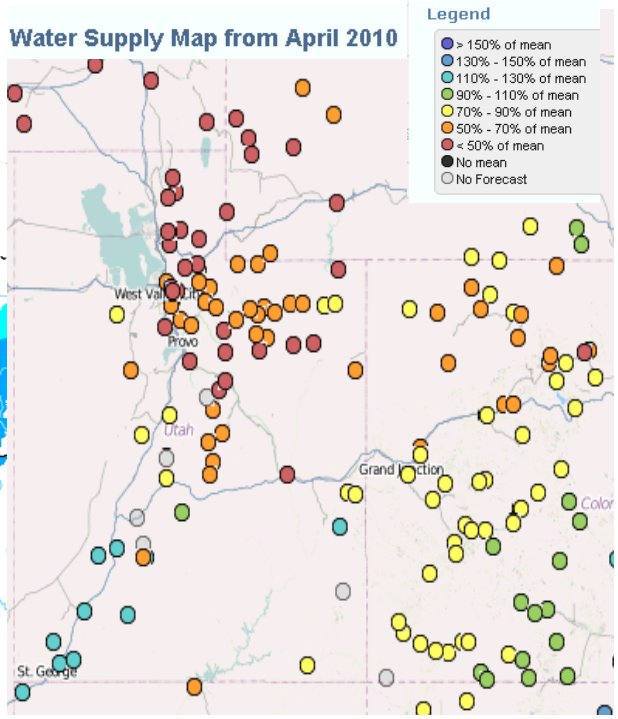




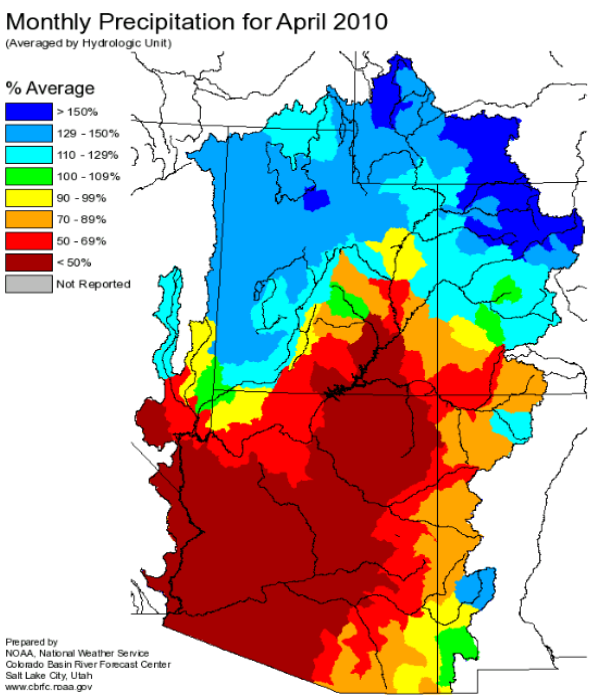
April 1, 2010

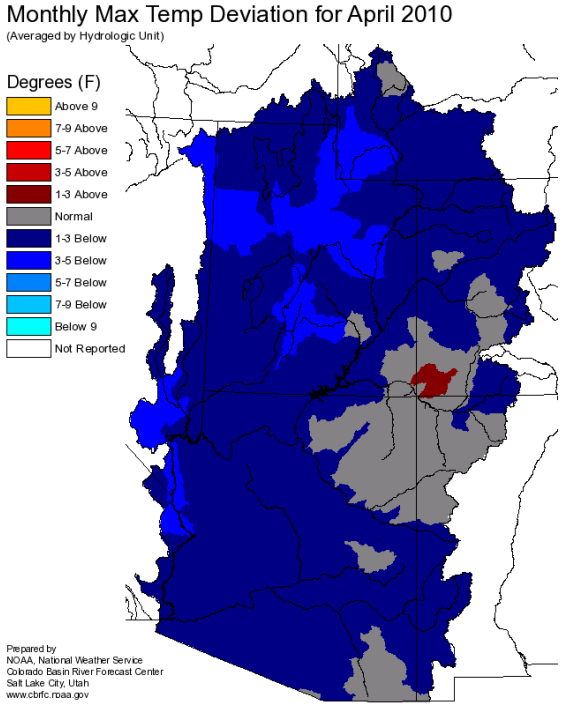

Seasonal Precipitation, October 2009 - March 2010
(Averaged by Hydrologic Unit)
% Average
> 150%
129 - 150%
110 - 129%
100 - 109%
90 - 99%
70 - 89%
50 - 69%
< 50%
Not Reported
Prepared by
NOAA, National Weather Service
Colorado Basin River Forecast Center
Salt Lake City, Utah
www.cbrfc.noaa.gov

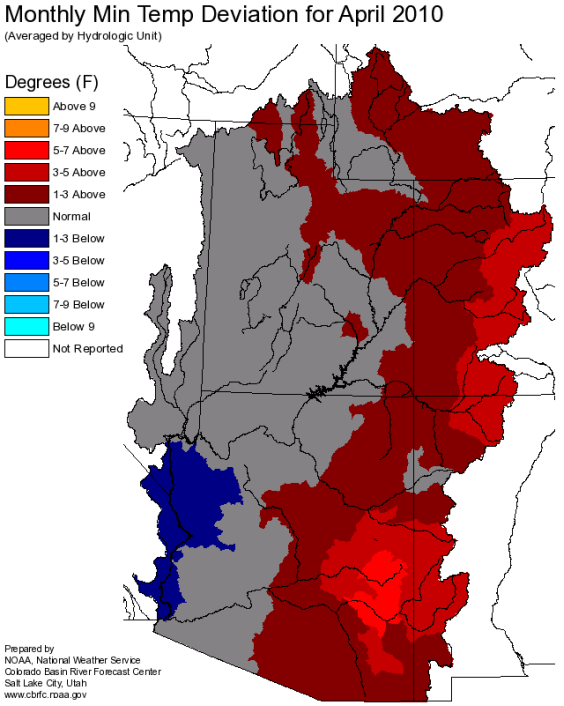

Percent
1971 to 2000 Av
> 180
150 - 180
130 - 149
110 - 129
90 - 109
70 - 89
50 - 69
25 - 49
< 25
No Survey
Mountain Snowpack
as of April 1, 2010


Water Supply Map from April 2010
Legend
> 150% of mean
130% - 150% of mean
110% - 130% of mean
90% - 110% of mean
70% - 90% of mean
50% - 70% of mean
< 50% of mean
No mean
No Forecast
Provo
Utah
St. George

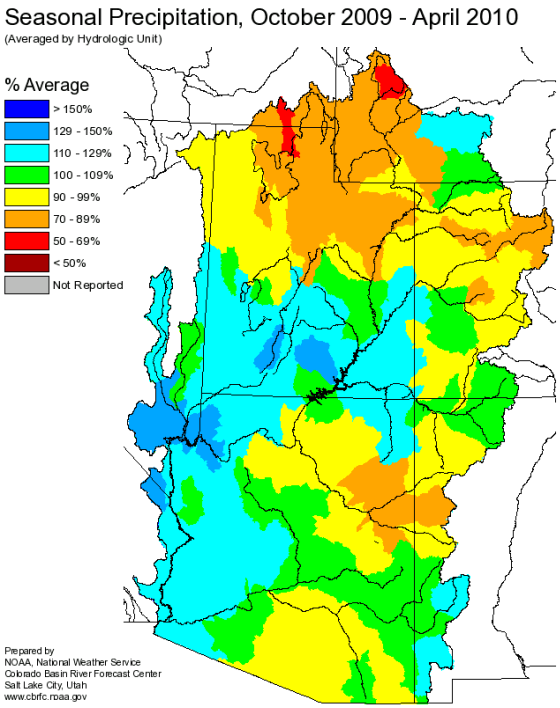
April Precipitation and Temperature

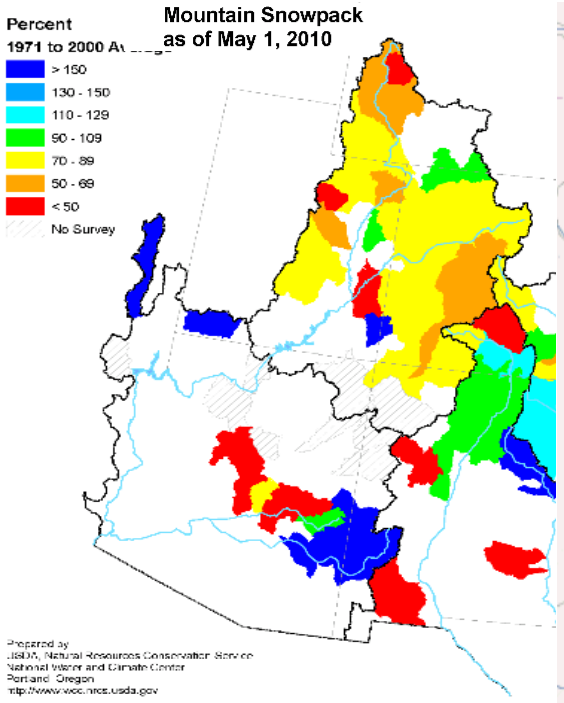


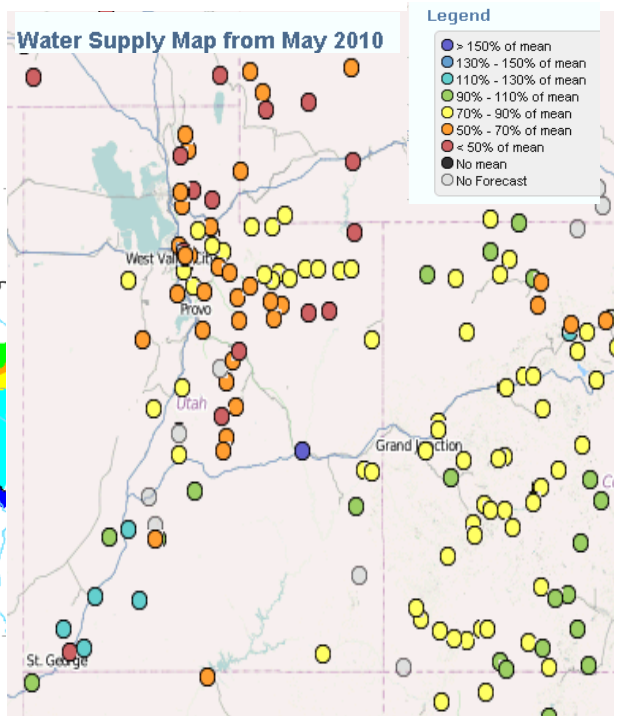




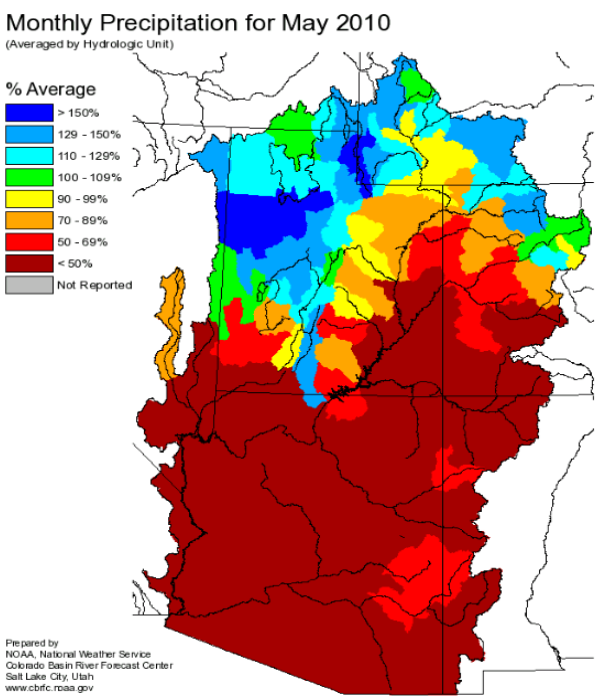
May 1, 2010

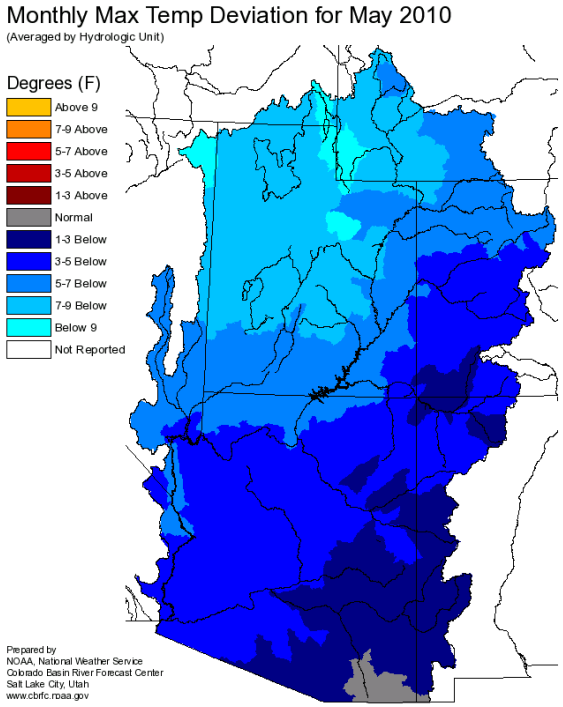

Seasonal Precipitation, October 2009 - April 2010
(Averaged by Hydrologic Unit)
% Average
> 150%
129 - 150%
110 - 129%
100 - 109%
90 - 99%
70 - 89%
50 - 69%
< 50%
Not Reported
Prepared by
NOAA, National Weather Service
Colorado Basin River Forecast Center
Salt Lake City, Utah
www.cbrfc.noaa.gov

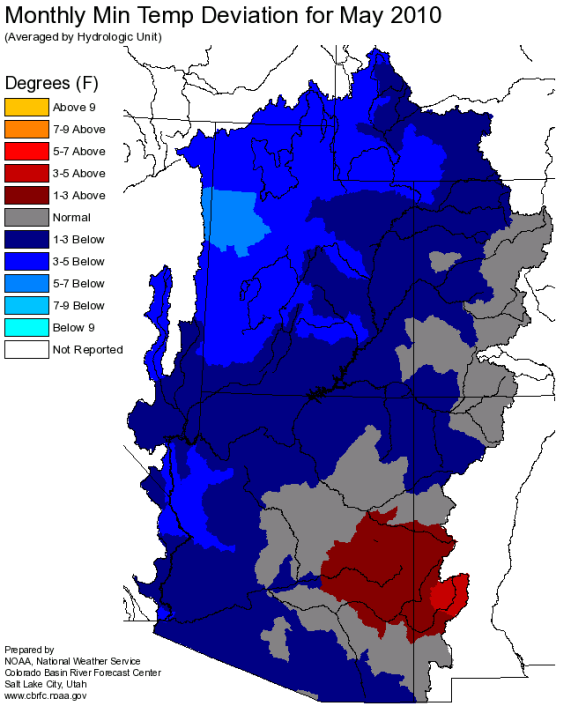

Mountain Snowpack
as of May 1, 2010
Percent
> 150
130 - 150
110 - 129
90 - 109
70 - 89
50 - 69
< 50
No Survey


Water Supply Map from May 2010
Legend
> 150% of mean
130% - 150% of mean
110% - 130% of mean
90% - 110% of mean
70% - 90% of mean
50% - 70% of mean
< 50% of mean
No mean
No Forecast
Provo
Utah
St. George

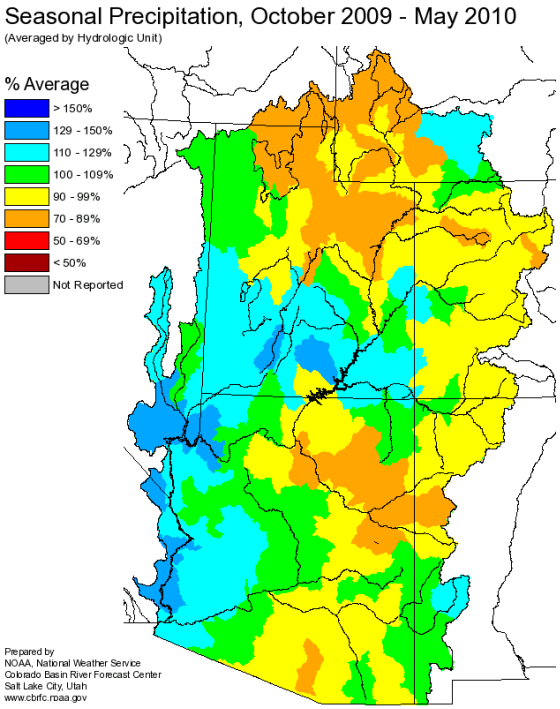
May Precipitation and Temperature

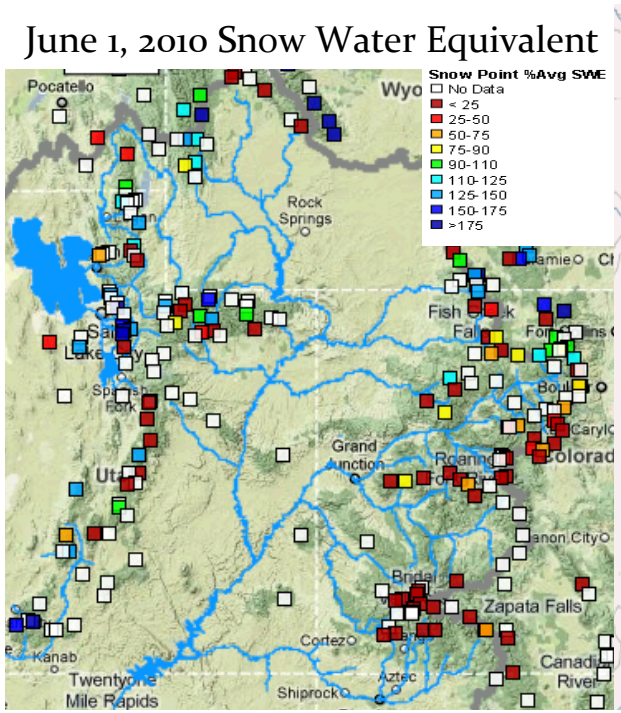


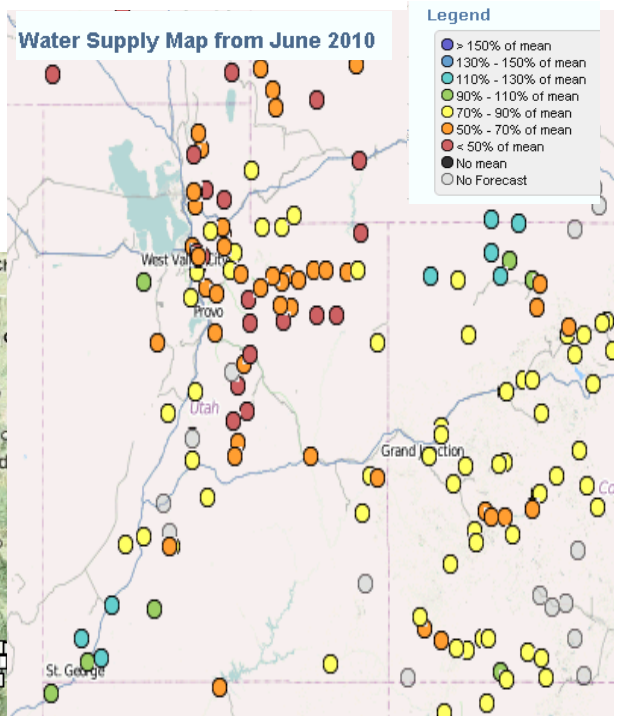




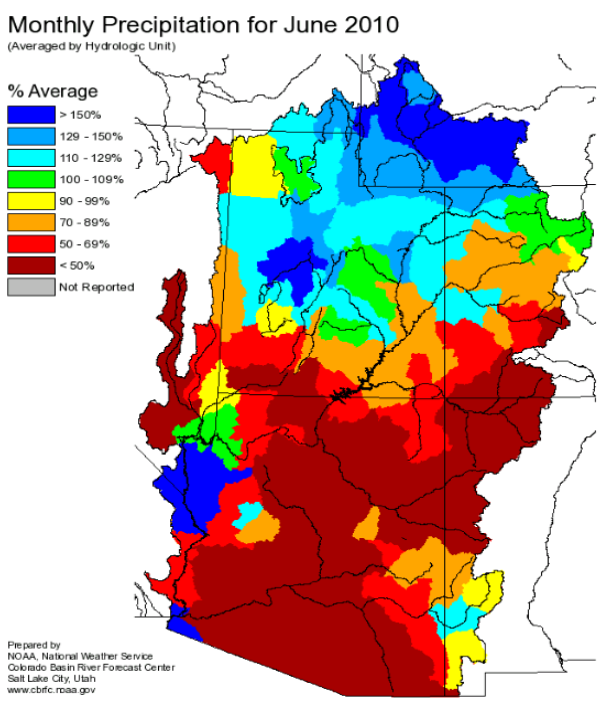
June 1, 2010

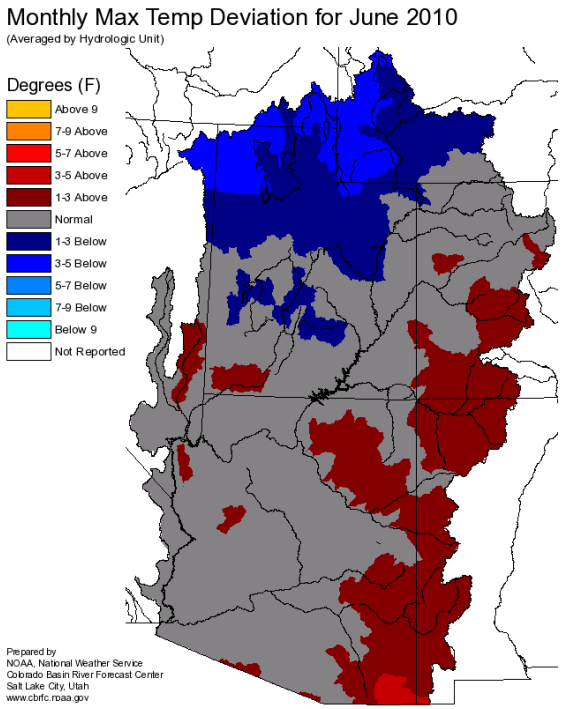

Seasonal Precipitation, October 2009 - May 2010
(Averaged by Hydrologic Unit)
% Average
> 150%
129 - 150%
110 - 129%
100 - 109%
90 - 99%
70 - 89%
50 - 69%
< 50%
Not Reported
Prepared by
NOAA, National Weather Service
Colorado Basin River Forecast Center
Salt Lake City, Utah
www.cbrfc.noaa.gov

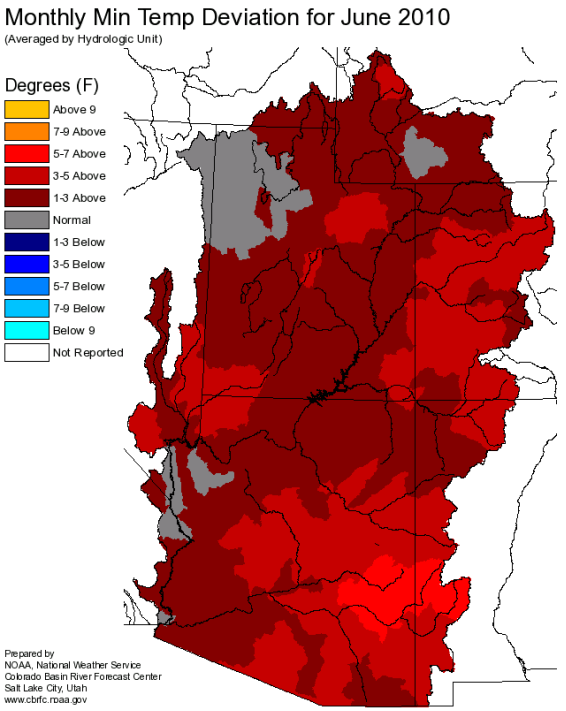

June 1, 2010 Snow Water Equivalent
Snow Point %Avg SWE
No Data
< 25
25-50
50-75
75-90
90-110
110-125
125-150
150-175
>175
Pocatello
Rock Springs
Grand Junction
Zapata Falls
Cortez
Kanab
Twentymile Mile Rapids
Shiprock


Water Supply Map from June 2010
Legend
> 150% of mean
130% - 150% of mean
110% - 130% of mean
90% - 110% of mean
70% - 90% of mean
50% - 70% of mean
< 50% of mean
No mean
No Forecast
Provo
Utah
Grand Junction
St. George

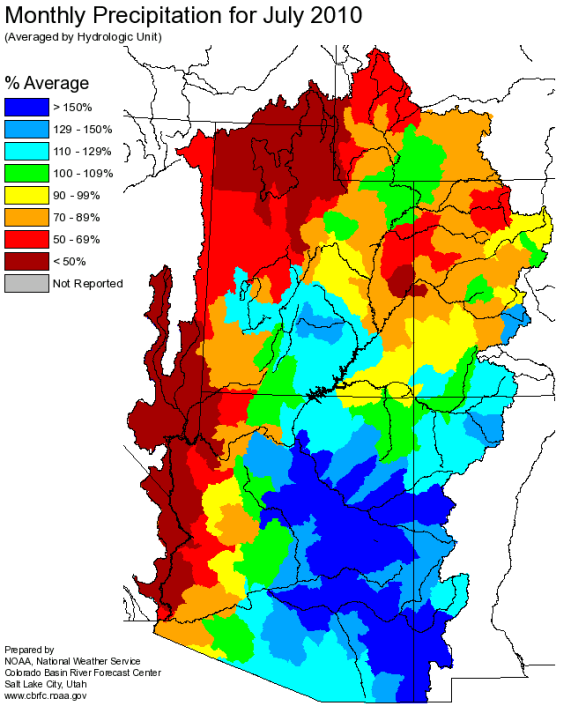
June Precipitation and Temperature

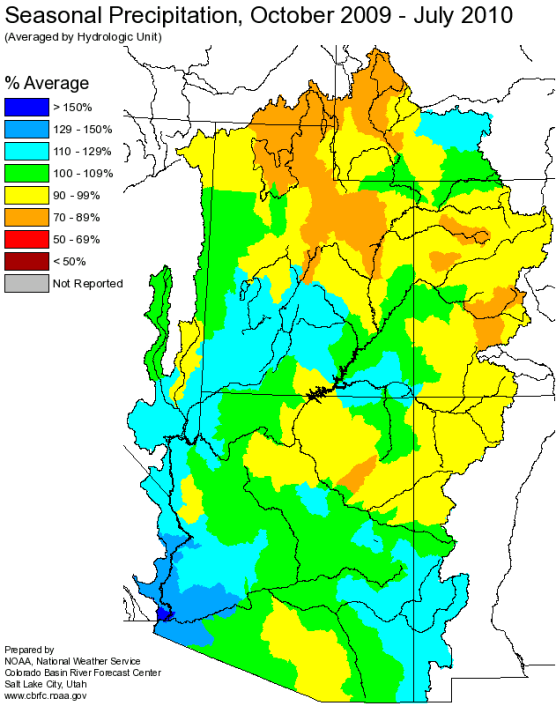


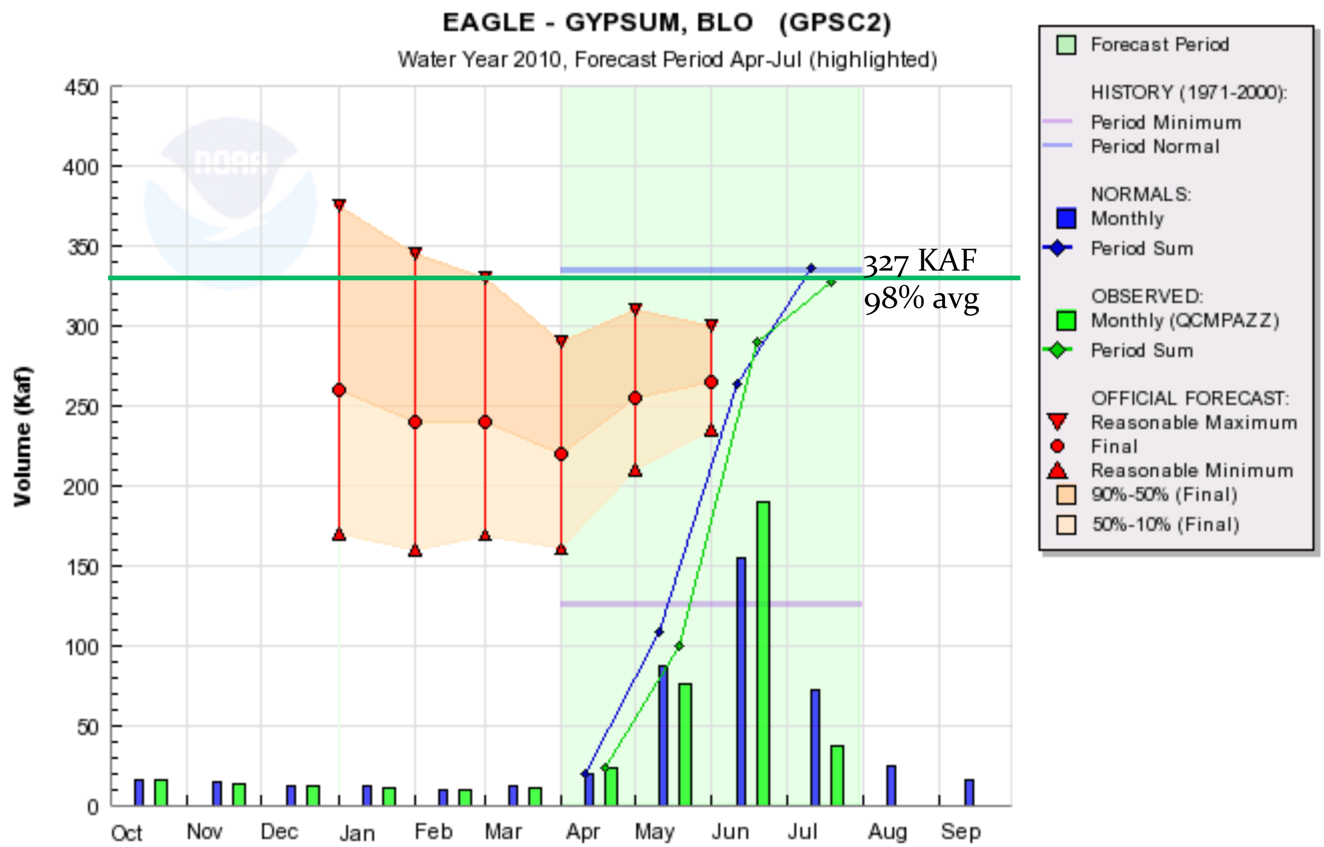


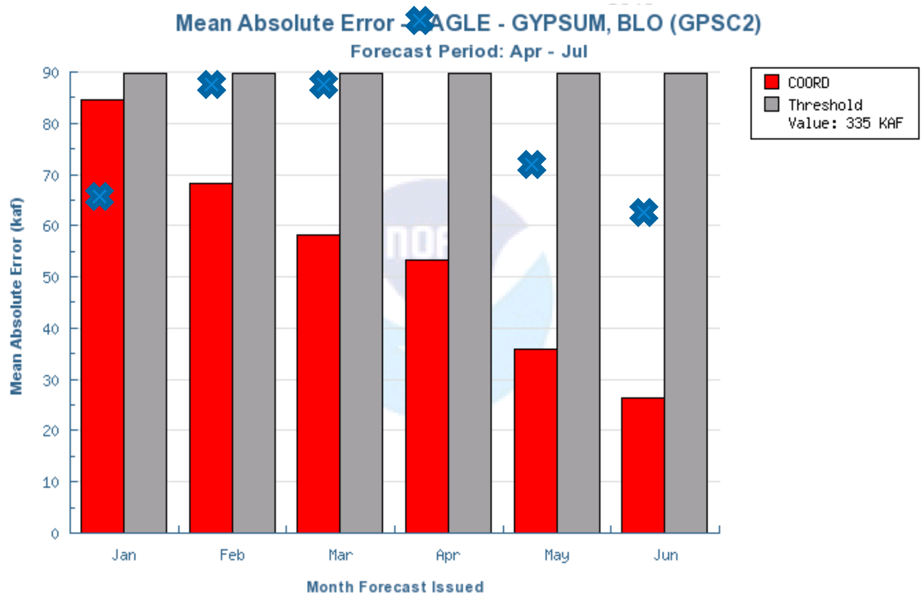


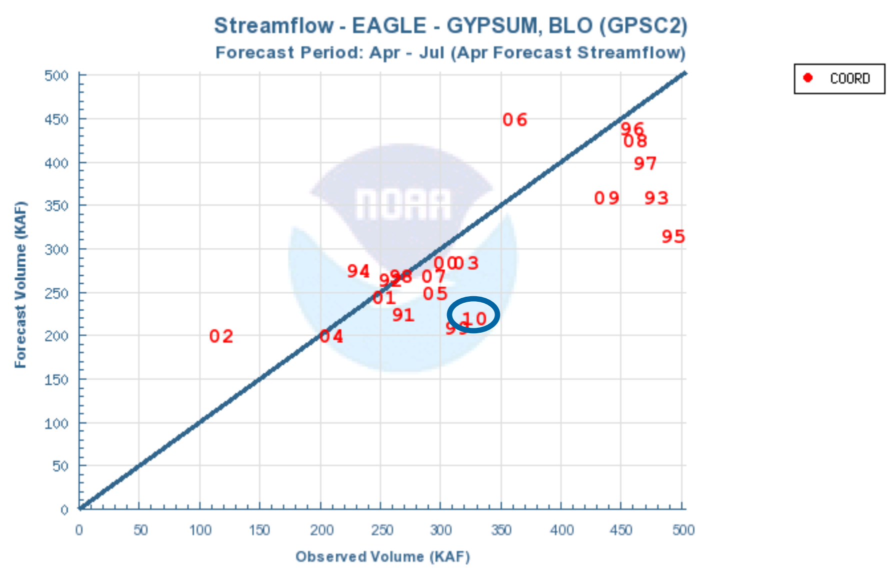
July Precipitation

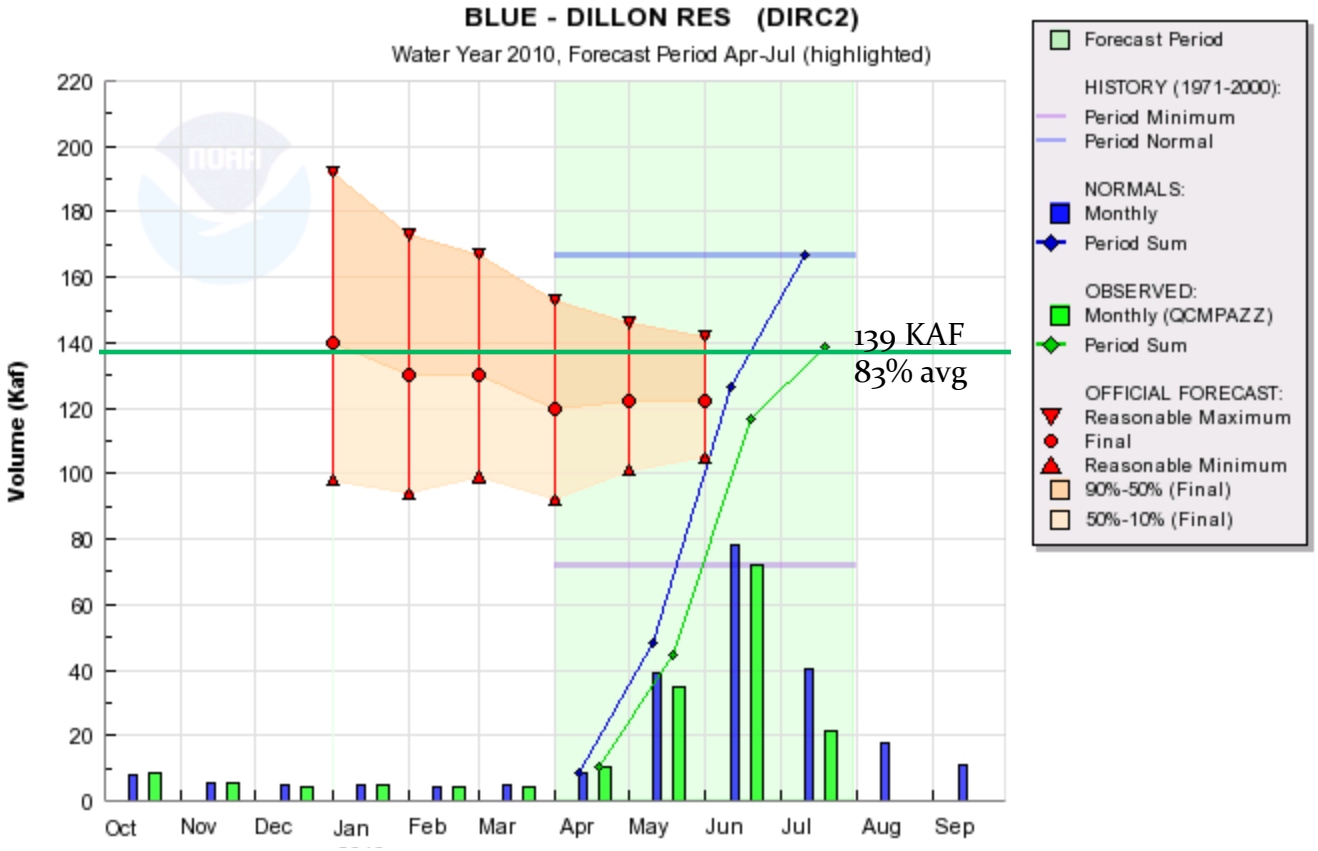


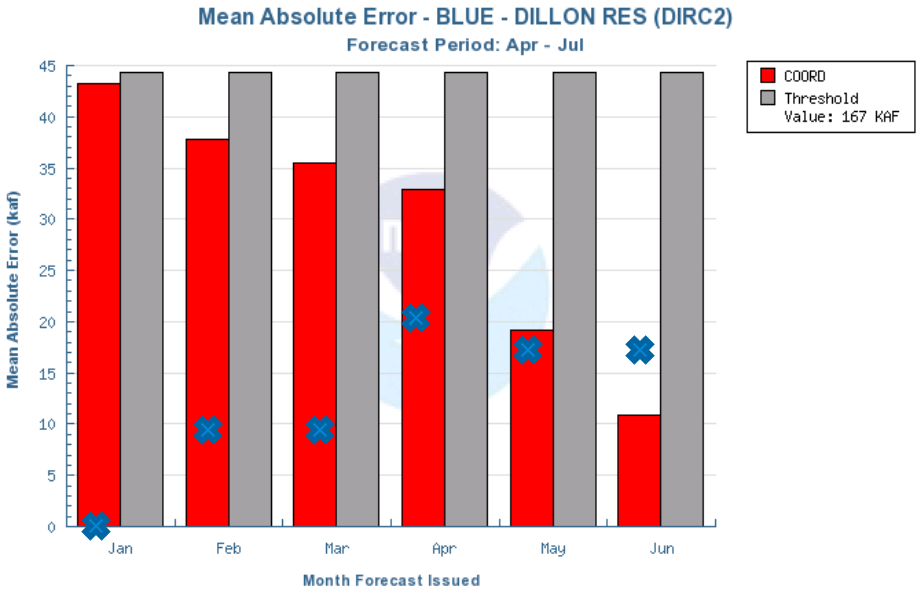


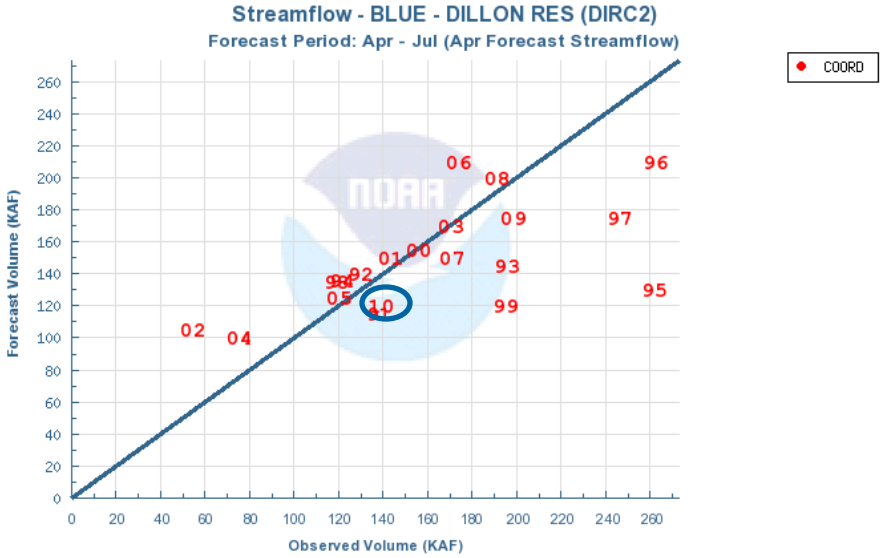

EAGLE - GYPSUM, BLO (GPSC2)
Water Year 2010, Forecast Period Apr-Jul (highlighted)
Volume (Kaf)
0
50
100
150
200
250
300
350
400
450
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
327 KAF
98% avg
Forecast Period
HISTORY (1971-2000):
Period Minimum
Period Normal
NORMALS:
Monthly
Period Sum
OBSERVED:
Monthly (QCMPAZZ)
Period Sum
OFFICIAL FORECAST:
Reasonable Maximum
Final
Reasonable Minimum
90%-50% (Final)
50%-10% (Final)

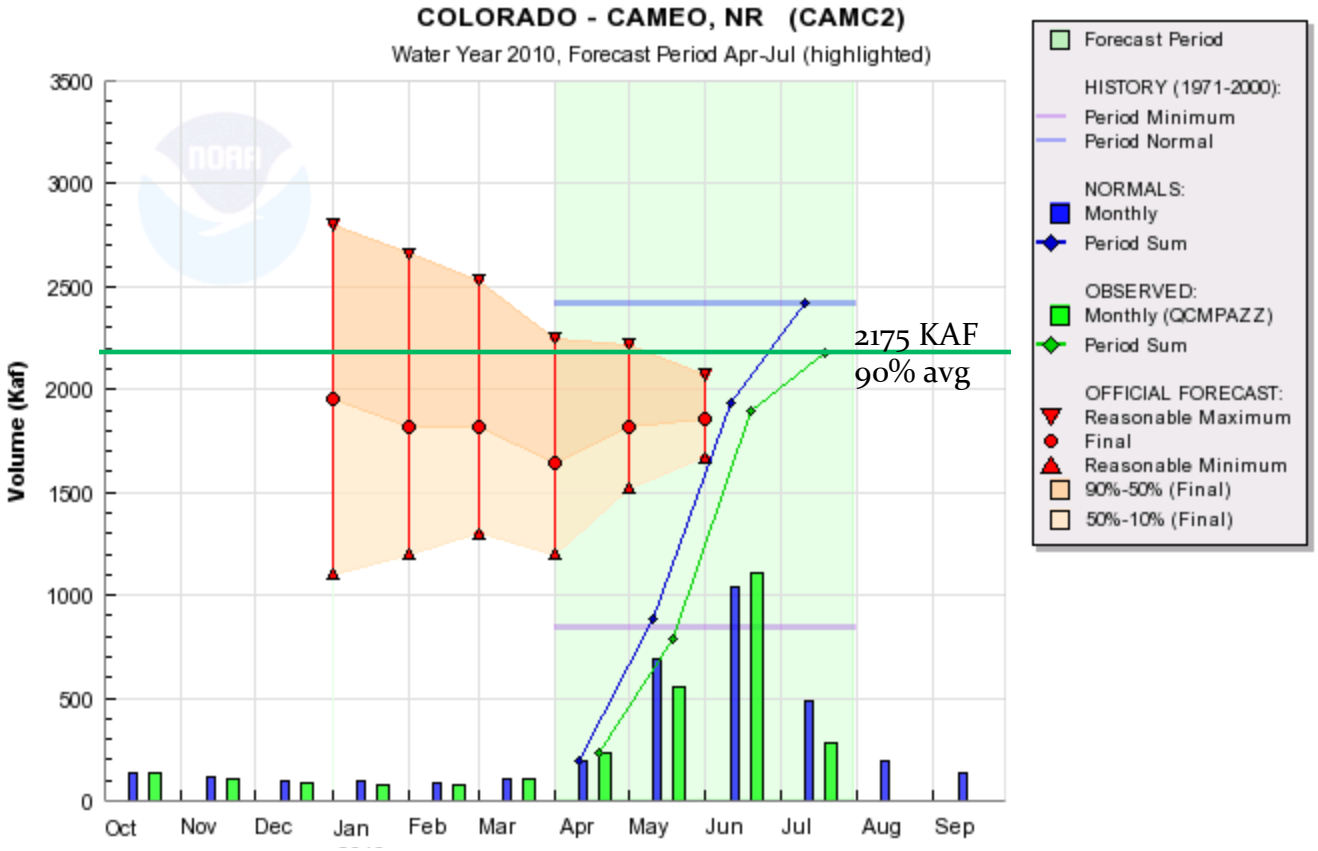

Mean Absolute Error - EAGLE - GYPSUM, BLO (GPSC2)
Forecast Period: Apr - Jul
Mean Absolute Error (kaf)
0
10
20
30
40
50
60
70
80
90
Jan
Feb
Mar
Apr
May
Jun
Month Forecast Issued
COORD
Threshold
Value: 335 KAF

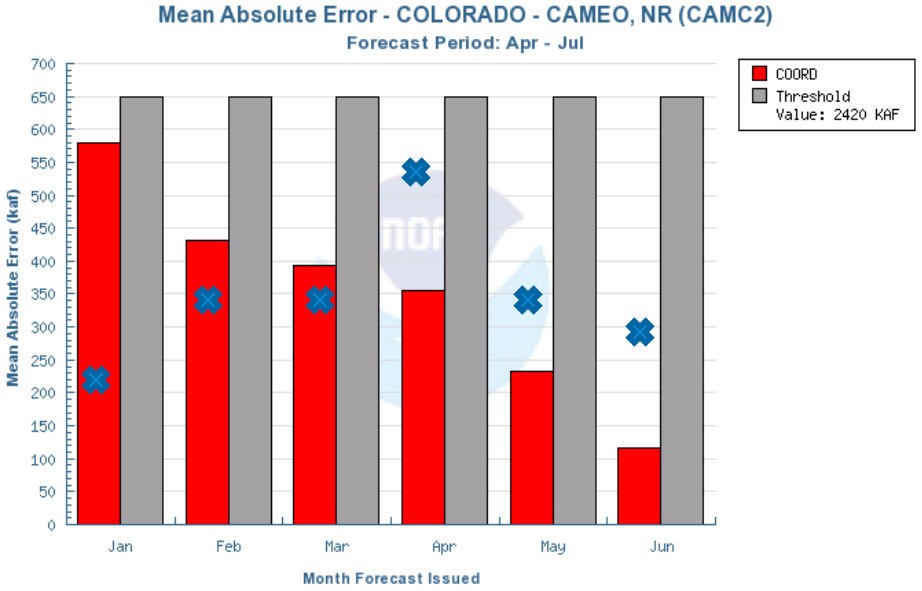

Streamflow - EAGLE - GYPSUM, BLO (GPSC2)
Forecast Period: Apr - Jul (Apr Forecast Streamflow)
Forecast Volume (KAF)
Observed Volume (KAF)
0
50
100
150
200
250
300
350
400
450
500
COORD
06
96
08
97
09
93
95
94
00
03
07
05
01
91
10
02
04

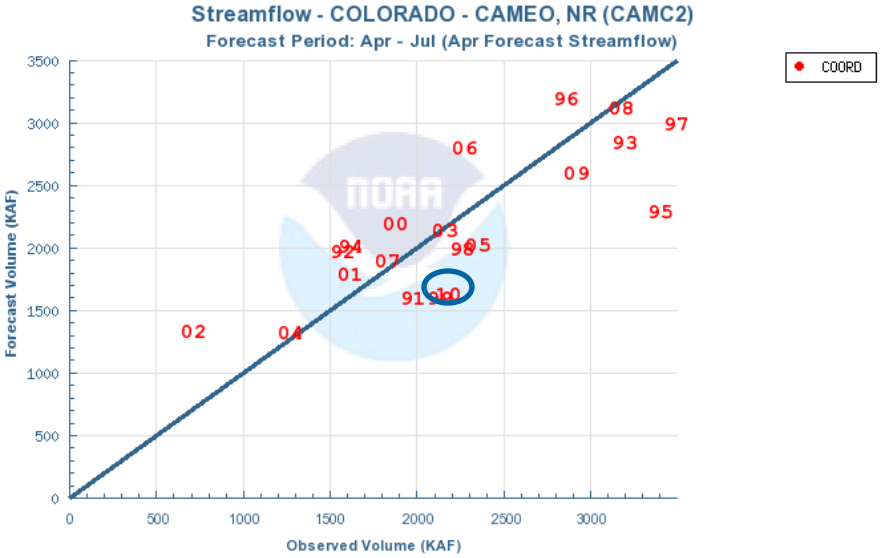

BLUE - DILLON RES (DIRC2)
Water Year 2010, Forecast Period Apr-Jul (highlighted)
Volume (Kaf)
220
200
180
160
140
120
100
80
60
40
20
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
139 KAF
83% avg
Forecast Period
HISTORY (1971-2000):
Period Minimum
Period Normal
NORMALS:
Monthly
Period Sum
OBSERVED:
Monthly (QCMPAZZ)
Period Sum
OFFICIAL FORECAST:
Reasonable Maximum
Final
Reasonable Minimum
90%-50% (Final)
50%-10% (Final)

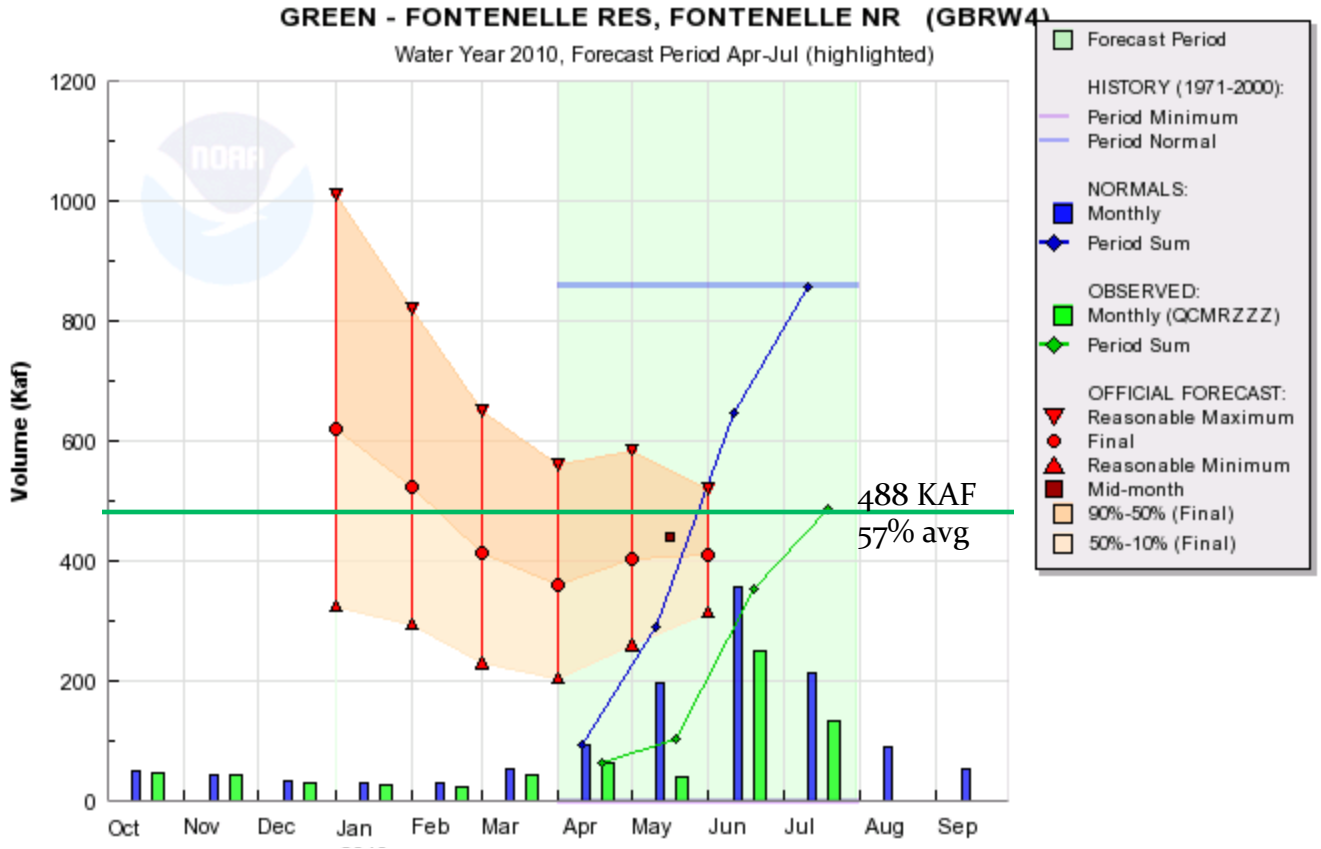

Mean Absolute Error - BLUE - DILLON RES (DIRC2)
Forecast Period: Apr - Jul
Mean Absolute Error (kaf)
45
40
35
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Month Forecast Issued
COORD
Threshold
Value: 167 KAF

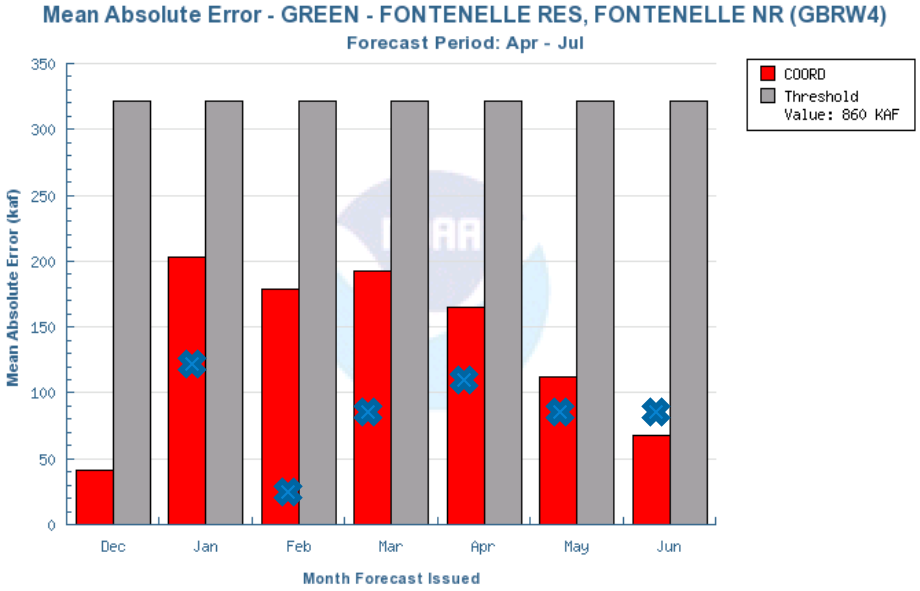

Streamflow - BLUE - DILLON RES (DIRC2)
Forecast Period: Apr - Jul (Apr Forecast Streamflow)
Forecast Volume (KAF)
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Observed Volume (KAF)
COORD
02
04
05
06
08
09
10
93
95
96
97
99

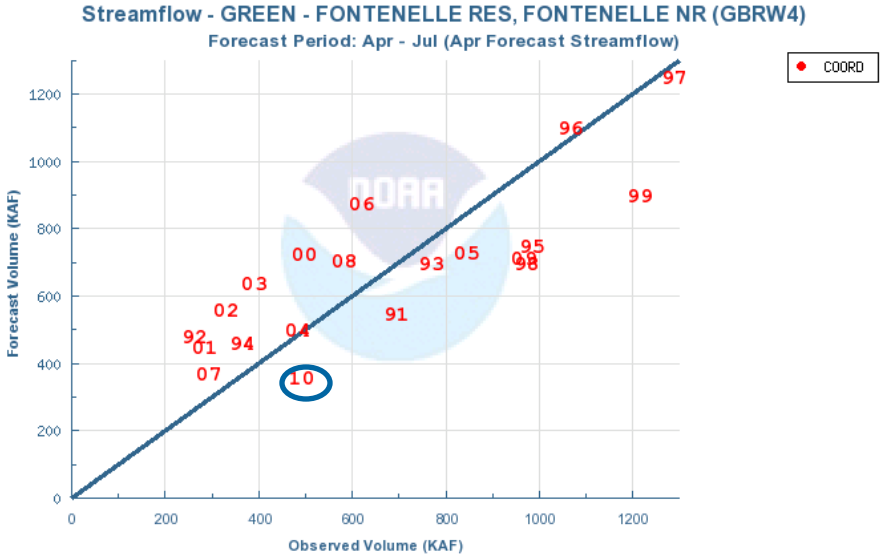

COLORADO - CAMEO, NR (CAMC2)
Water Year 2010, Forecast Period Apr-Jul (highlighted)
Volume (Kaf)
3500
3000
2500
2000
1500
1000
500
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
2175 KAF
90% avg
Forecast Period
HISTORY (1971-2000):
Period Minimum
Period Normal
NORMALS:
Monthly
Period Sum
OBSERVED:
Monthly (QCMPAZZ)
Period Sum
OFFICIAL FORECAST:
Reasonable Maximum
Final
Reasonable Minimum
90%-50% (Final)
50%-10% (Final)

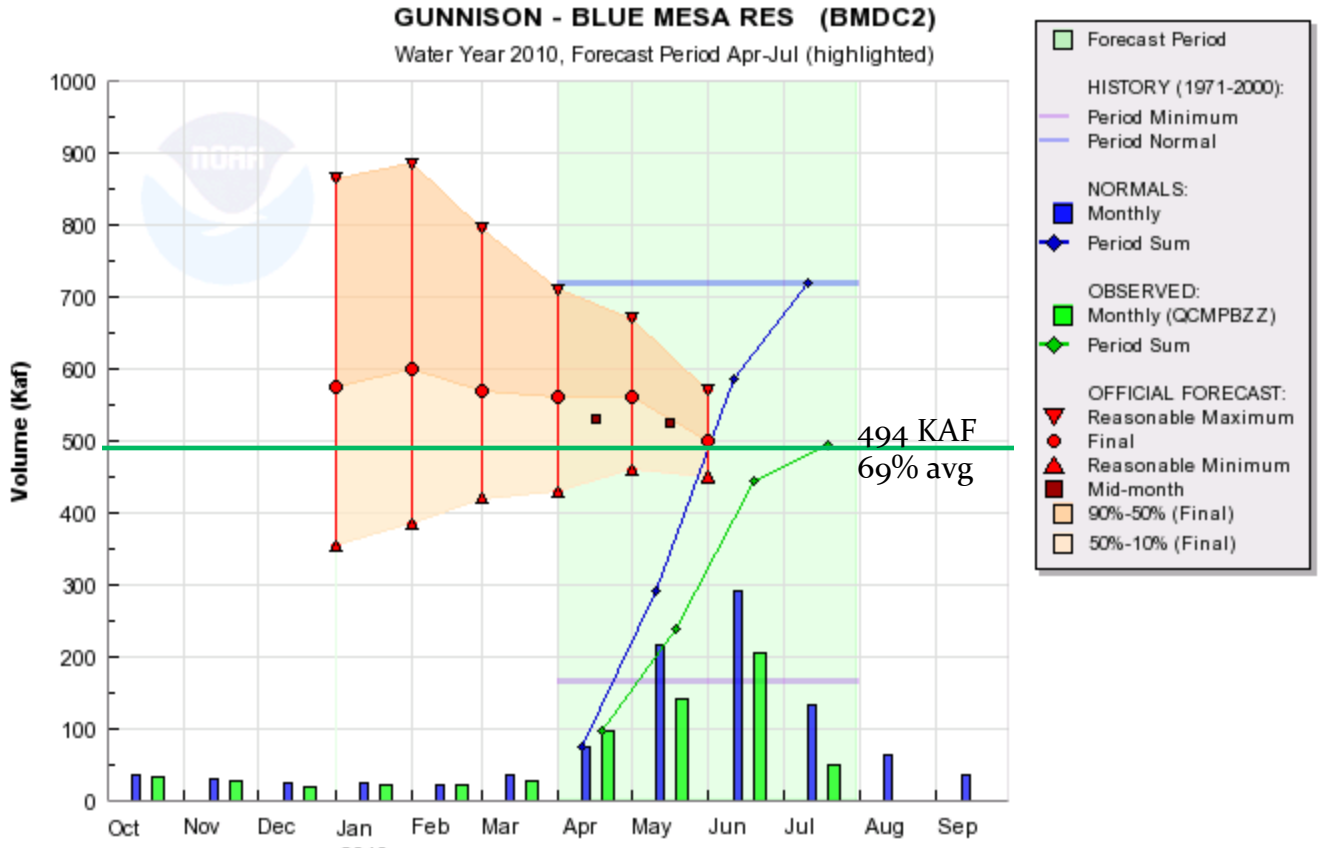

Mean Absolute Error - COLORADO - CAMEO, NR (CAMC2)
Forecast Period: Apr - Jul
Mean Absolute Error (kaf)
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Month Forecast Issued
COORD
Threshold
Value: 2420 KAF

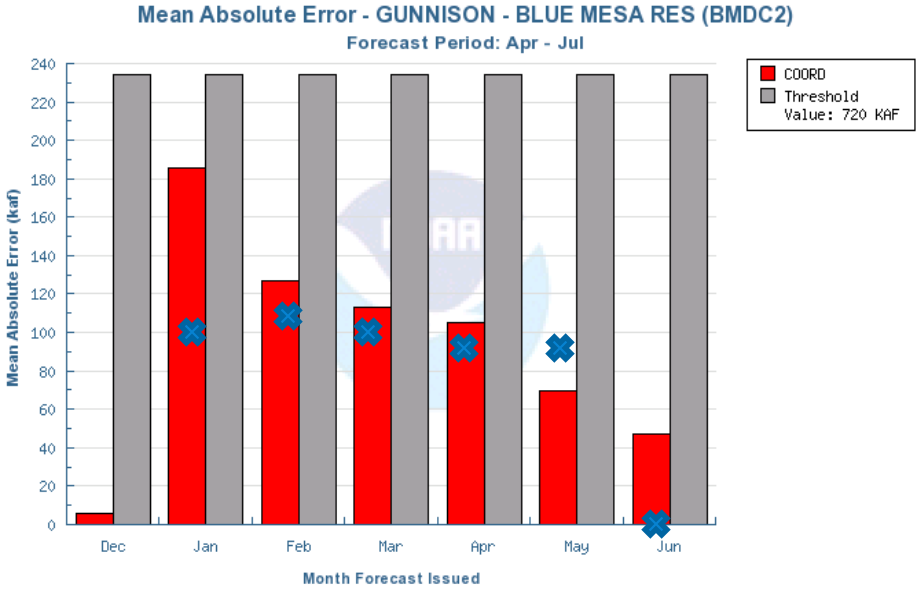

Streamflow - COLORADO - CAMEO, NR (CAMC2)
Forecast Period: Apr - Jul (Apr Forecast Streamflow)
Forecast Volume (KAF)
3500
3000
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000
Observed Volume (KAF)
96
08
97
93
06
09
95
00
03
94
92
98
05
07
01
02
04
COORD

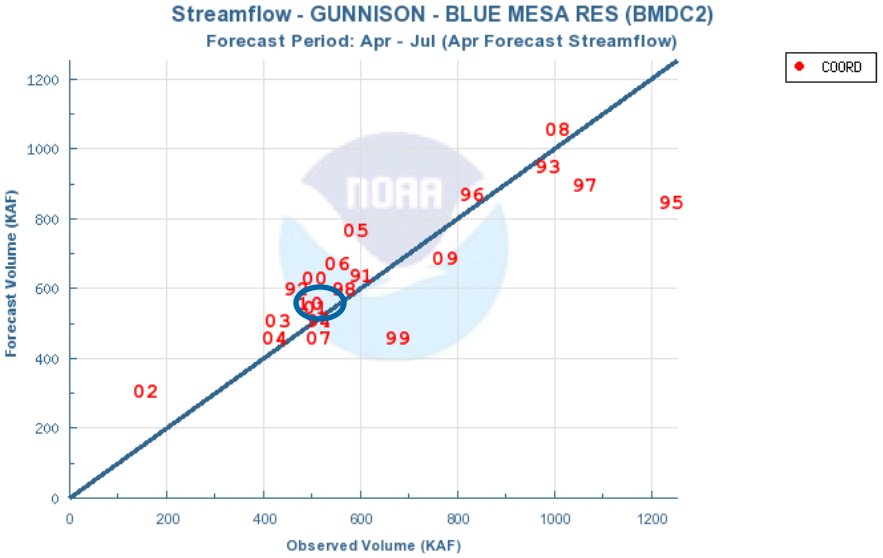

GREEN - FONTENELLE RES, FONTENELLE NR (GBRW4)
Water Year 2010, Forecast Period Apr-Jul (highlighted)
Volume (Kaf)
1200
1000
800
600
400
200
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
488 KAF
57% avg
Forecast Period
HISTORY (1971-2000):
Period Minimum
Period Normal
NORMALS:
Monthly
Period Sum
OBSERVED:
Monthly (QCMRZZZ)
Period Sum
OFFICIAL FORECAST:
Reasonable Maximum
Final
Reasonable Minimum
Mid-month
90%-50% (Final)
50%-10% (Final)

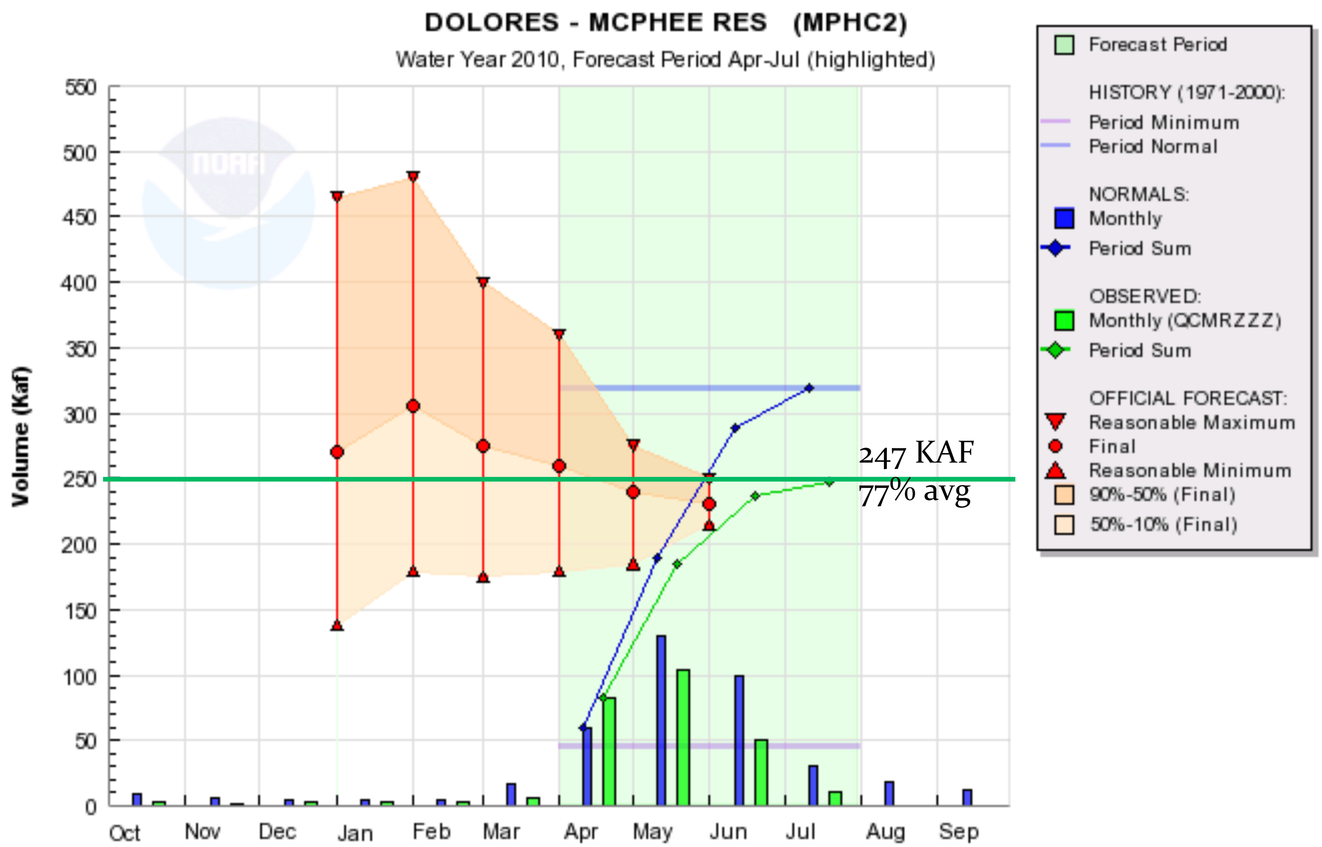

Mean Absolute Error - GREEN - FONTENELLE RES, FONTENELLE NR (GBRW4)
Forecast Period: Apr - Jul
Mean Absolute Error (kaf)
350
300
250
200
150
100
50
0
Dec
Jan
Feb
Mar
Apr
May
Jun
Month Forecast Issued
COORD
Threshold
Value: 860 KAF

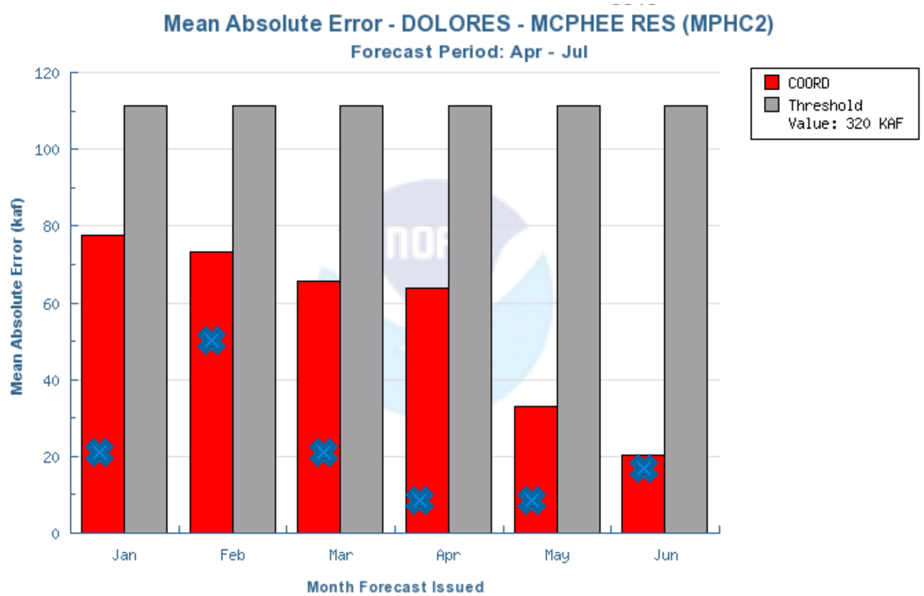

Streamflow - GREEN - FONTENELLE RES, FONTENELLE NR (GBRW4)
Forecast Period: Apr - Jul (Apr Forecast Streamflow)
Forecast Volume (KAF)
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
Observed Volume (KAF)
COORD
97
96
99
06
00
08
93
05
95
03
02
92
01
94
04
91
07
10

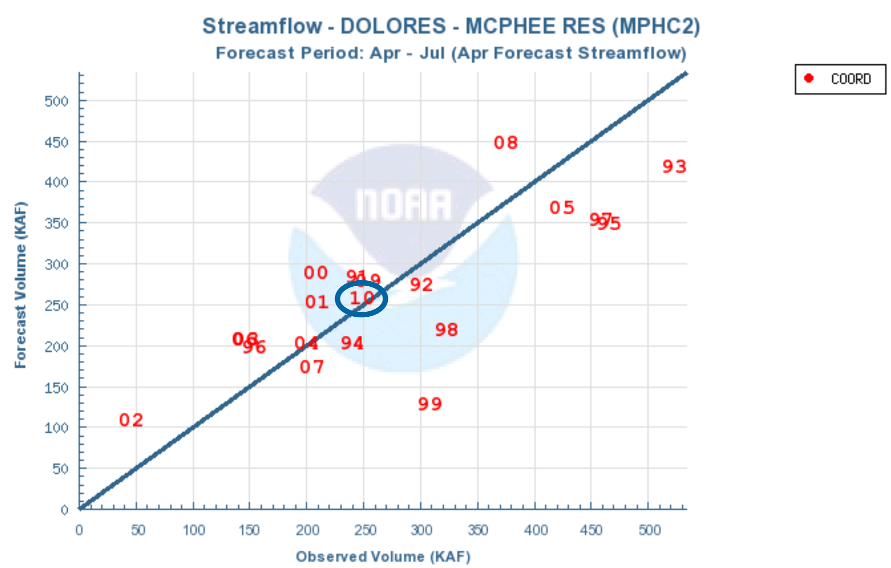

GUNNISON - BLUE MESA RES (BMDC2)
Water Year 2010, Forecast Period Apr-Jul (highlighted)
Volume (Kaf)
1000
900
800
700
600
500
400
300
200
100
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
494 KAF
69% avg
Forecast Period
HISTORY (1971-2000):
Period Minimum
Period Normal
NORMALS:
Monthly
Period Sum
OBSERVED:
Monthly (QCMPBZZ)
Period Sum
OFFICIAL FORECAST:
Reasonable Maximum
Final
Reasonable Minimum
Mid-month
90%-50% (Final)
50%-10% (Final)

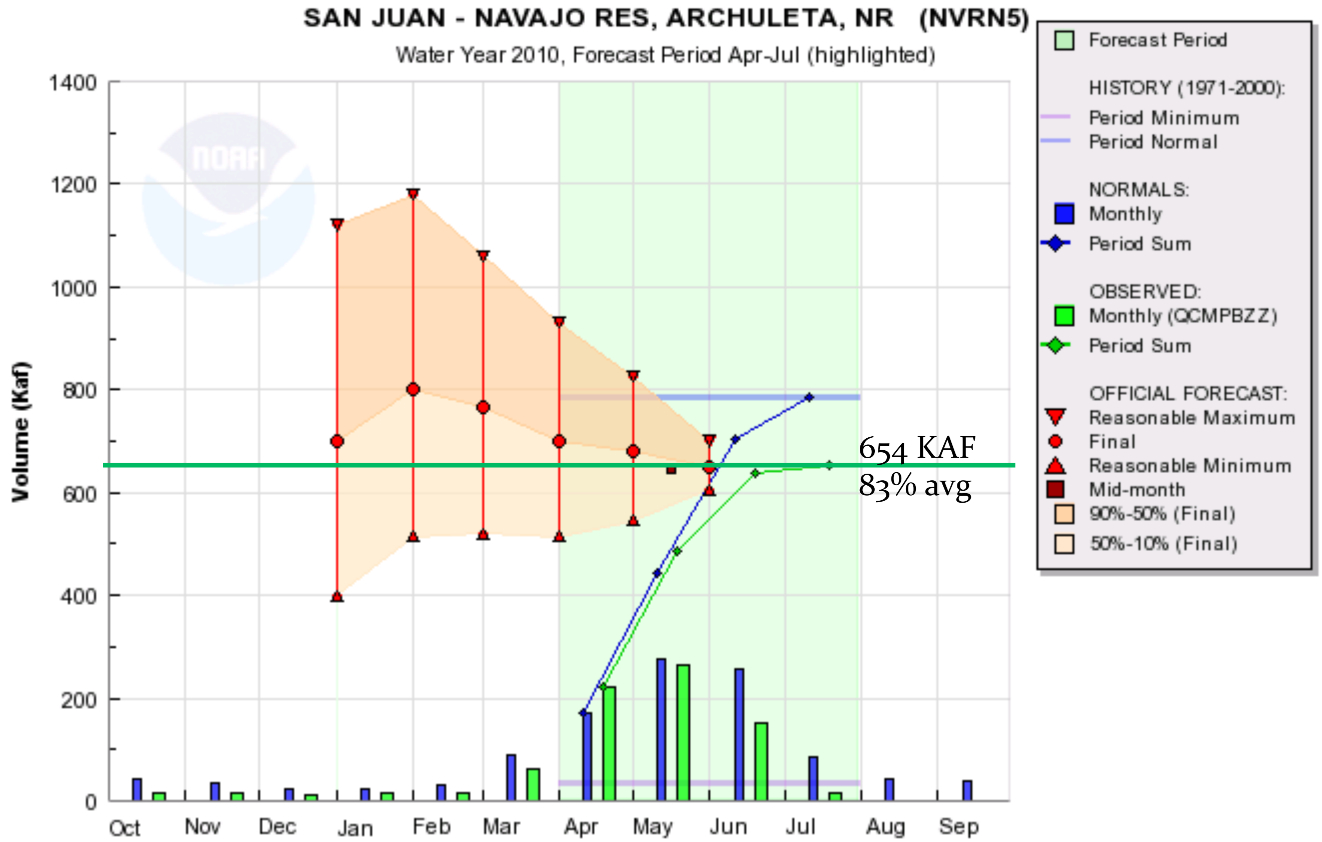

Mean Absolute Error - GUNNISON - BLUE MESA RES (BMDC2)
Forecast Period: Apr - Jul
Mean Absolute Error (kaf)
240
220
200
180
160
140
120
100
80
60
40
20
0
Dec
Jan
Feb
Mar
Apr
May
Jun
Month Forecast Issued
COORD
Threshold
Value: 720 KAF


Streamflow - GUNNISON - BLUE MESA RES (BMDC2)
Forecast Period: Apr - Jul (Apr Forecast Streamflow)
Forecast Volume (KAF)
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
Observed Volume (KAF)
COORD
02
03
04
05
06
07
08
09
91
93
95
96
97
99

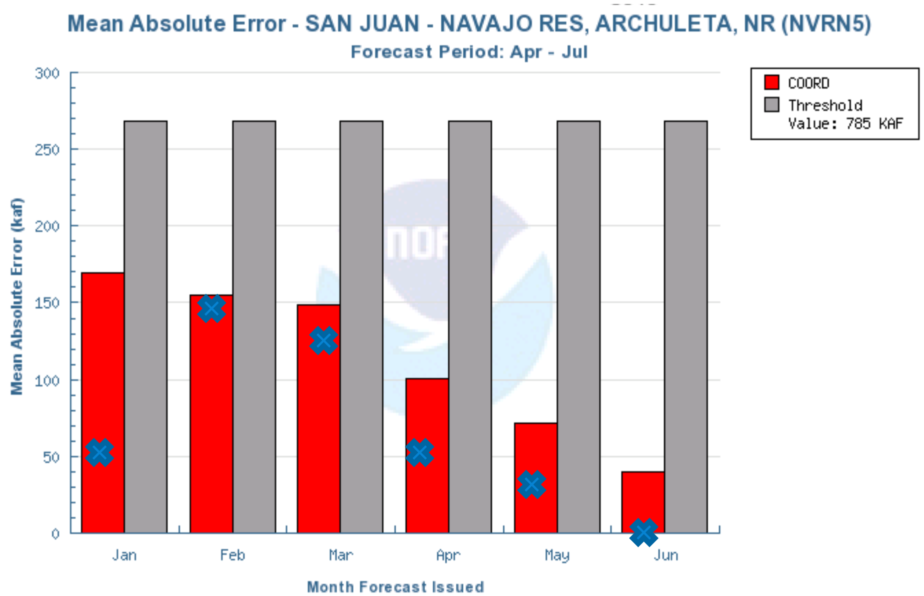

DOLORES - MCPHEE RES (MPHC2)
Water Year 2010, Forecast Period Apr-Jul (highlighted)
Volume (Kaf)
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
247 KAF
77% avg
Forecast Period
HISTORY (1971-2000):
Period Minimum
Period Normal
NORMALS:
Monthly
Period Sum
OBSERVED:
Monthly (QCMRZZZ)
Period Sum
OFFICIAL FORECAST:
Reasonable Maximum
Final
Reasonable Minimum
90%-50% (Final)
50%-10% (Final)


Mean Absolute Error - DOLORES - MCPHEE RES (MPHC2)
Forecast Period: Apr - Jul
Mean Absolute Error (kaf)
COORD
Threshold
Value: 320 KAF
Jan
Feb
Mar
Apr
May
Jun
Month Forecast Issued

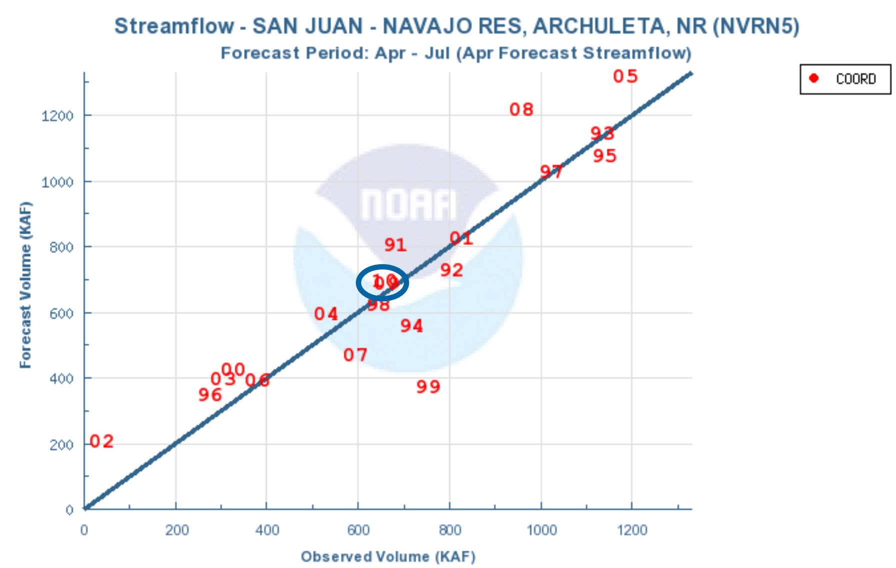

Streamflow - DOLORES - MCPHEE RES (MPHC2)
Forecast Period: Apr - Jul (Apr Forecast Streamflow)
Forecast Volume (KAF)
Observed Volume (KAF)
COORD



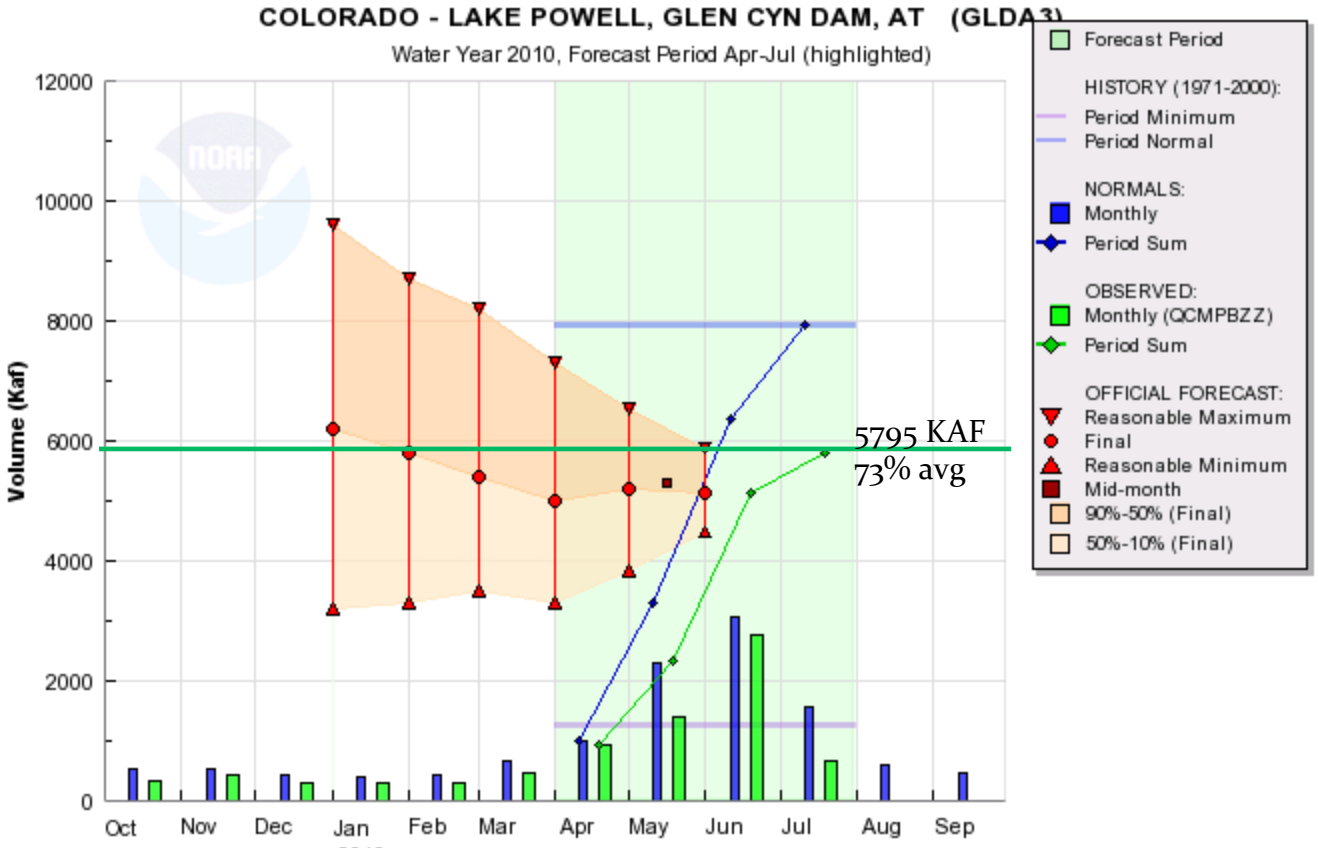
SAN JUAN - NAVAJO RES, ARCHULETA, NR (NVRN5)
Water Year 2010, Forecast Period Apr-Jul (highlighted)
Volume (Kaf)
1400
1200
1000
800
600
400
200
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
654 KAF
83% avg
Forecast Period
HISTORY (1971-2000):
Period Minimum
Period Normal
NORMALS:
Monthly
Period Sum
OBSERVED:
Monthly (QCMPBZZ)
Period Sum
OFFICIAL FORECAST:
Reasonable Maximum
Final
Reasonable Minimum
Mid-month
90%-50% (Final)
50%-10% (Final)

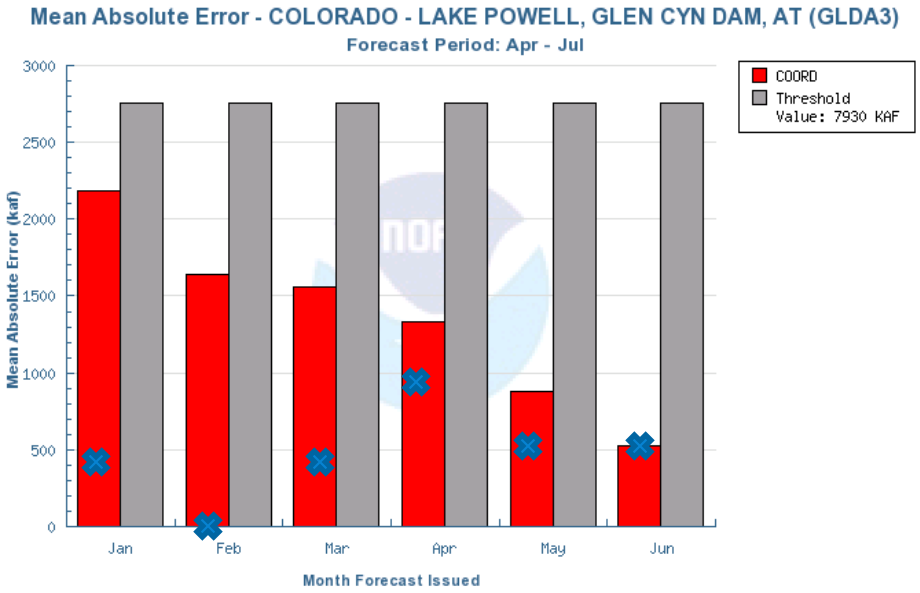


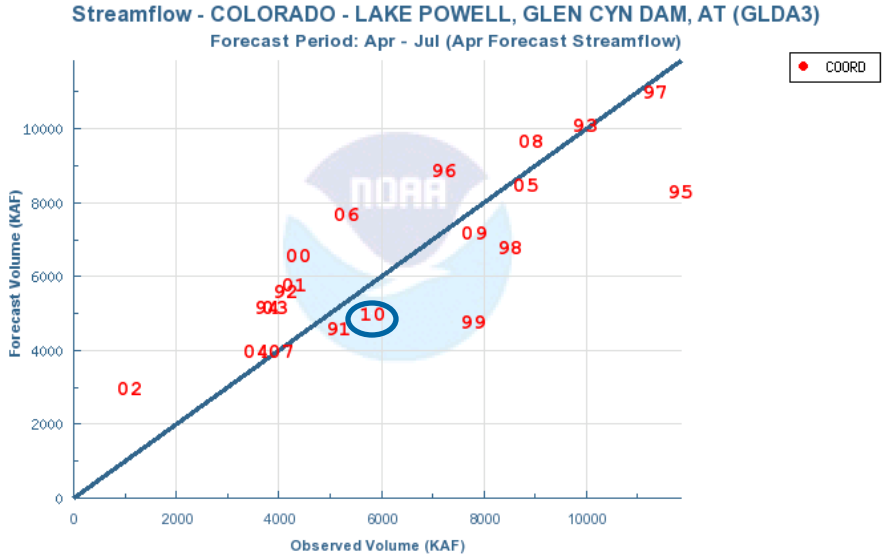
Mean Absolute Error - SAN JUAN - NAVAJO RES, ARCHULETA, NR (NVRN5)
Forecast Period: Apr - Jul
Mean Absolute Error (kaf)
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Month Forecast Issued
COORD
Threshold
Value: 785 KAF



Streamflow - SAN JUAN - NAVAJO RES, ARCHULETA, NR (NVRN5)
Forecast Period: Apr - Jul (Apr Forecast Streamflow)
Forecast Volume (KAF)
Observed Volume (KAF)
COORD
05
08
93
95
97
91
01
92
10
98
04
94
07
00
03
06
96
99
02

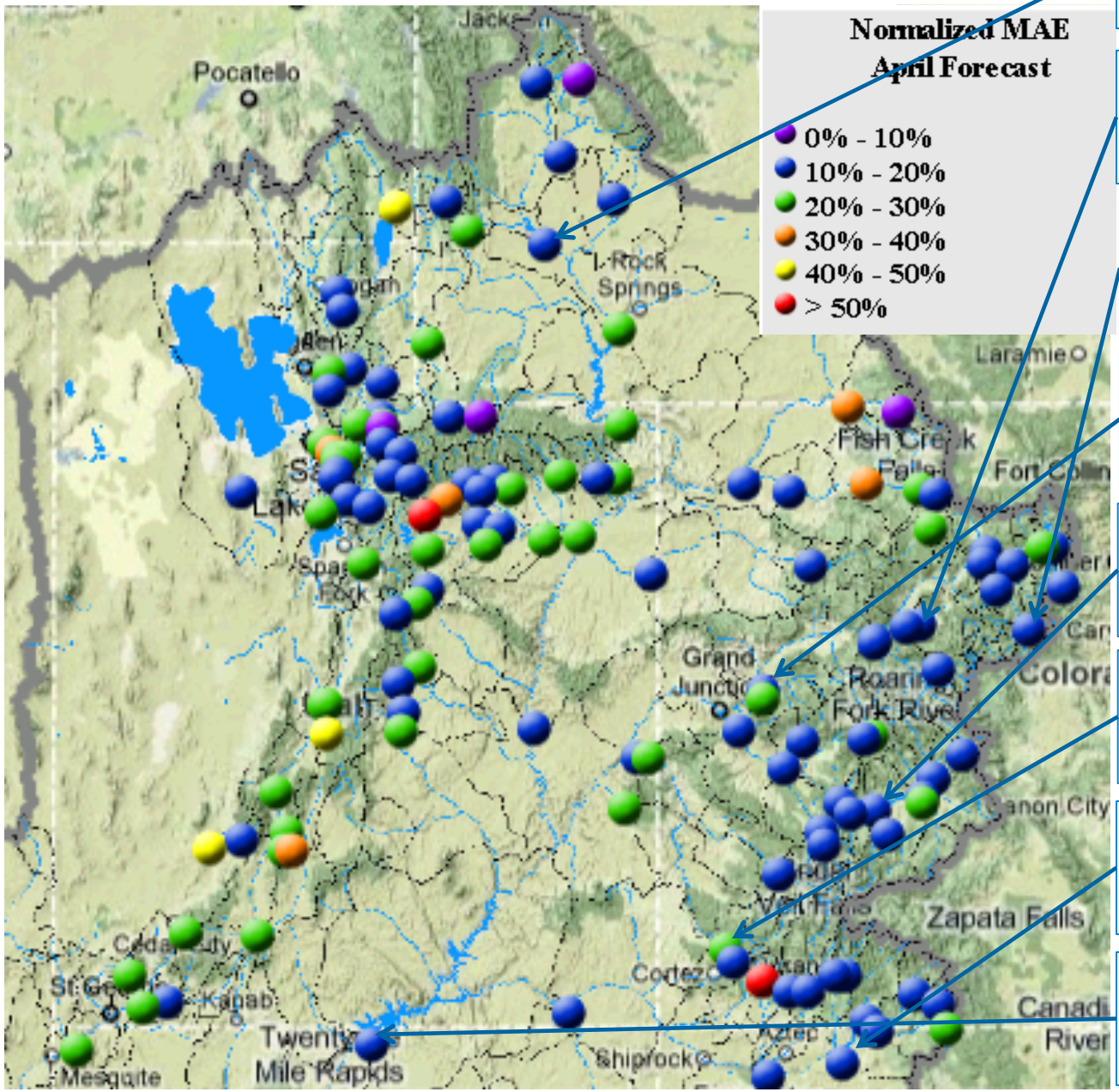

COLORADO - LAKE POWELL, GLEN CYN DAM, AT (GLDA3)
Water Year 2010, Forecast Period Apr-Jul (highlighted)
Volume (Kaf)
12000
10000
8000
6000
4000
2000
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
5795 KAF
73% avg
Forecast Period
HISTORY (1971-2000):
Period Minimum
Period Normal
NORMALS:
Monthly
Period Sum
OBSERVED:
Monthly (QCMPBZZ)
Period Sum
OFFICIAL FORECAST:
Reasonable Maximum
Final
Reasonable Minimum
Mid-month
90%-50% (Final)
50%-10% (Final)


Mean Absolute Error - COLORADO - LAKE POWELL, GLEN CYN DAM, AT (GLDA3)
Forecast Period: Apr - Jul
Mean Absolute Error (kaf)
3000
2500
2000
1500
1000
500
0
Jan
Feb
Mar
Apr
May
Jun
Month Forecast Issued
COORD
Threshold
Value: 7930 KAF


Streamflow - COLORADO - LAKE POWELL, GLEN CYN DAM, AT (GLDA3)
Forecast Period: Apr - Jul (Apr Forecast Streamflow)
Forecast Volume (KAF)
10000
8000
6000
4000
2000
0
0
2000
4000
6000
8000
10000
Observed Volume (KAF)
COORD
97
93
08
96
05
95
06
09
98
00
01
92
03
10
91
99
04
07
02

Water Supply Forecast Evaluation

April - July Evaluation



Fontenelle Reservoir
1991-2008 - 19%
2010 – 20%

Eagle-Gypsum
1991-2008 - 16%
2010 – 33%

Dillon Reservoir
1991-2008 - 20%
2010 – 14%

Colorado-Cameo
1991-2008 - 15%
2010 – 15%

Blue Mesa Reservoir
1991-2008 - 15%
2010 – 20%

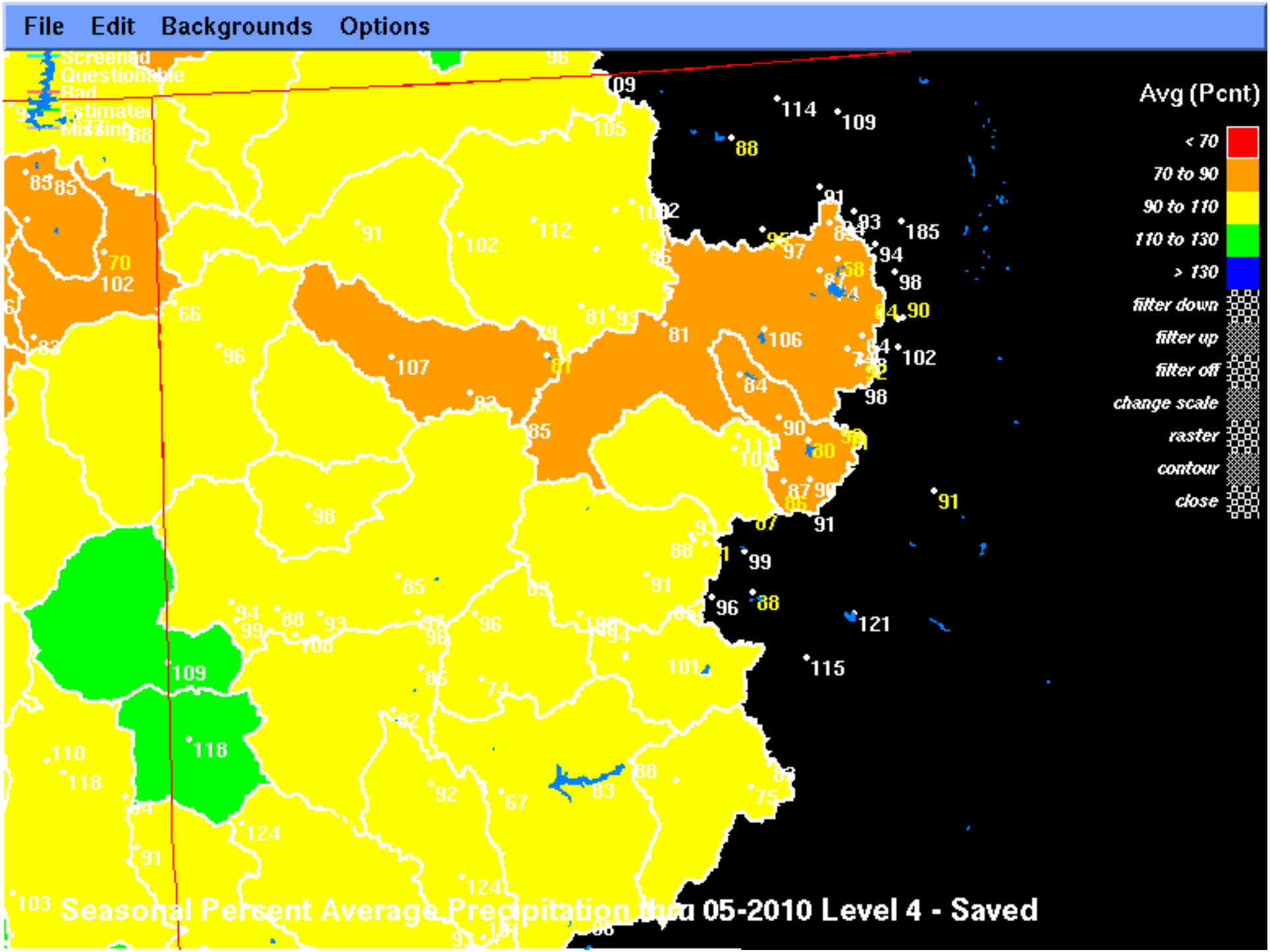
McPhee Reservoir
1991-2008 - 21%
2010 – 5%

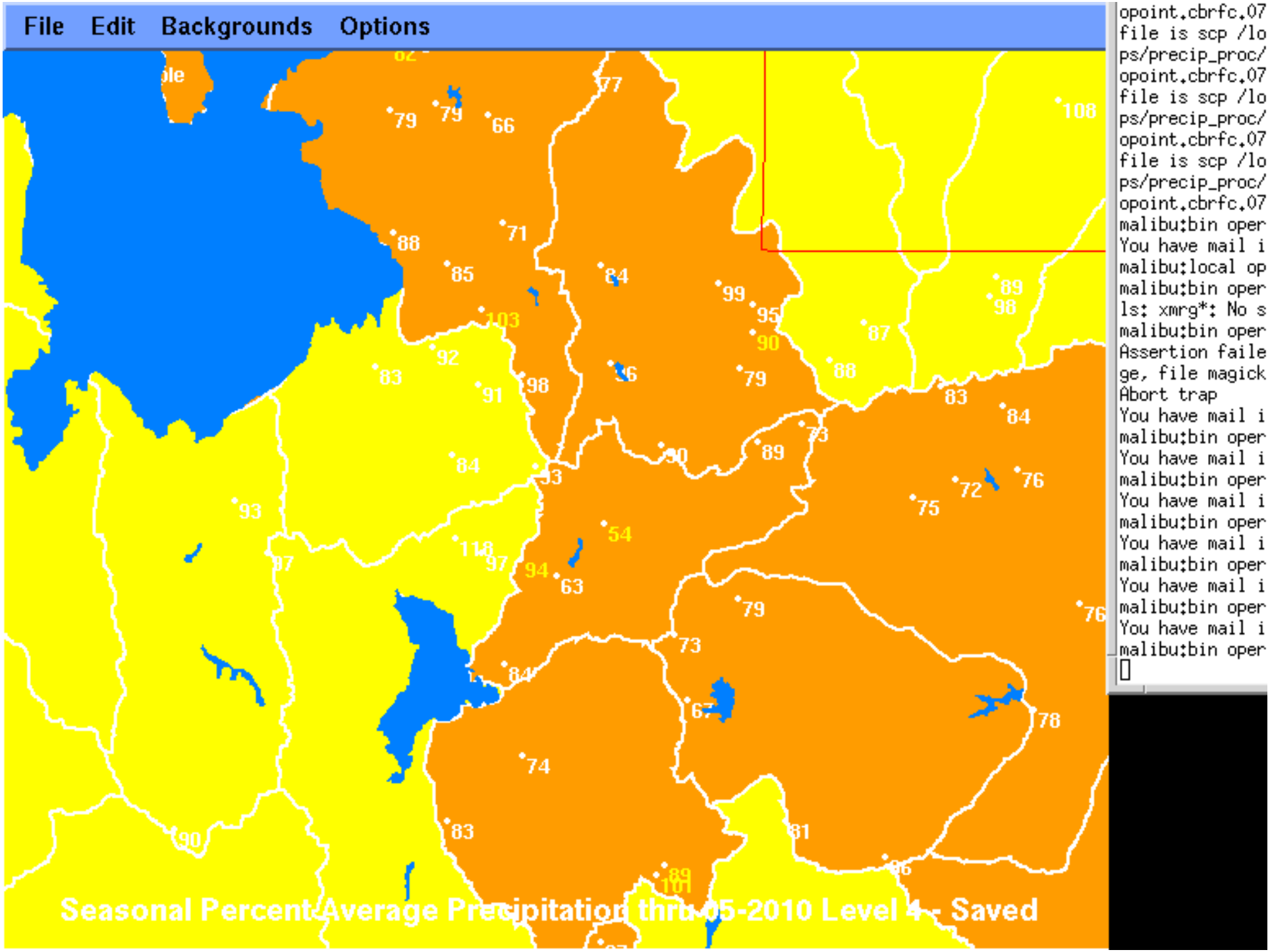
Navajo Reservoir
1991-2008 - 13%
2010 – 8%

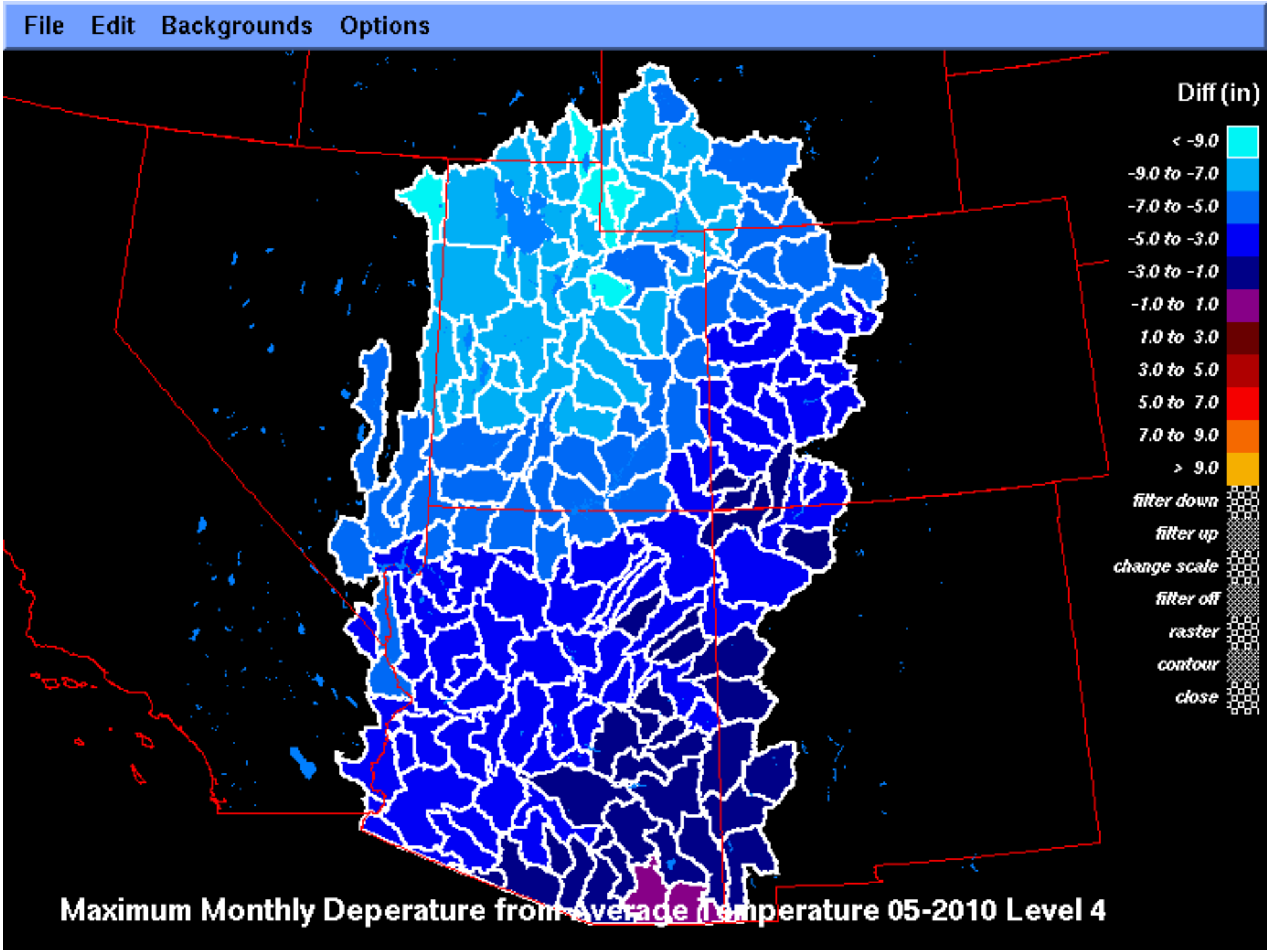
Lake Powell
1991-2008 - 17%
2010 – 14%

Some Observations (Craig)

- 7 days of high flow (6/6-6/13)
- Near normal/below normal seasonal precipitation
- Below Normal temperatures in May (slightly below in April)
  - Melt was delayed
- Season volumes affected somewhat
- Seen on:
  - Roaring Fork
  - Eagle
  - Uncompahgre (a little)
  - Granby (a little)
  - Yampa
  - Big/Little Cottonwood
  - Headwaters of Provo/Weber/Bear/Uinta streams
- Did not affect
  - Gunnison/San Juan Rivers
  - Blue
  - Upper Green

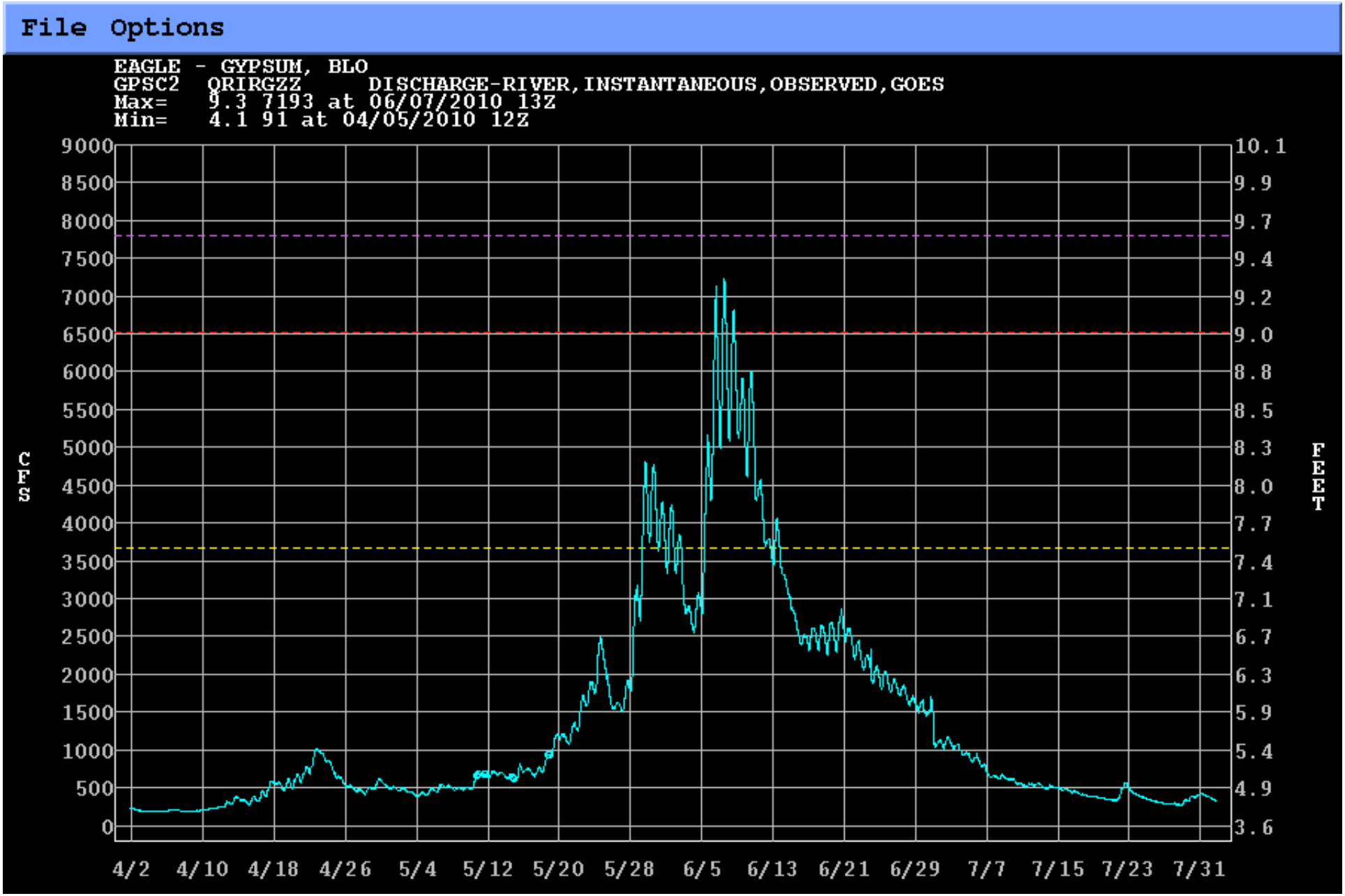

File Edit Backgrounds Options
Screened
Questionable
Bad
Estimated
Missing
Avg (Pcnt)
< 70
70 to 90
90 to 110
110 to 130
> 130
filter down
filter up
filter off
change scale
raster
contour
close
Seasonal Percent Average Precipitation thru 05-2010 Level 4 - Saved

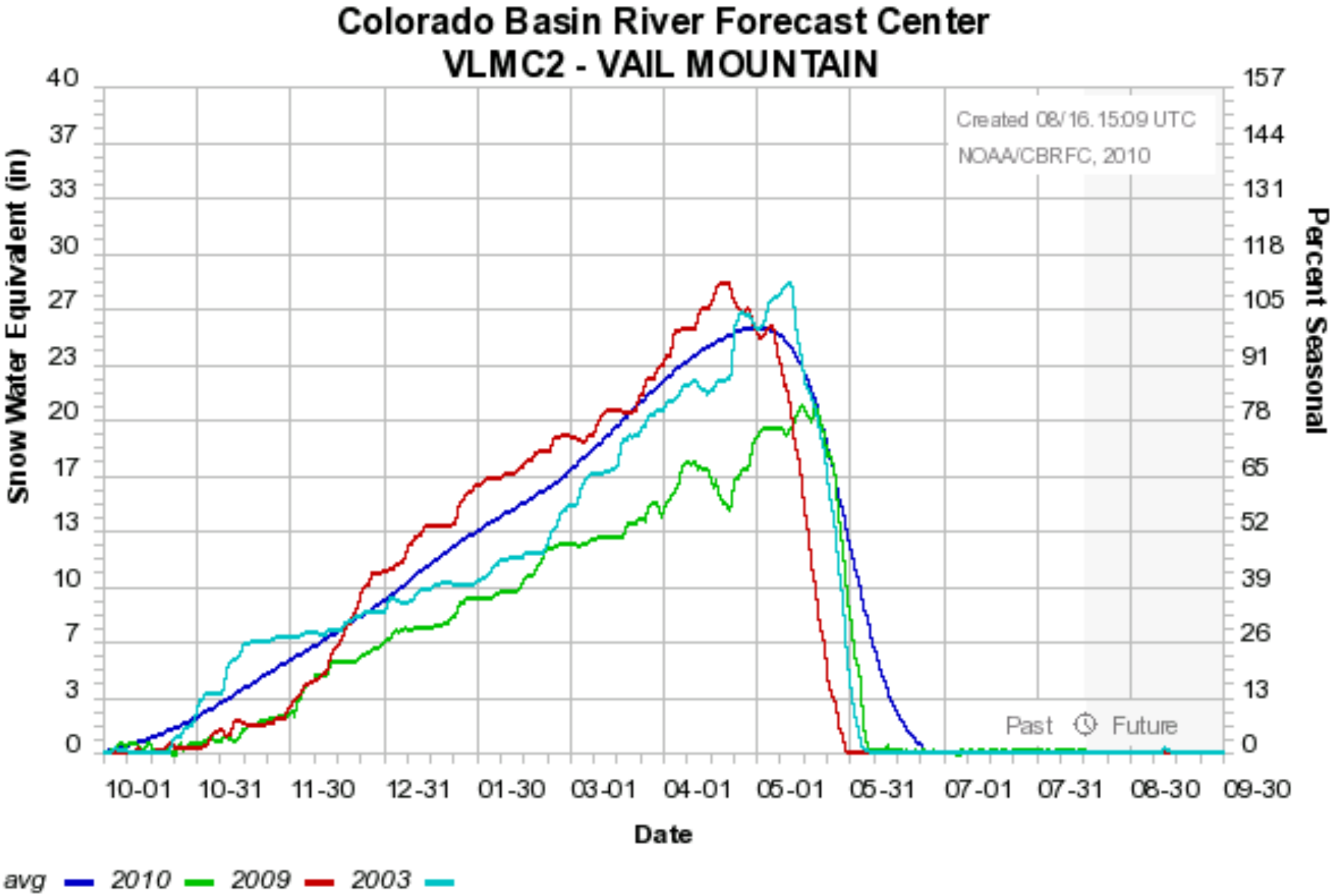

File Edit Backgrounds Options
Seasonal Percent Average Precipitation thru 05-2010 Level 4 - Saved
opoint.cbrfc.07
file is scp /lo
ps/precip_proc/
opoint.cbrfc.07
file is scp /lo
ps/precip_proc/
opoint.cbrfc.07
file is scp /lo
ps/precip_proc/
opoint.cbrfc.07
malibu:bin oper
You have mail i
malibu:local op
malibu:bin oper
ls: xmrg*: No s
malibu:bin oper
Assertion faile
ge, file magick
Abort trap
You have mail i
malibu:bin oper
You have mail i
malibu:bin oper
You have mail i
malibu:bin oper
You have mail i
malibu:bin oper
You have mail i
malibu:bin oper
You have mail i
malibu:bin oper


File
Edit
Backgrounds
Options
Diff (in)
< -9.0
-9.0 to -7.0
-7.0 to -5.0
-5.0 to -3.0
-3.0 to -1.0
-1.0 to 1.0
1.0 to 3.0
3.0 to 5.0
5.0 to 7.0
7.0 to 9.0
> 9.0
filter down
filter up
change scale
filter off
raster
contour
close
Maximum Monthly Deperature from Average Temperature 05-2010 Level 4

File Options

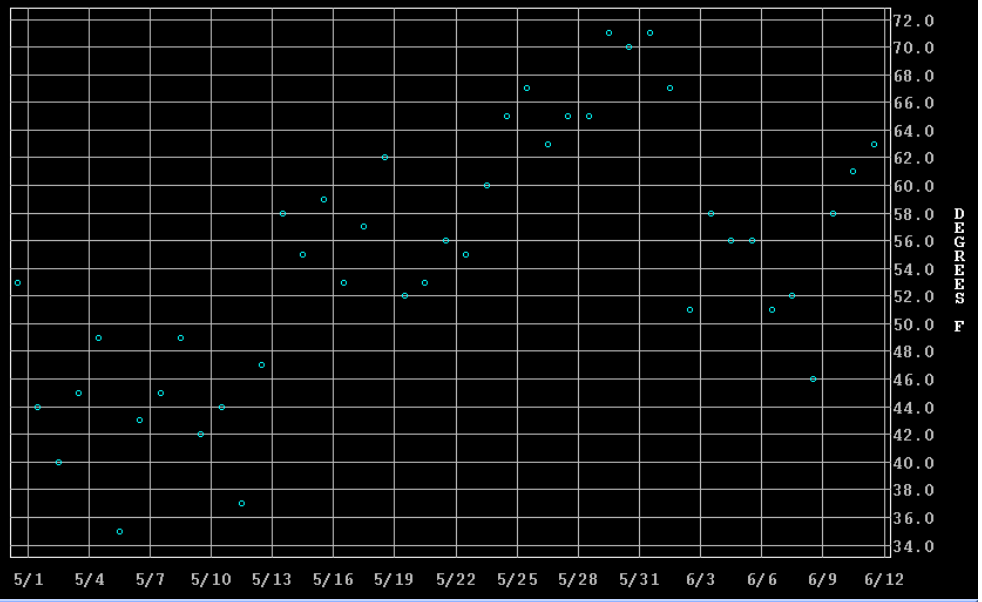
File Options




Colorado Basin River Forecast Center
VLMC2 - VAIL MOUNTAIN
Created 08/16.15:09 UTC
NOAA/CBRFC, 2010
Past
Future
Snow Water Equivalent (in)
Percent Seasonal
Date
40
37
33
30
27
23
20
17
13
10
7
3
0
157
144
131
118
105
91
78
65
52
39
26
13
0
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
avg
2010
2009
2003

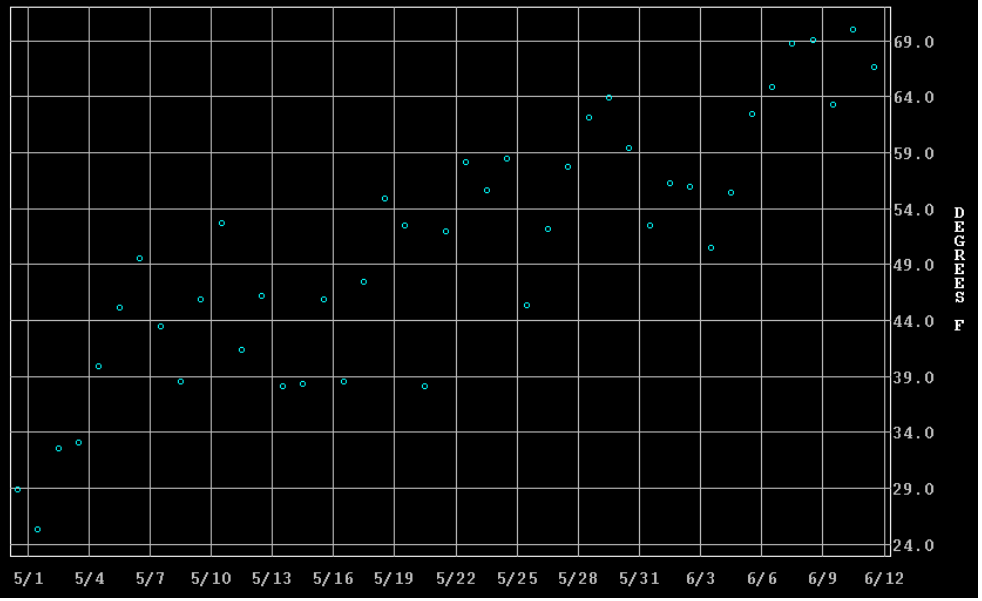
File Options

VAIL MOUNTAIN
VLMC2 TAI1MXZ AIR TEMPERATURE,INSTANTANEOUS,PROCESSED LEVEL 1,METEOR,MAXIMUM:DAILY
Max= 71.0 at 05/31/2003 12Z
Min= 35.0 at 05/05/2003 12Z



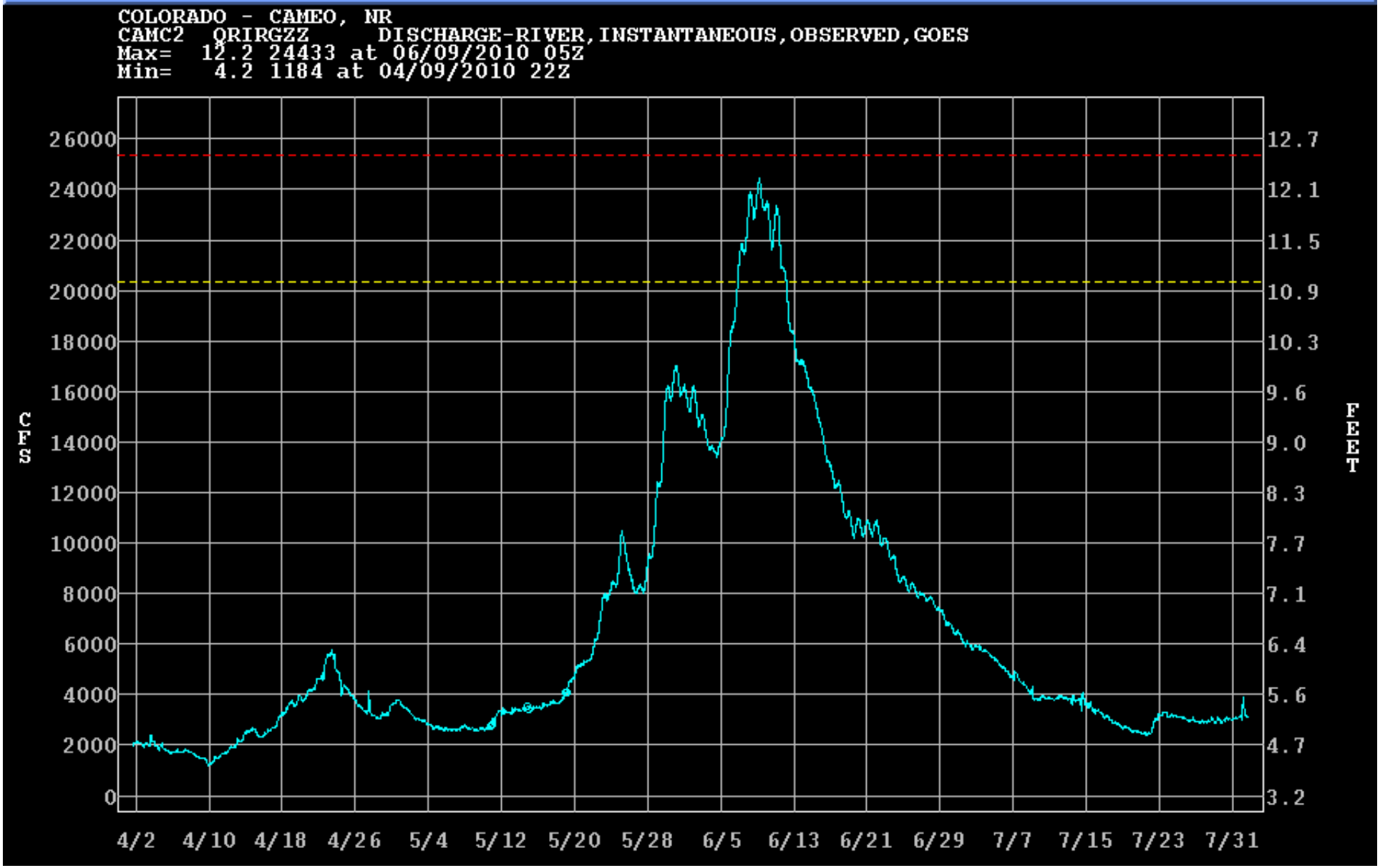
File Options

VAIL MOUNTAIN
VLMC2 TAI1MXZ AIR TEMPERATURE,INSTANTANEOUS,PROCESSED LEVEL 1,METEOR,MAXIMUM:DAILY
Max= 70.0 at 06/10/2010 12Z
Min= 25.3 at 05/01/2010 12Z

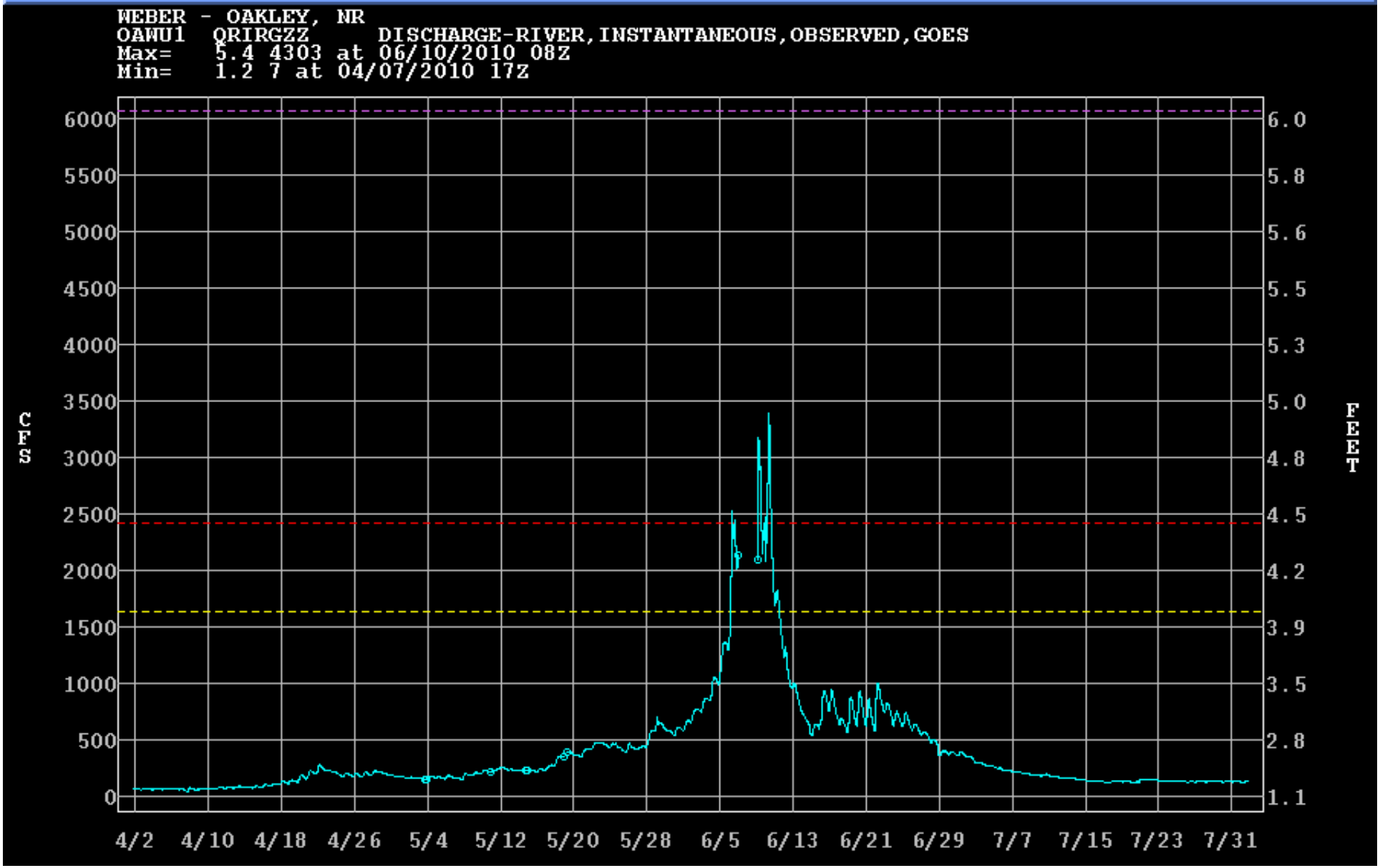


File Options

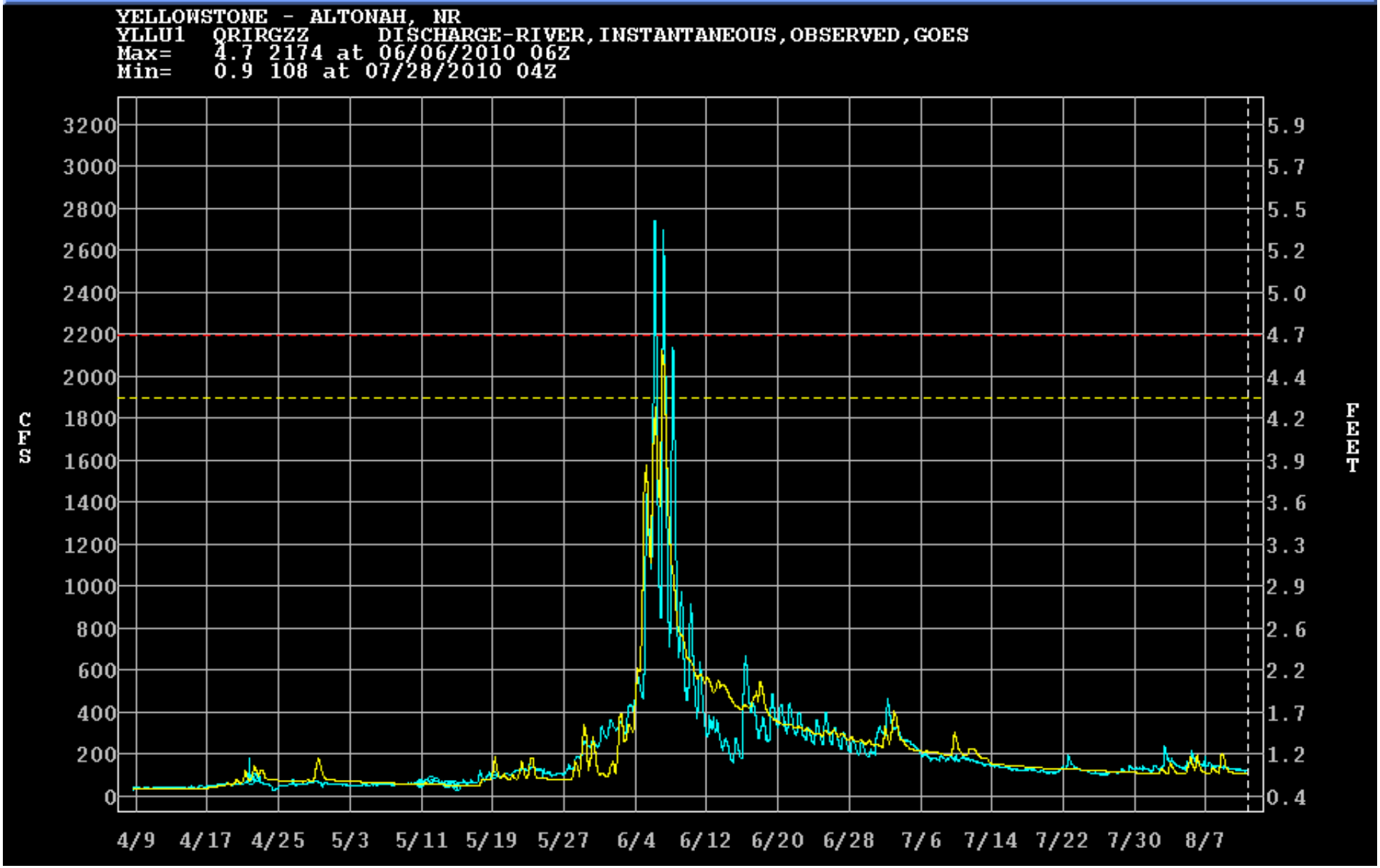
File Options



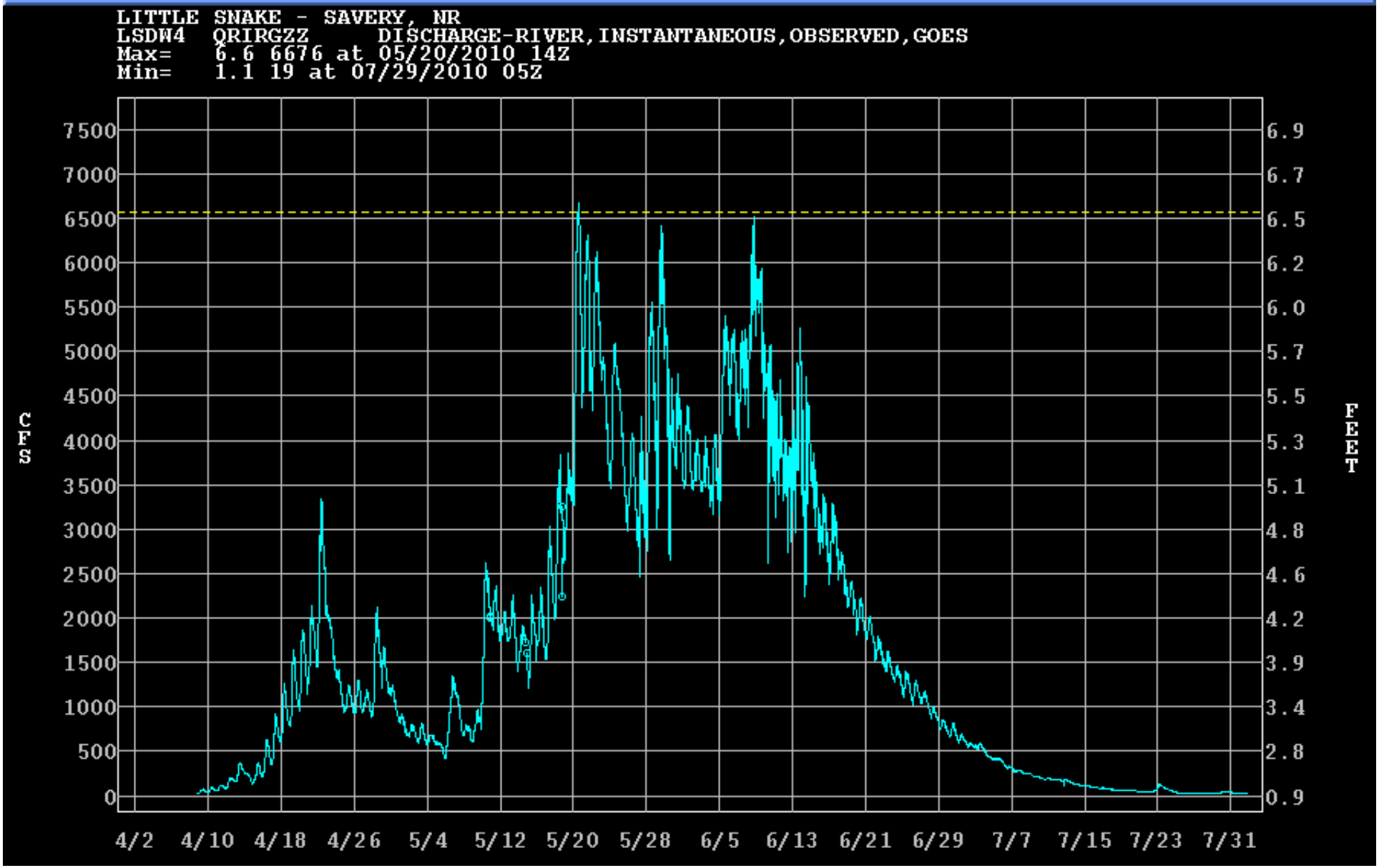
File Options



File Options



File Options



Possible Reasons

- Possible Input errors
  - Precipitation
  - Temperature
    - Fixes for the future
  - Running model in calibration mode showed similar errors
- Known SNOW-17 low bias in rapid melt situations
  - Temperature index model
- Melt of snow probably was atypical
  - Model is split by elevation zones not aspect
    - Significant melt in May in exposed areas
    - Delay of melt in colder, less exposed areas
      - Hypothesis: North facing lower level melted at same time as south facing high level
        - Not captured by SNOTEL network or model
- Similar error in one other year (1984)

Possible Solutions

- Areal Extent updates
- Distributed models
- Late melt = flooding potential