

Water Supply Forecasting For Fontenelle Reservoir Inflow

April 28, 2010

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Colorado Basin River Forecast Center



- How We Develop Forecasts
- The April Forecast
- How It's Looking Now
- What We Can Expect



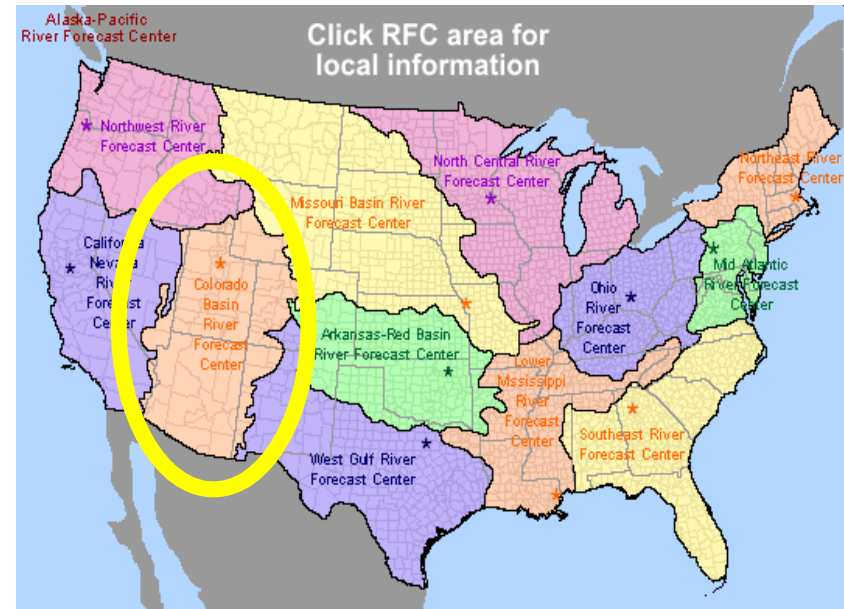
Colorado Basin River Forecast Center

One of 13 River Forecast Centers

Established in the 1940s for water supply forecasting

Three primary missions:

1. Seasonal **Water supply forecasts** for water management
2. **Daily forecasts** for flood, recreation, water management
3. **Flash flood warning support**



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Forecast Tools and Process

- Statistical Water Supply (SWS)
 - Green – Daniel, Nr, Warren Bridge (forecast point)
 - Pine CK – Fremont LK, Abv (forecast point)
 - New Fork - Big Piney, Nr (forecast point)
 - Green – Fontenelle (forecast point)
- NWS River Forecast System - Ensemble Streamflow Prediction (ESP)
 - Four Forecast Points Above Plus:
 - Fontenelle Ck - Herschler, Nr (additional point in model)
 - Green - La Barge, Nr (additional data point in model)
- Coordination with the Natural Resources Conservation Service (NRCS)



Statistical Water Supply (SWS)

Sample Equation for April 1 2010:

Apr-Jul volume for Fontenelle Reservoir

- Apr 1 Green – Daniel, Nr Warren Bridge forecast
- Apr 1 New Fork – Big Piney, Nr forecast

File Options Actions Help

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GBRW4 QCMRZZZ P Apr-Jul (GREEN - FONTENELLE RES. FONTENELLE NR) JR2: 0.781 years: 71-97 (27)
AVG: 860.000 YTRANS: none

-----
GREEN - DANIEL, NR, WARREN BRIDGE, AT MBRW4/QCMFZZ4
Apr 149.71 57% * 0.167 = 25.00

NEW FORK - BIG PINEY, NR BPNW4/QCMFZZ4
Apr 231.12 58% * 2.543 = 587.73

-196.229 + 612.73 = 416.50 ( 48%)

w/ coordinated:

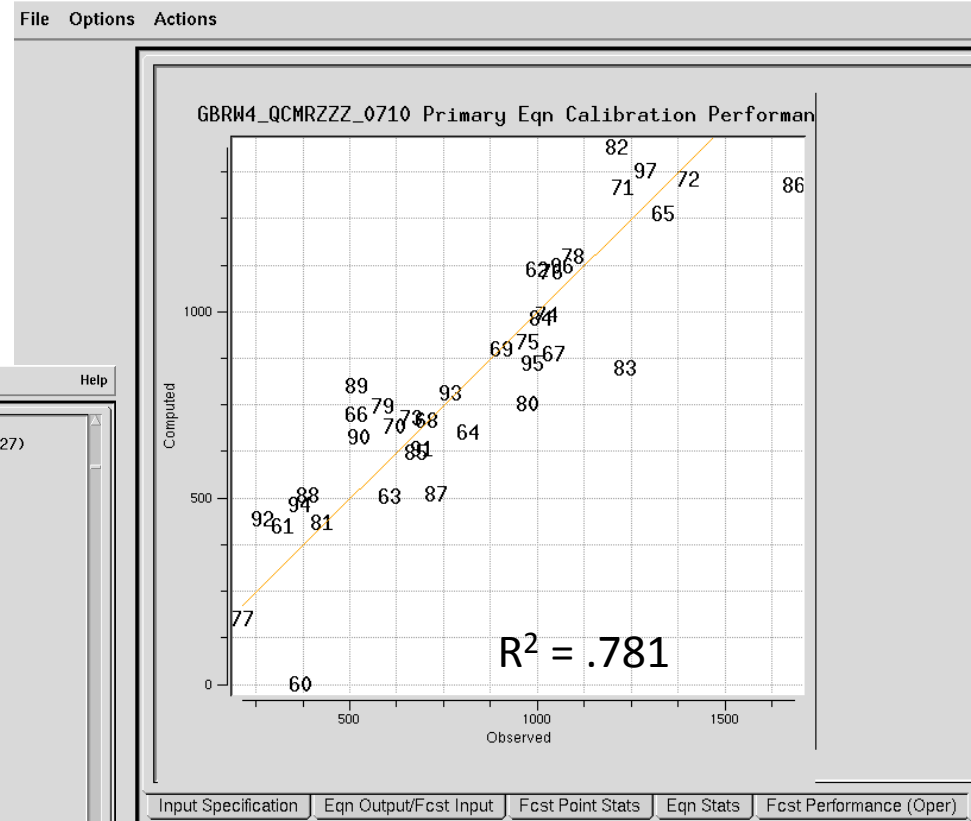
GREEN - DANIEL, NR, WARREN BRIDGE, AT MBRW4/QCMFZZ4
Apr 130.00 49% * 0.167 = 21.71

NEW FORK - BIG PINEY, NR BPNW4/QCMFZZ4
Apr 200.00 51% * 2.543 = 508.60

-196.229 + 530.31 = 334.08 ( 39%)
    
```

GBRW4 QCMR 0407	Coordinated	Model Computed	Comp. w/ Coord.	NWS Preferred.	Other Agency
R. Max	560.00 65%	656.83 76%	574.41 67%	610.33 71%	0.00 0%
Most Prob.	360.00 42%	416.50 48%	334.08 39%	370.00 43%	350.00 41%
R. Min	205.00 24%	176.17 20%	93.75 11%	129.67 15%	0.00 0%

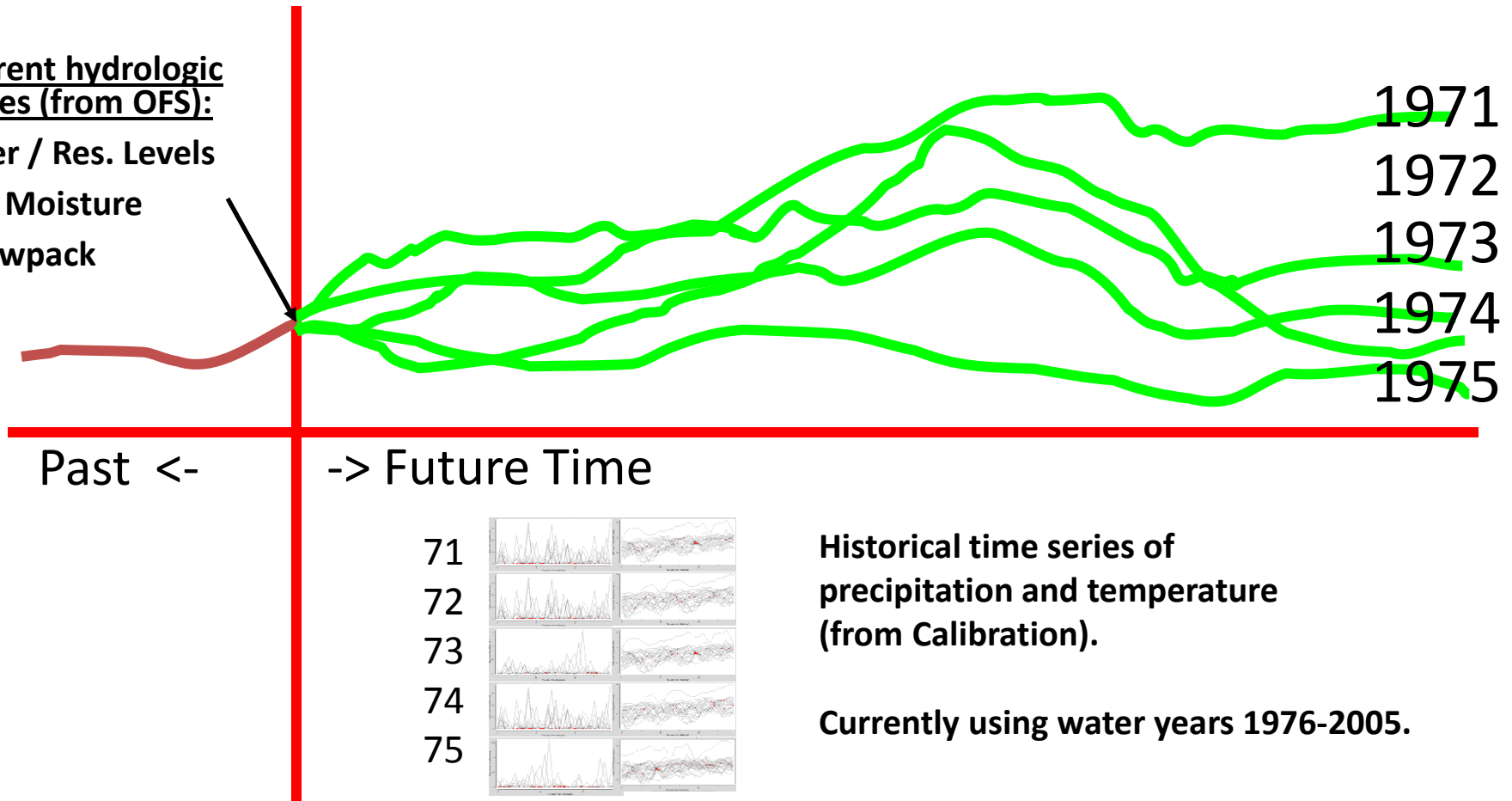
Input Specification Eqn Output/Fcst Input Fcst Point Stats Eqn Stats Fcst Performance (Oper) Fcst Performance (Calib) Log



Ensemble Streamflow Prediction (ESP)

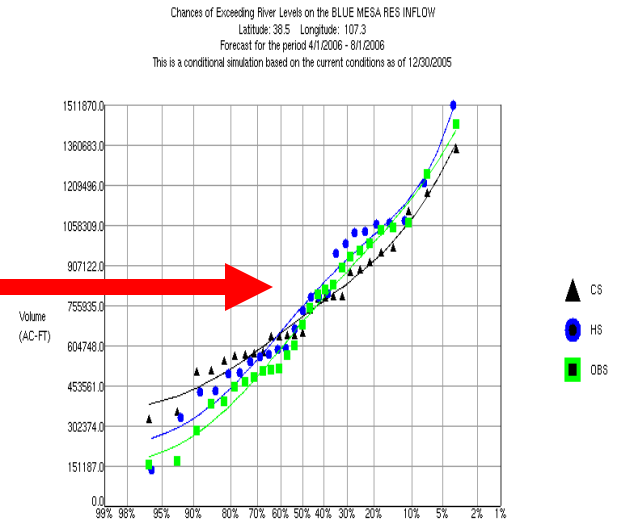
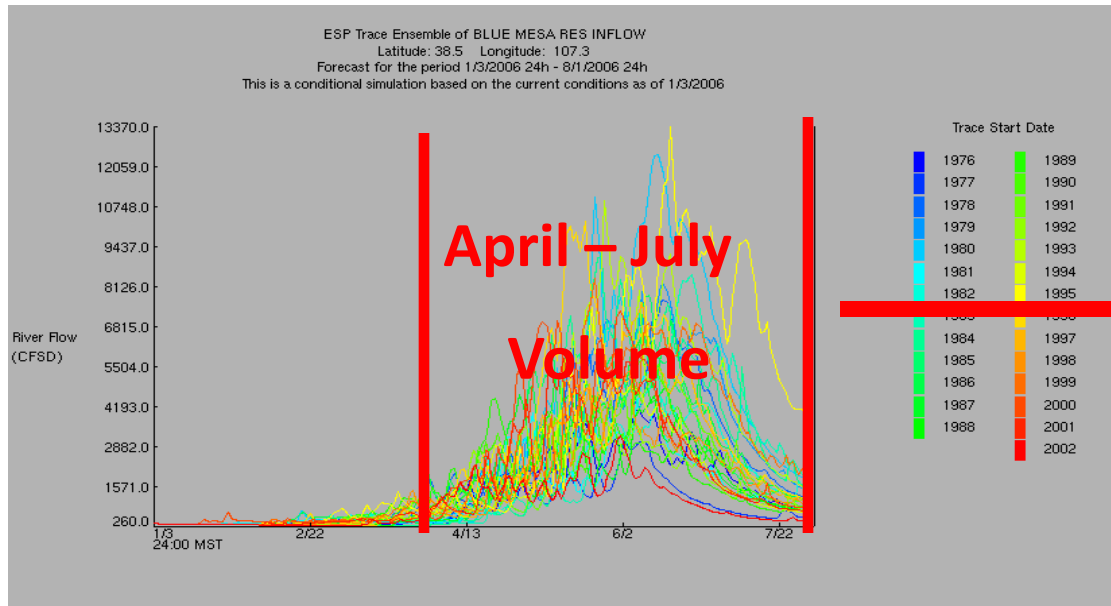
Current hydrologic states (from OFS):

River / Res. Levels
Soil Moisture
Snowpack



Start with current conditions – Apply each year of historical climate – Create several possible future streamflow patterns

Ensemble Streamflow Prediction (ESP)



1. Select a forecast window
2. Select a forecast variable
3. Model derives a distribution function
4. 50% exceedance value = most probable forecast
5. Correct for model bias

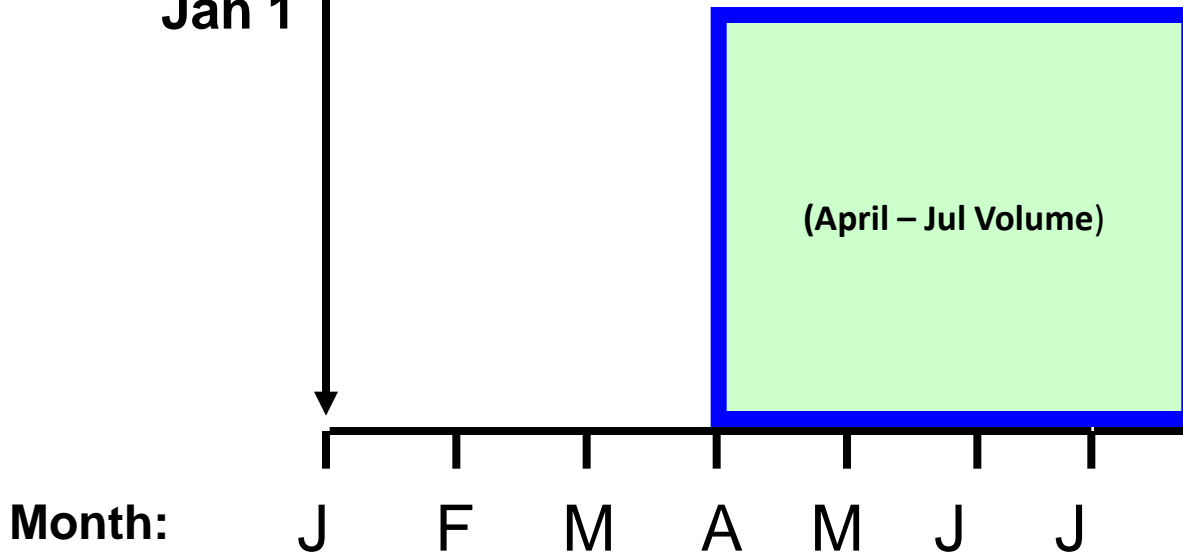
Statistics based on all years.

# Exceedance Probabilities	Conditional Simulation	Historical Simulation	Historical Observed
0.900	438320.500	328520.656	262730.375
0.750	552369.562	499977.531	435810.375
0.500	711742.375	751782.938	691946.625
0.250	877104.812	973699.188	935549.938
0.100	1080490.375	1170393.125	1157333.250

What drives the forecasts ???

Forecasts
Begin
Jan 1

Forecast
Target



Snowpack as the primary driver

~ 35% of seasonal snowpack has accumulated by January 1st.

~ 90% of seasonal snowpack has accumulated by April 1st.

Observed Snow Water Equivalent
Observed Precipitation
Observed Stream Flow
Modeled Soil Moisture Conditions

} Primary
Forecast
Drivers





River Points 
(Observed Stream Flow)

And Water Supply Points 



Green Multiple Station Snotel Plot

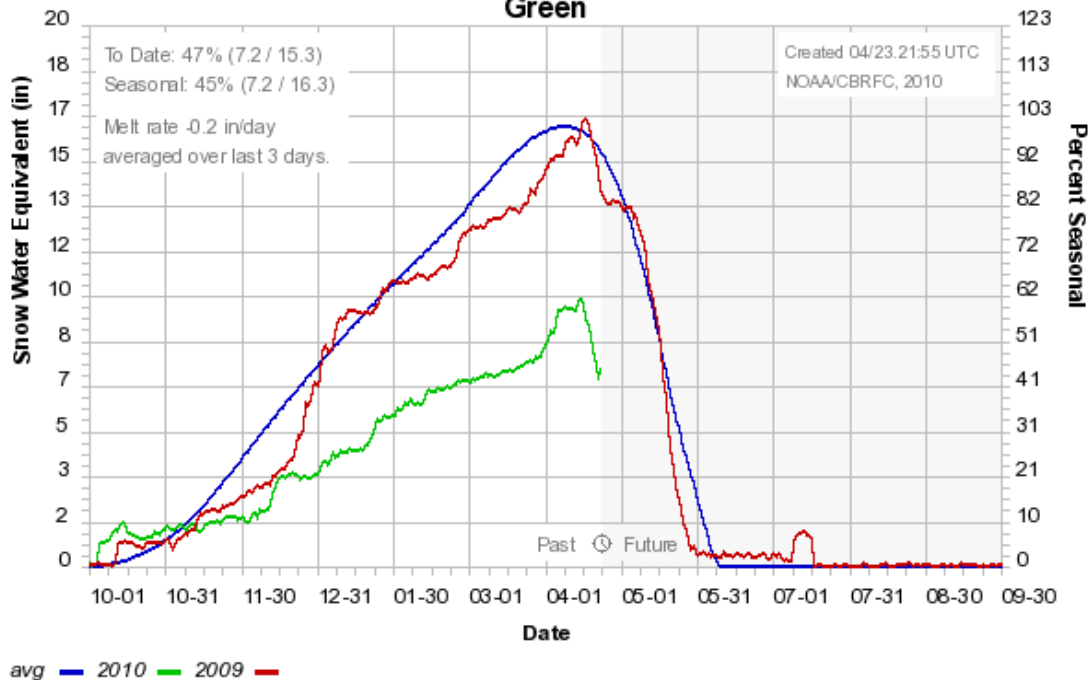
View station in [google maps](#) or [google earth](#). **NEW!**

The current time is: 04/23.21:55 UTC

Observed Snow Water Equivalent

Colorado Basin River Forecast Center

Green



Select multiple years and/or stations. Be sure to use your systems key-click combination to avoid inadvertent deselection.

Years	Stations	Data Type	Station Links
avg	EKPW4 ELKHART PARK G.S.	Daily Data	LOPW4
2010	GRVW4 GROS VENTRE SUMMIT	Monthly Data	KNDW4
2009	KNDW4 KENDALL RS		NFLW4
avg2	LOPW4 LOOMIS PARK		EKPW4
2008	NFLW4 NEW FORK LAKE		TRPW4
2007	TRPW4 TRIPLE PEAKS		GRVW4
2006	AGUU1 AGUA CANYON		
2005	APSC2 APISHAPA		
2004	AROC2 ARROW		
2003	ARPC2 ARAPAHO RIDGE		
2002	BAMN5 BATEMAN		
2001	BBSA3 BAKER BUTTE SUMMIT		
2000	BBSW4 BLIND BULL SUM		
1999	BCVC2 BEAVER CK VILLAGE		
1998	BERN2 BEAR CK		

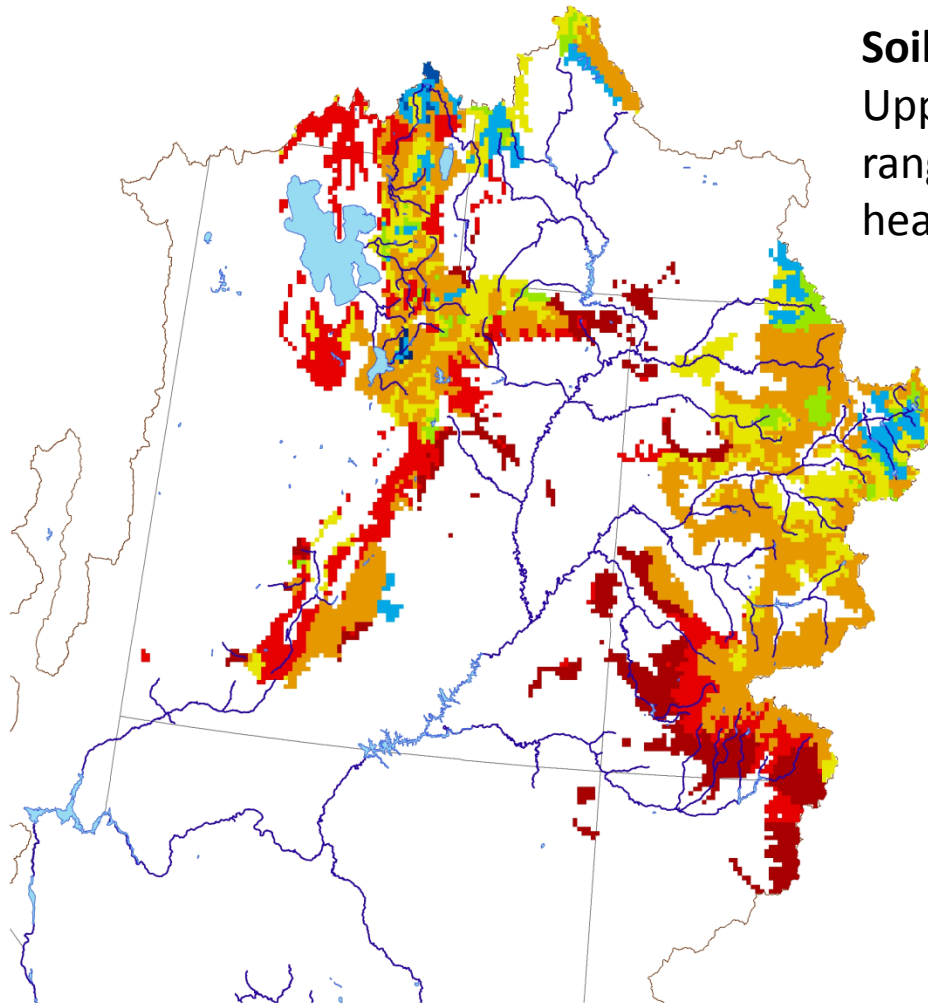
Y axis	Similar/Historical Years
Percent Seasonal	Off
Percent to Date	Closest Pattern
	Peak to Date
	Current Observation
	Highest Year
	Lowest Year

Apply High Res

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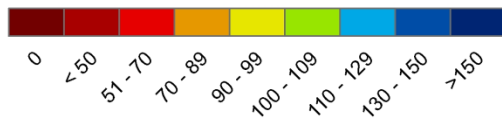
Upper Colorado
NWSRFS Modeled Lower Zone Soil Moisture



Soil Moisture:

Upper Green modeled soil moisture states ranged from below average to near average heading into the winter.

Percent Average (>1 in) November 1, 2009



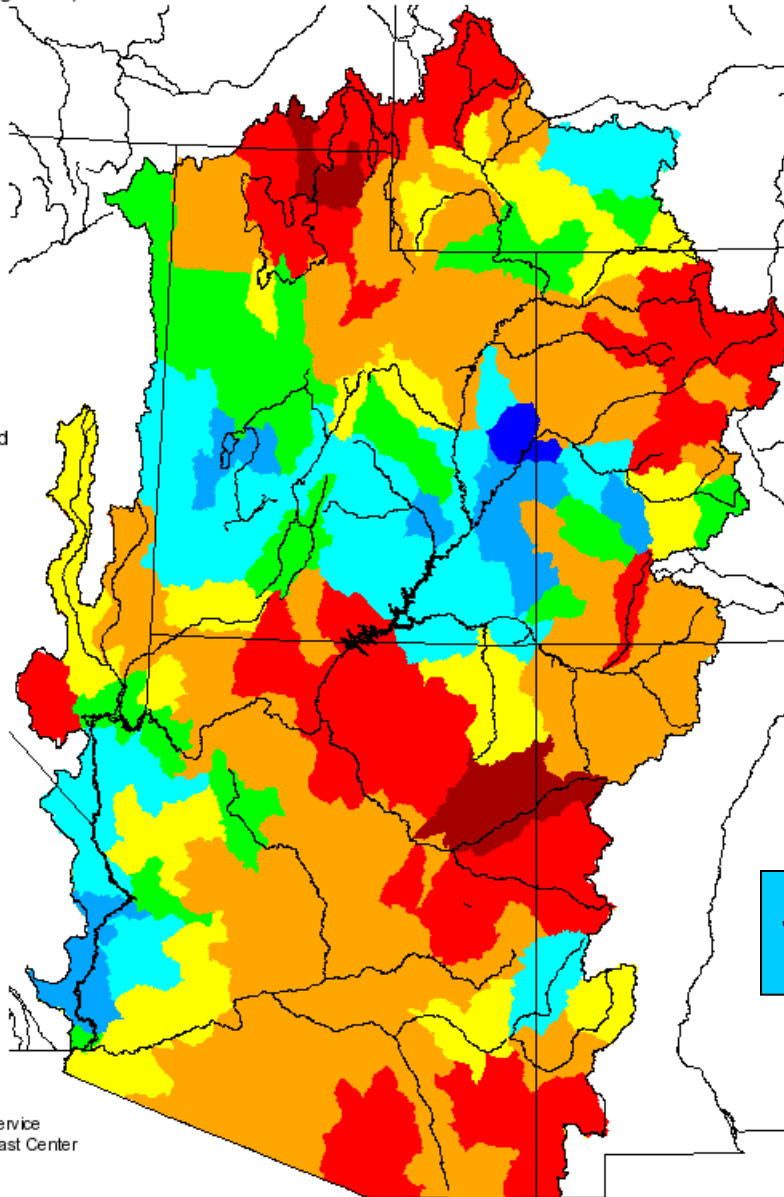
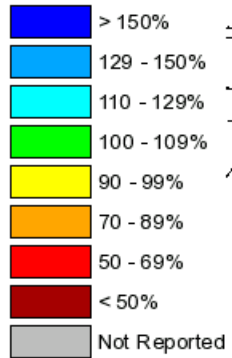
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Monthly Precipitation for March 2010

(Averaged by Hydrologic Unit)

% Average



Observed Precipitation

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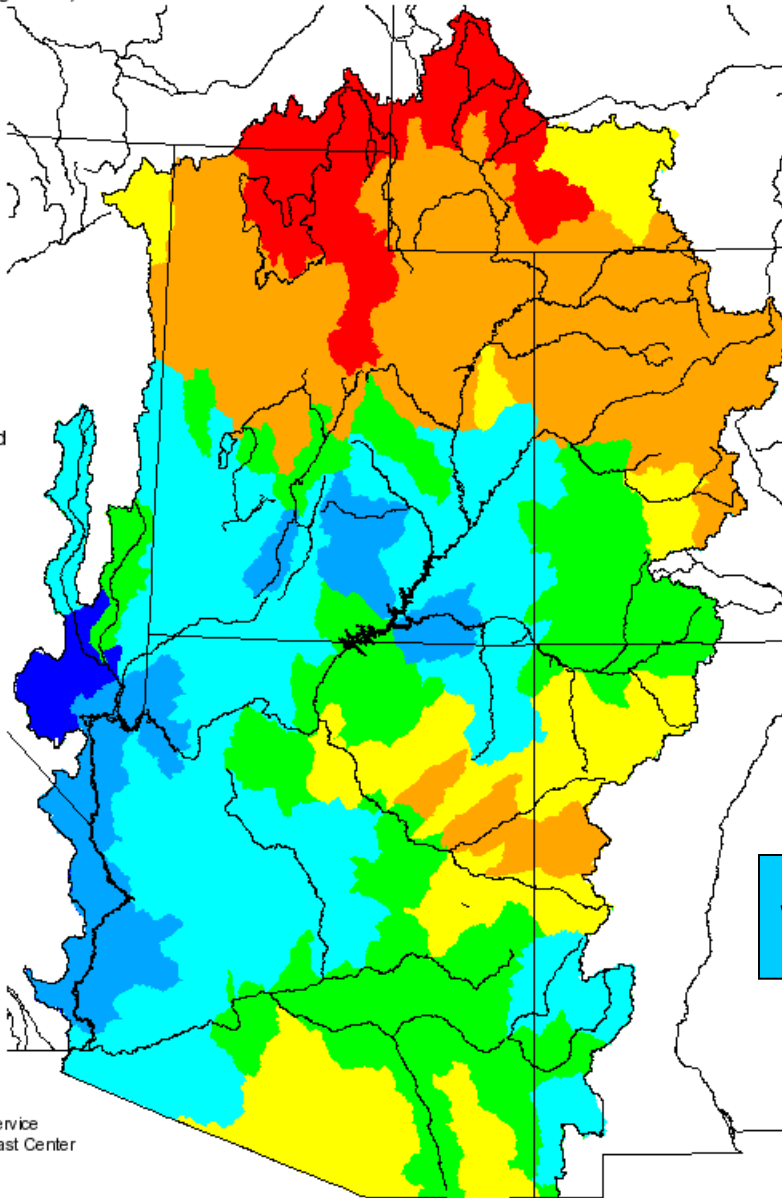
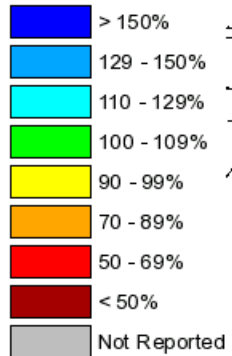
Prepared by
NOAA, National Weather Service
Colorado Basin River Forecast Center
Salt Lake City, Utah
www.cbrfc.noaa.gov



Seasonal Precipitation, October 2009 - March 2010

(Averaged by Hydrologic Unit)

% Average



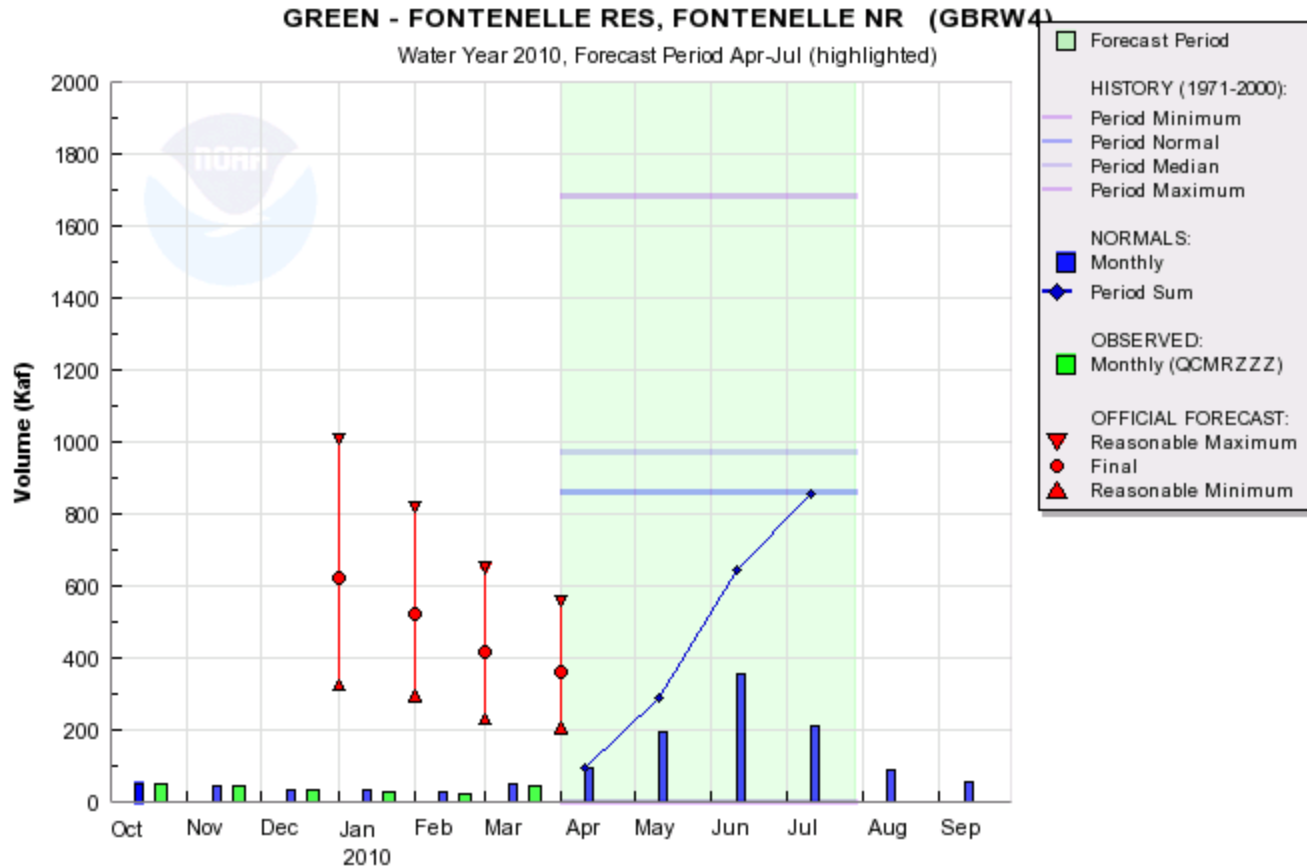
Observed Precipitation

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Colorado Basin River Forecast Center
Salt Lake City, Utah
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April Forecast



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CBRFC/NWS/NOAA 04/26/10 17:24:49 UTC



Weekly ESP for GREEN - FONTENELLE RES, FONTENELLE NR (GBRW4) Back

Input Options:

NWS ID:

Number of Forecasts:

ESP RAW MODEL GUIDANCE (Exceedence kaf)

Date Issued	Forecast Period	90%	70%	50%	30%	10%
4/22/2010	Apr21-Jul 2010	265	335	395	460	515
4/15/2010	Apr14-Jul 2010	250	295	410	450	515
4/8/2010	Apr7-Jul 2010	250	320	420	460	520
4/1/2010	Apr-Jul 2010	220	285	375	440	480
3/25/2010	Apr-Jul 2010	178	225	305	385	455
3/19/2010	Apr-Jul 2010	210	275	345	425	510
3/12/2010	Apr-Jul 2010	215	295	365	425	535
3/1/2010	Apr-Jul 2010	220	285	360	435	570
2/23/2010	Apr-Jul 2010	215	305	390	450	560
2/16/2010	Apr-Jul 2010	270	380	455	520	635
2/9/2010	Apr-Jul 2010	230	335	400	510	690
2/1/2010	Apr-Jul 2010	275	360	445	550	745
1/27/2010	Apr-Jul 2010	260	350	415	525	720

OFFICIAL COORDINATED FORECAST (Exceedence kaf)

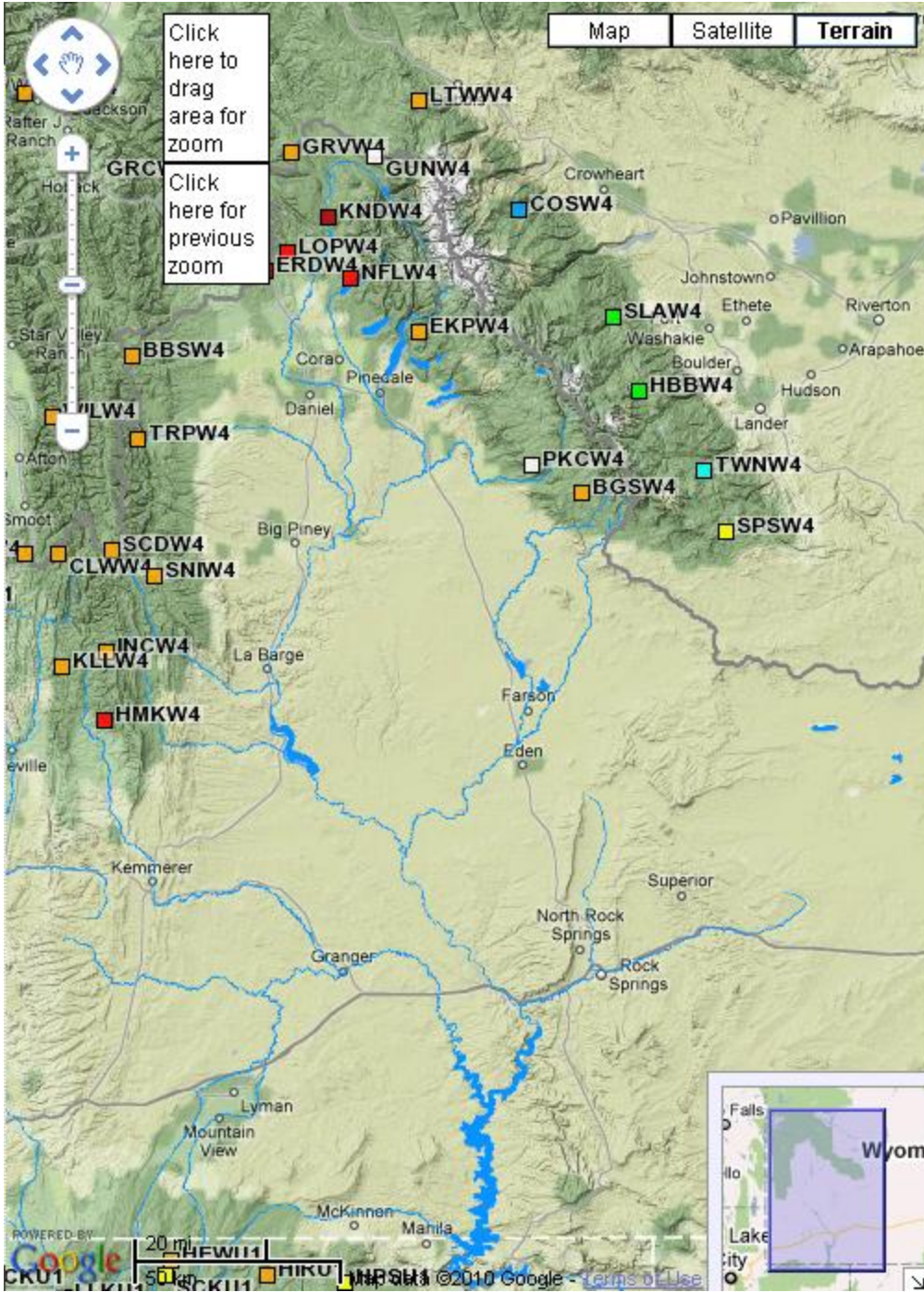
Date Issued	Forecast Period	90%	50%	10%
4/1/2010	Apr-Jul 2010	205	360	560
3/1/2010	Apr-Jul 2010	230	415	650
2/1/2010	Apr-Jul 2010	295	525	820
2/1/2010	Apr-Jul 2010	295	525	820

April observed as of 4/22/2010 was 42

April observed as of 4/15/2010 was 22 (Apr-Jul forecast 430)

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Overlays

- Rivers
- RFC
- Basins
- Active Basins
- Grids (Precip etc.)

Display Options

- Show NWS ID
- Show Data

Snow Point %Avg SWE

- No Data
- < 25
- 25-50
- 50-75
- 75-90
- 90-110
- 110-125
- 125-150
- 150-175
- >175

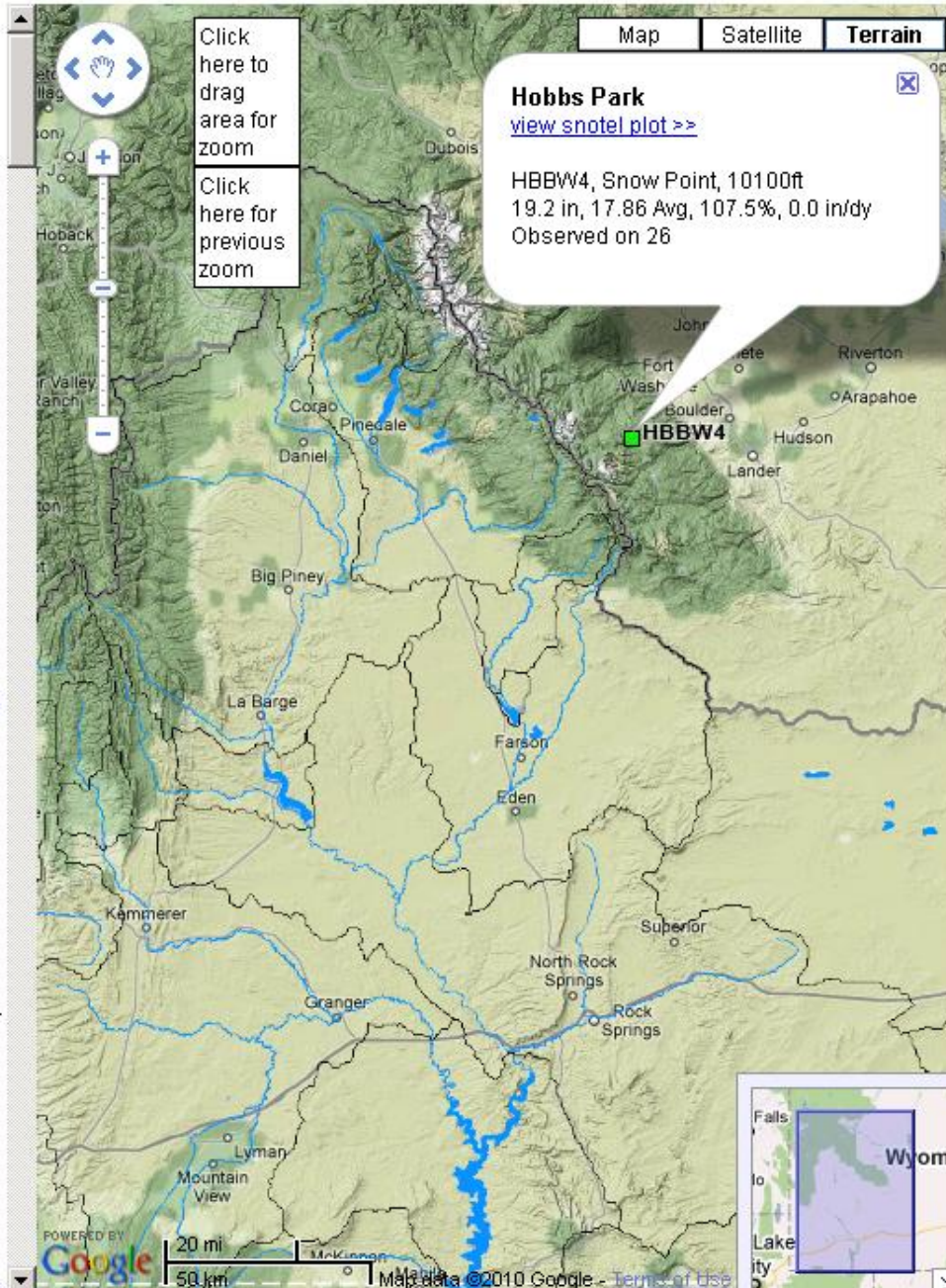
Snow Point Options

- All
- < 7000
- 7000-8000
- 8000-9000
- 9000-10000
- > 10000

Snow as of April 26, 2010



[big map](#)



Overlays

- Rivers
- RFC
- Basins
- Active Basins
- Grids (Precip etc.)

Display Options

- Show NWS ID
- Show Data

Snow Point %Avg SWE

- No Data
- < 25
- 25-50
- 50-75
- 75-90
- 90-110
- 110-125
- 125-150
- 150-175
- >175

Snow Point Options

- All
- < 7000
- 7000-8000
- 8000-9000
- 9000-10000
- > 10000

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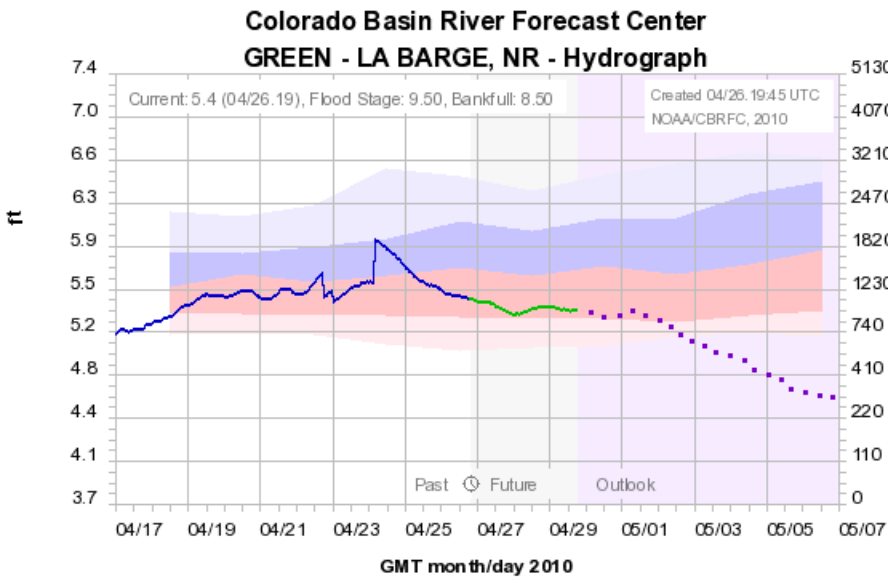
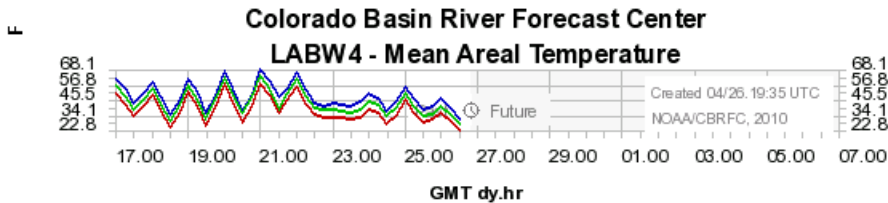
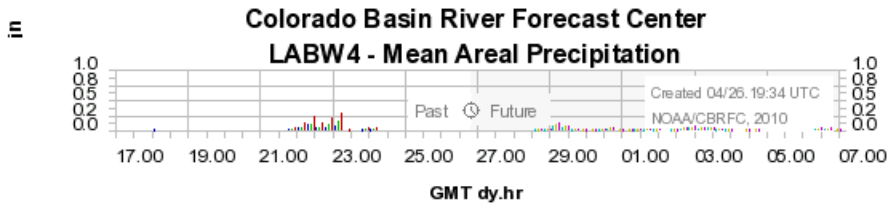
In the general area only one gage above 10,000 and it is not in the basin



GREEN - LA BARGE, NR (LABW4)

Forecasts are guidance only. [Click here](#) for official warnings and forecasts.

View station on [Conditions Map](#) or [Download KML](#)

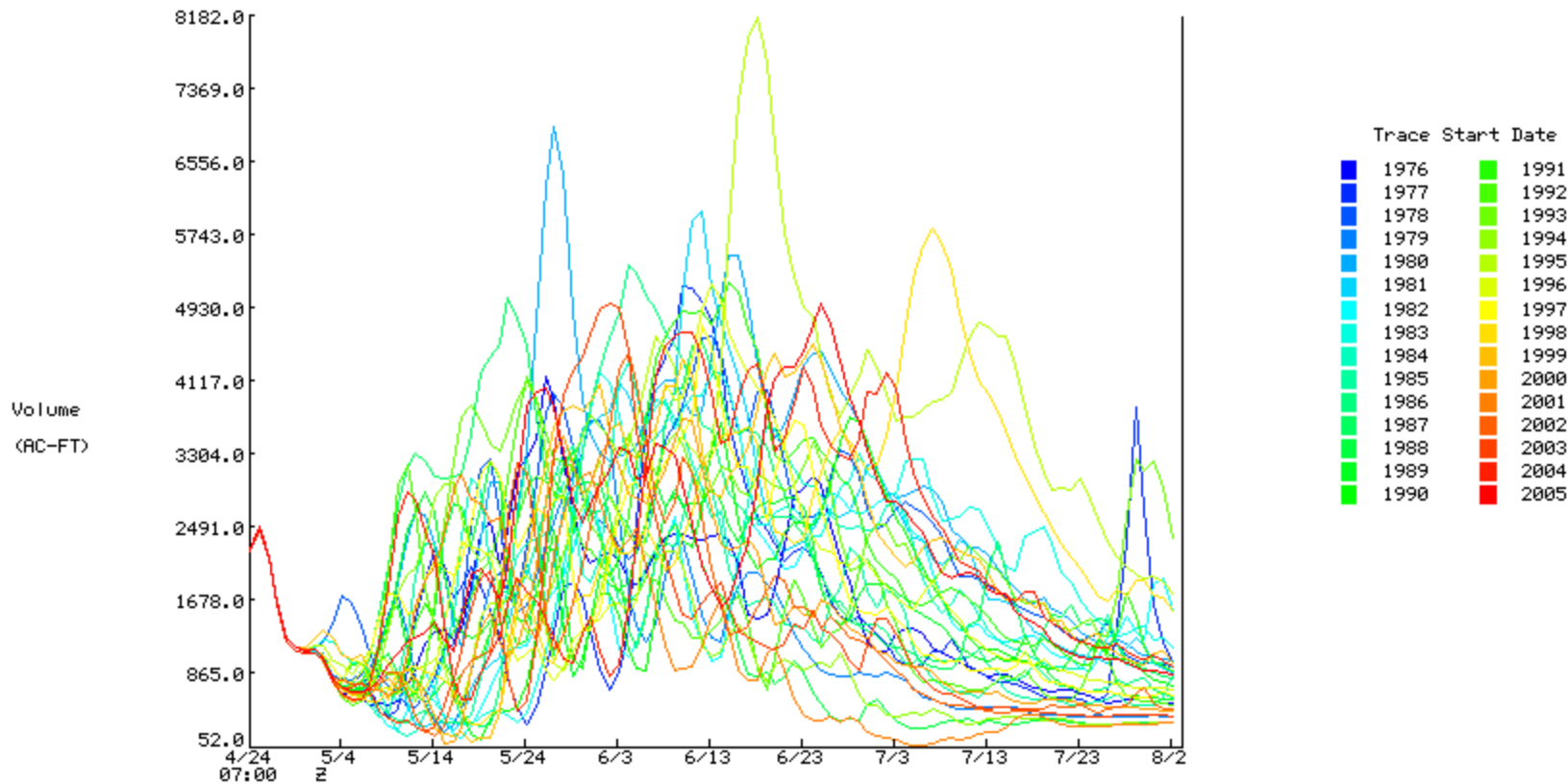


Observed — Forecast (04/26, 18:00) — Outlook (increasing uncertainty) - - -
 Historical Exceedance Probability (USGS): 90-75% ■ 75-50% ■ 50-25% ■ 25-10% ■
 Observed=QRIRGZZ, Simulated=QRIPAZZ, Forecast=QRIFEZZ F (04/26,18:00)
 resoutid=

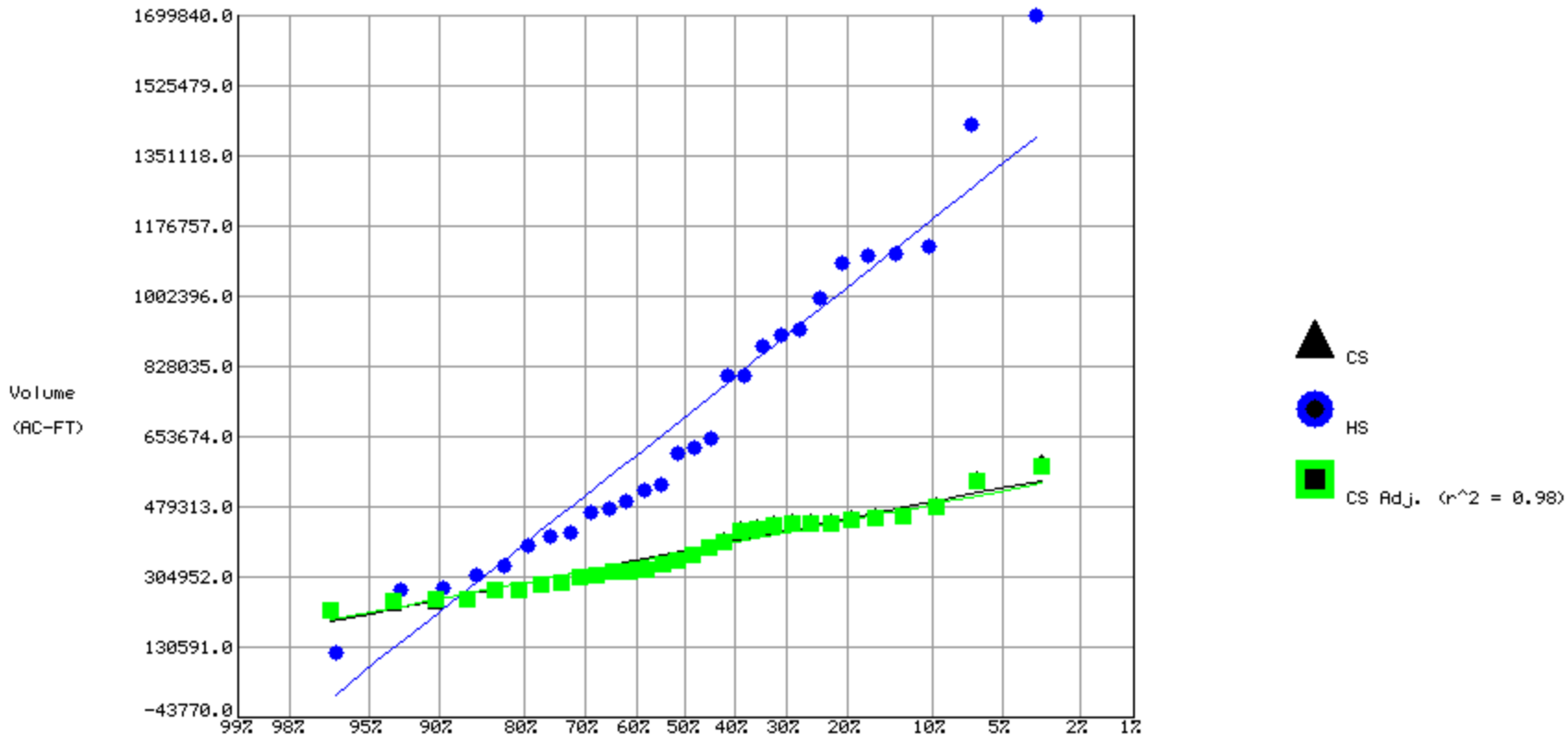
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ESP Trace Ensemble of FONTENELLE RES INF
 Latitude: 42.0 Longitude: 110.1
 Forecast for the period 4/24/2010 7h - 8/2/2010 7h
 This is a conditional simulation based on the current conditions as of 4/24/2010



Chances of Exceeding River Levels on the FONTENELLE RES INF
 Latitude: 42.0 Longitude: 110.1
 Forecast for the period 4/24/2010 - 8/2/2010
 This is a conditional simulation based on the current conditions as of 4/24/2010



46 + 367 = 413 (essentially the same as 430 on 4/15/2010)





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