NOAA's National Weather Service

Colorado Basin River Forecast Center

CBRFC Forecast Products: Where, When, and What is Issued?

CBRFC Fourth Annual Stakeholder Forum

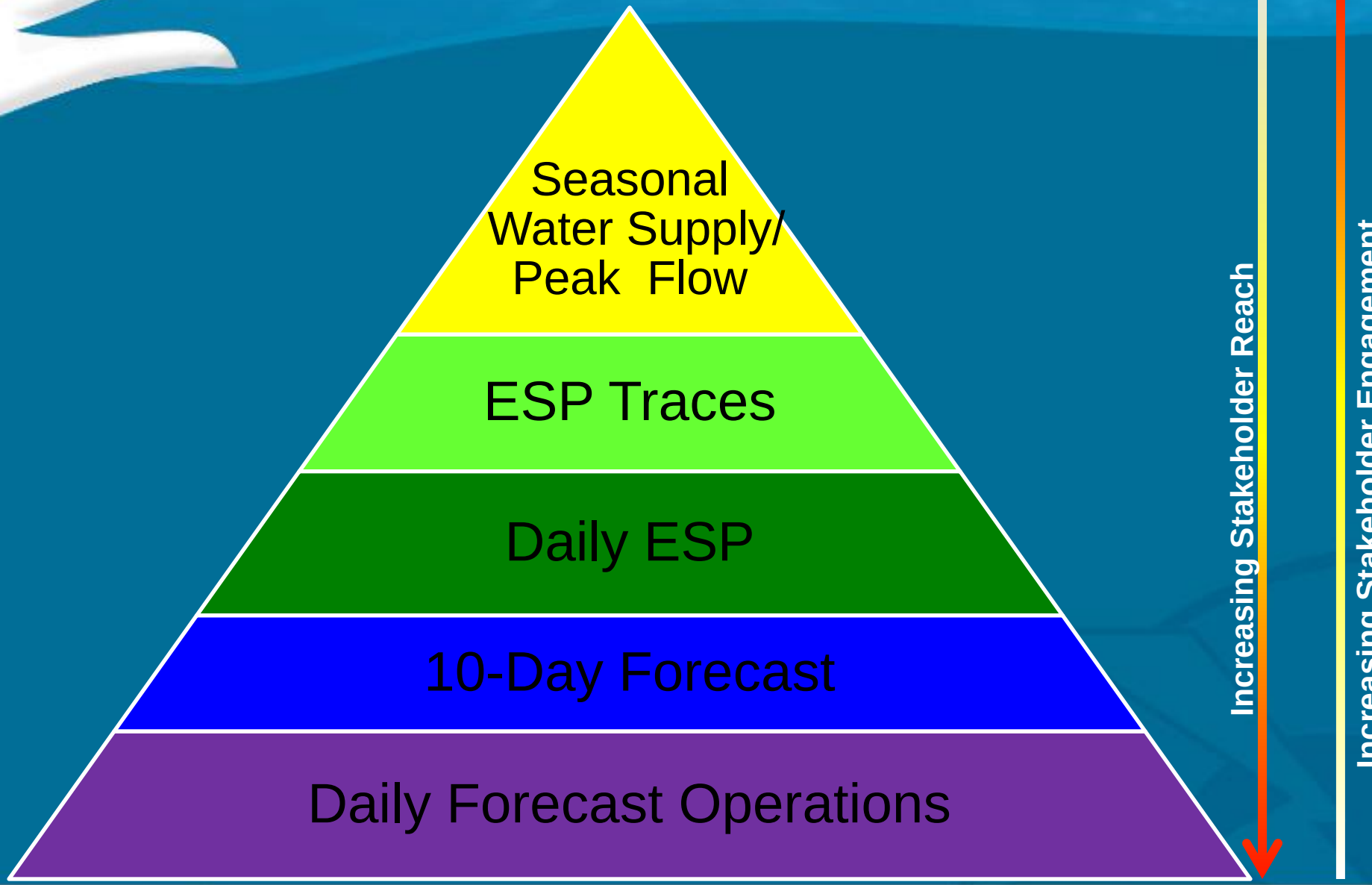
February 25th– 26th, 2014

Salt Lake City, Utah

Overview

- ***Daily Model***
  - **Accessing**
  - **Interpretation**
- ***Daily ESP***
- ***Seasonal Water Supply Forecasts***
- ***Peak Flow Forecasts***
- ***Discussion***

Overview


Seasonal
Water Supply/
Peak Flow
ESP Traces
Daily ESP
10-Day Forecast
Daily Forecast Operations
Increasing Stakeholder Reach
Increasing Stakeholder Engagement

What you should take away…

- *We incorporate information from a variety of sources to come up with our forecasts, which are distributed at various intervals throughout the month during the year.*
- *ESP is becoming our primary forecasting tool for water supply.*
- *Our products can evolve to meet your needs, so let us know!*

Part 1:

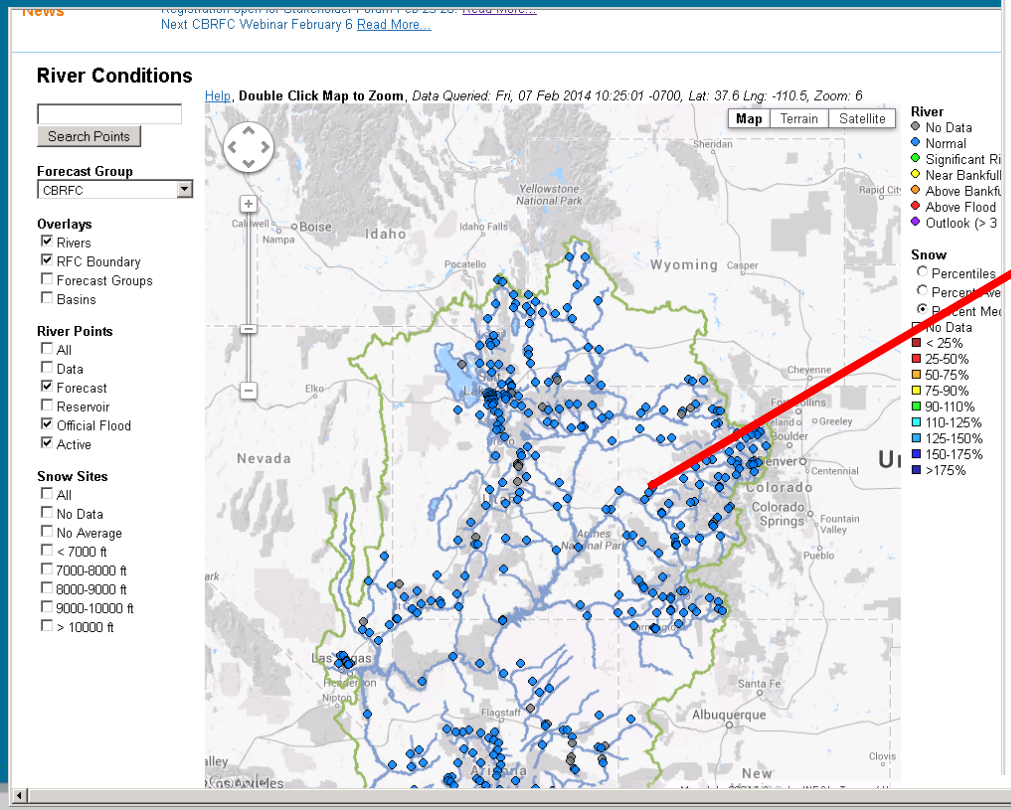
Daily Model

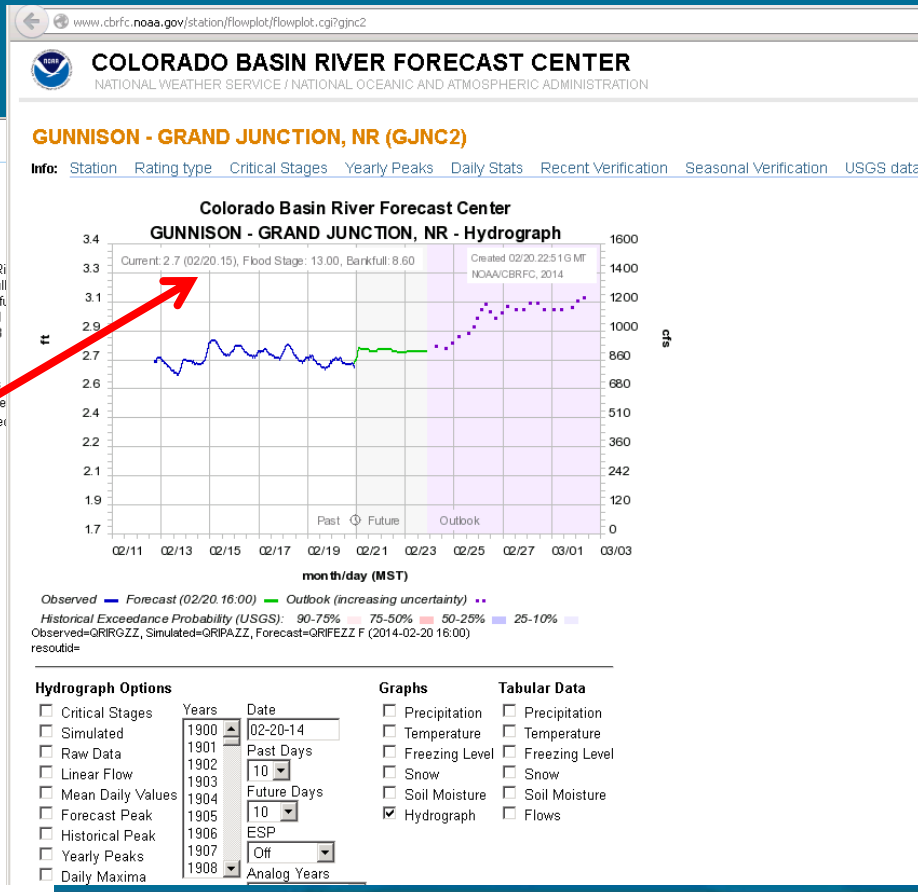
Daily Model

- ***Deterministic forecast that is updated at least once daily, though more frequently during times of hydrologic significance***
  - **Coupled, lumped, hydrologic model within the Community Hydrologic Prediction System (CHPS)**
  - **Sacramento Soil Moisture Accounting (SAC-SMA)**
  - **SNOW-17 (Temperature-indexed snow accumulation/melt model)**
- ***Dependent on observed temperature, precipitation, freezing level, and reservoir data***

Daily Model

- *The results of this model output are ultimately what is available through the CBRFC website*





Click here to start web demonstration

COLORADO BASIN RIVER FORECAST CENTER

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HOME | RIVERS | SNOW | WATER SUPPLY | RESERVOIRS | WEATHER | CLIMATE | HELP | OFFICE | LINKS | SEARCH

News

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See areas of hydrologic interest

River Conditions

Help, **Double Click Map to Zoom**, *Data Queried: Fri, 14 Feb 2014 09:50:01 -0700, Lat: 38.65 Lng: -109.48, Zoom: 9*

fgrp=POWELL
Search Points

Forecast Group
Lake Powell

Overlays
- [x] Rivers
- [x] RFC Boundary
- [x] Forecast Groups
- [ ] Basins

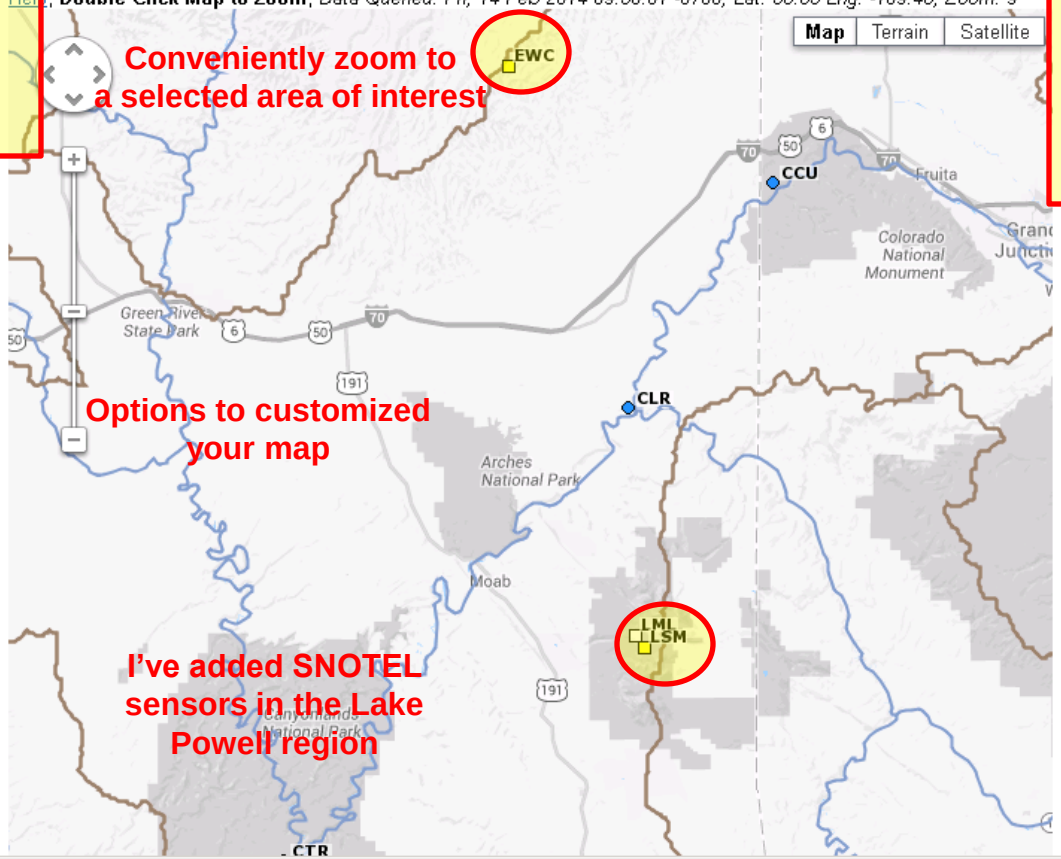
River Points
- [ ] All
- [ ] Data
- [x] Forecast
- [ ] Reservoir
- [x] Official Flood
- [x] Active

Snow Sites
- [x] All
- [ ] No Data
- [ ] No Average
- [x] < 7000 ft
- [x] 7000-8000 ft
- [x] 8000-9000 ft
- [x] 9000-10000 ft
- [x] > 10000 ft

Conveniently zoom to a selected area of interest

Options to customized your map

I've added SNOTEL sensors in the Lake Powell region



River
- No Data
- Normal
- Significant Rise
- Near Bankfull
- Above Bankfull
- Above Flood Stage
- Outlook (> 3 days)

Snow
- ( ) Percentiles
- ( ) Percent Average
- (•) Percent Median
- No Data
- < 25%
- 25-50%
- 50-75%
- 75-90%
- 90-110%
- 110-125%
- 125-150%
- 150-175%
- >175%

fgrp=POWELL
(3 River Points Found)
- CCU: Colorado , Co
- CLR: Colorado , Cisco, Nr
- CTR: Colorado , Cataract Canyon

(7 Snow Points Found)
- BUC: Buckboard Flat Snowcourse
- CJS: Camp Jackson
- DRS: Donkey Reservoir
- EWC: East Willow Creek

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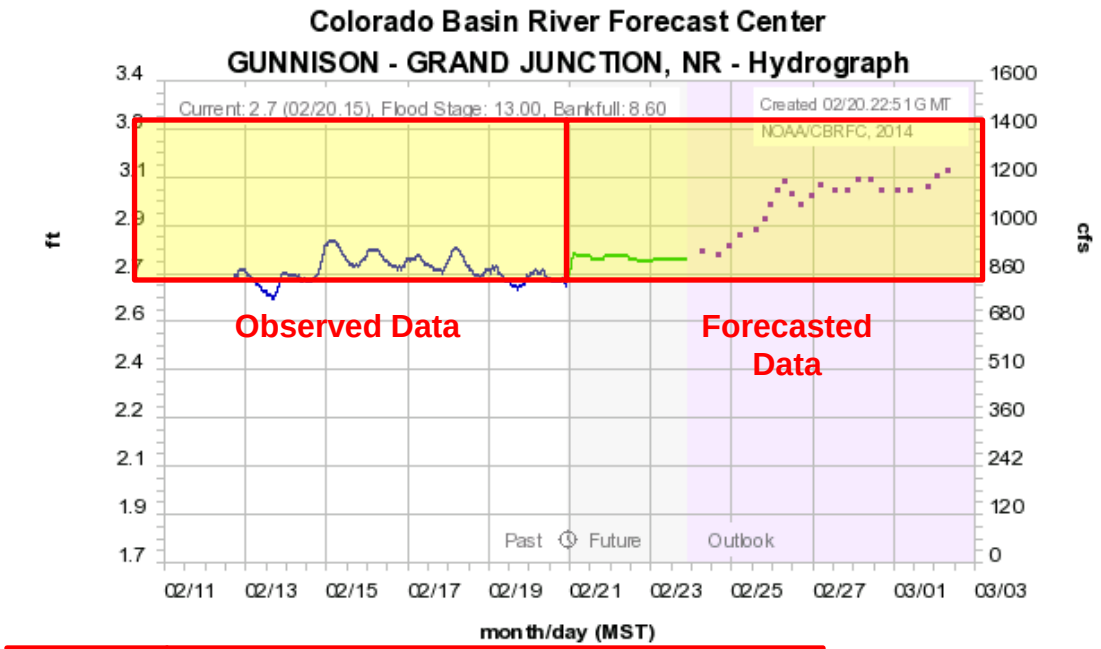
GUNNISON - GRAND JUNCTION, NR (GJNC2)

Info: Station | Rating type | Critical Stages | Yearly Peaks | Daily Stats | Recent Verification | Seasonal Verification | USGS data



Hydrograph Options

- Critical Stages
- Simulated
- Raw Data
- Linear Flow
- Mean Daily Values
- Forecast Peak
- Historical Peak
- Yearly Peaks
- Daily Maxima

Years: 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908

Date: 02-20-14

Past Days: 10

Future Days: 10

ESP: Off

Analog Years

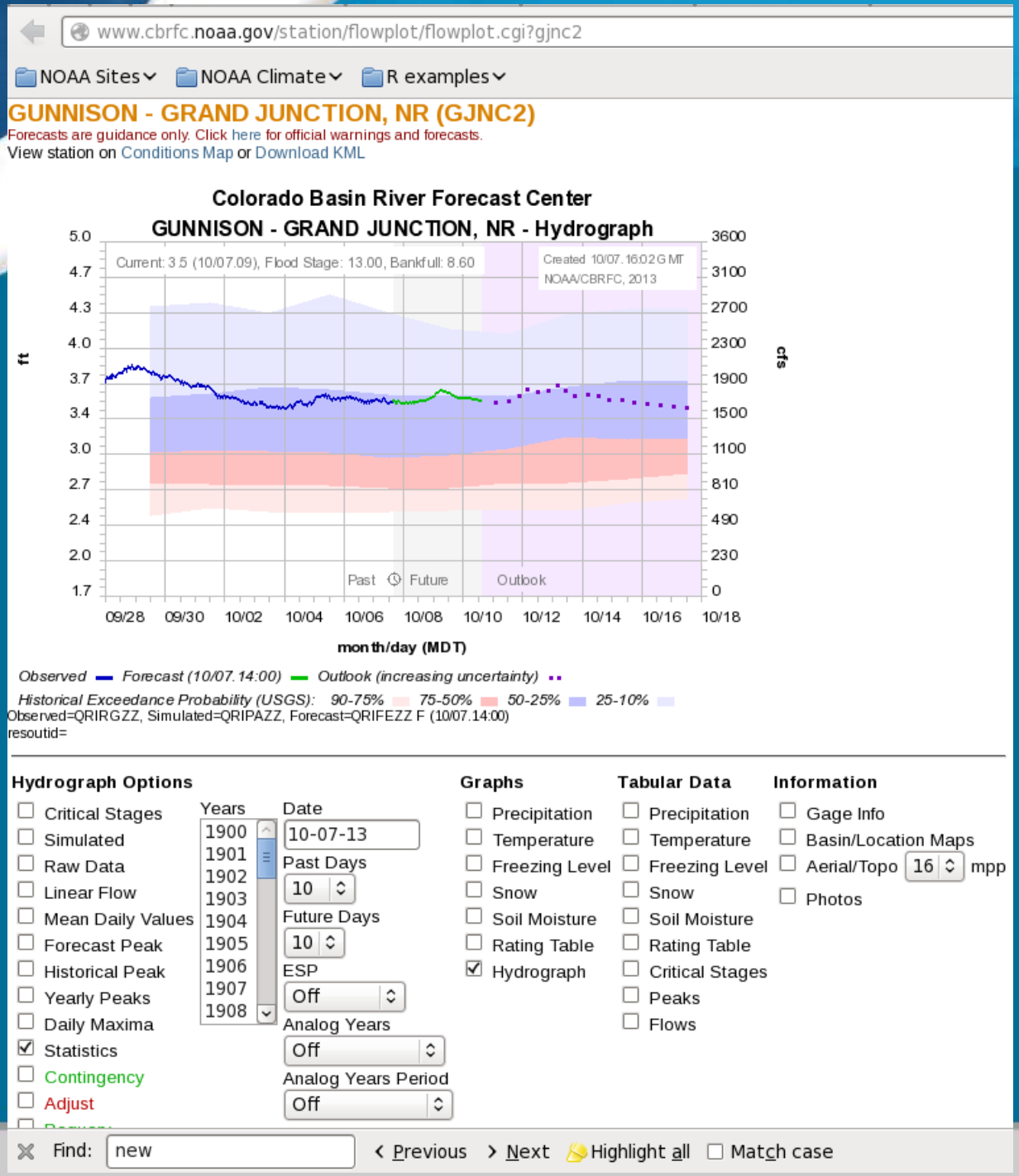
Graphs

- Precipitation
- Temperature
- Freezing Level
- Snow
- Soil Moisture
- Hydrograph

Tabular Data

- Precipitation
- Temperature
- Freezing Level
- Snow
- Soil Moisture
- Flows

Options to customize the hydrograph



CBRFC forecasts and supporting data are available through the CBRFC website. Forecasts are plotted together with historical exceedance probabilities derived from the USGS gage record.

CBRFC incorporates 10 days of forecasted temperature data and 5 days of forecasted precipitation data into these forecasts. These are REGULATED values.

Because of their dependence on weather forecasts which become less certain with increasing lead time, CBRFC streamflow forecasts also become less certain with increasing lead time.

Forecasts are usually available by 10:00 a.m. every day.

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River List

Click point type or enter search to change points displayed. Click column heading to sort by that data. Click ID to show plot for point.
Download pipe-delimited file of displayed points.

SEARCH POINTS

Area: CBRFC Lake Powell Upper Colorado Green San Juan Great Basin Sevier Virgin Lower Colorado
Points: Active Forecast Reservoir Non-Forecast All
Plots: Auto Off On

River Point Condition

NA Normal Rise Near Bankfull Bankfull Flood Stage Trend (> 3 days)

River Point Types

0-Data 1-Forecast 2-Reservoir

	NWS ID	River	Location	Forecast Condition	Point Type	Observed Date (Day, Time)	Latest Flow	Latest Stage	Flood Stage	Bankfull Stage	HUC	State	HSA	Elevation	Forecast Group	Segment
1	CAVA3	Cave Ck	Cave Ck, Nr, Cottonwood Wash, Blo		1	14, 16:00	0	4		9	15060106	AZ	PSR	2280	AGUAFRIA	1
2	MCZA3	Cave Ck	Cave Creek Rd, Nr		1	14, 16:00	0	0.9		8	15060106	AZ	PSR	1800	AGUAFRIA	2
3	MCVA3	Cave Ck	Cactus Road		1	14, 15:00	2	0.72		12	15060106	AZ	PSR	1280	AGUAFRIA	5
4	MAOA3	Acdc	14th Street		1	14, 13:00	0	0.4		10	15060106	AZ	PSR	1230	AGUAFRIA	6
5	MHFA3	Acdc	43rd Avenue		1					4	15060106	AZ	PSR	1225	AGUAFRIA	7
6	MSXA3	Acdc	67th Ave		1	14, 17:00	6	0.27		6	15070102	AZ	PSR	1220	AGUAFRIA	8
7	SCPA3	Skunk Ck	Phoenix, Nr		1	14, 17:00	0	0.79		8.4	15070102	AZ	PSR	1473	AGUAFRIA	9
8	NWRA3	New	Rock Spgs, Nr		1	14, 16:00	0	0.98		8	15070102	AZ	PSR	2310	AGUAFRIA	12
9	MBLA3	New	Bell Road		1	14, 15:00	0	0.2		9	15070102	AZ	PSR	1205	AGUAFRIA	15
10	MNRA3	New	Glendale Ave		1	14, 16:00	380	0.28		5	15070102	AZ	PSR	1050	AGUAFRIA	16
11	AFHA3	Agua Fria	Humbolt, Blo		1	14, 16:00	2	2		15.4	15070102	AZ	FGZ	4400	AGUAFRIA	17
12	AFMA3	Agua Fria	Mayer, Nr		1	14, 16:00	2	2.1		14.8	15070102	AZ	FGZ	3434	AGUAFRIA	18
13	AFRA3	Agua Fria	Rock Spgs, Nr		1	14, 16:00	0	1.6	16	15	15070102	AZ	PSR	1800	AGUAFRIA	19
14	MCFA3	Mcmicken Floodway			1	14, 12:00	0	0.15		13	15070102	AZ	PSR	1335	AGUAFRIA	23
15	MAFA3	Agua Fria	Grand Ave		1	14, 16:00	0	1.8		14	15070102	AZ	PSR	1125	AGUAFRIA	24
16	MDEA3	Dysart	El Mirage		1	14, 14:00	208	2.6		12	15070102	AZ	PSR	1052	AGUAFRIA	25
17	AVOA3	Agua Fria	Buckeye		1	14, 11:00	0	1.3		8	15070102	AZ	PSR	970	AGUAFRIA	26
						14, 16:00	e35	e3.98	8	7	16010101	UT	SLC	7965	BEAR	1

gmap/list/list.php?search=&point=forecast&plot=&sort=riverfgroups&type=river&basin=0&subbasin=&espqpf=0&espdist=empirical

So….

What does Daily forecasting tell us?

It gives us a forecast of instantaneous flow at defined model points using current hydrologic conditions, along with 5 days of precipitation and 10 days of temperature forecasts. Any information we have regarding regulation and diversions is also included.

When does it tell us?

Every day at least, more frequently during times of hydrologic interest.

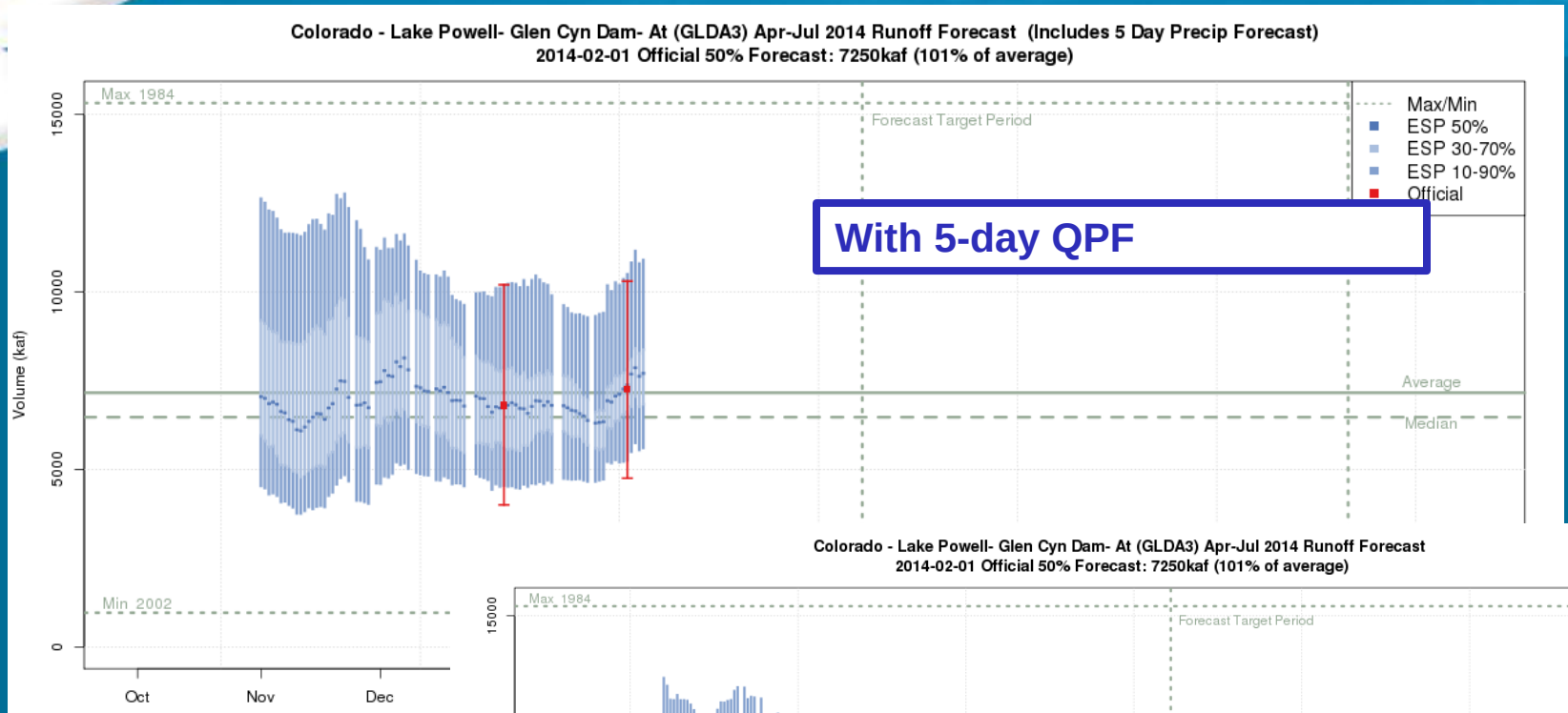
Part 2:

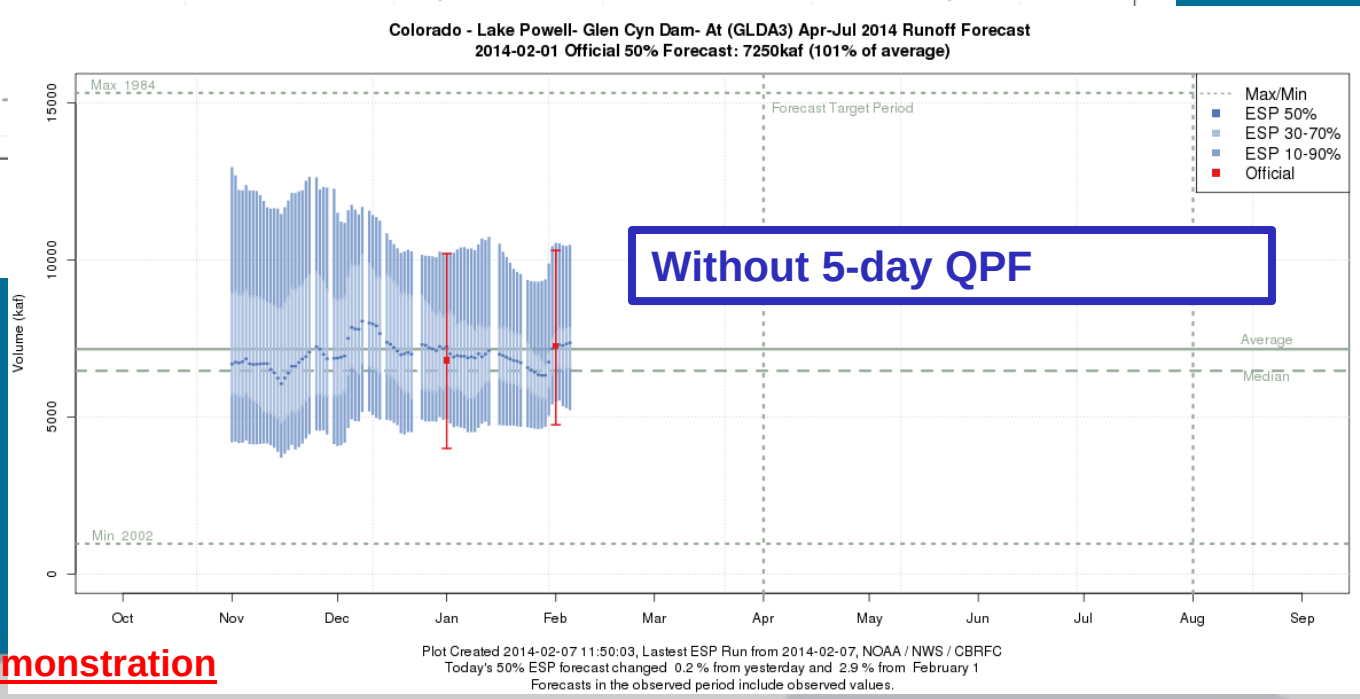
Daily ESP Forecast

Daily ESP Forecast

- ***Ensemble Streamflow Prediction***
  - ***Run daily with updated initial conditions***
  - ***Uses historical temperature and precipitation (currently using 30 traces from 1981-2010)***
- ***Four separate runs are produced***
  - ***Unregulated with 5 days QPF***
  - ***Unregulated without QPF***
  - ***Regulated with 5 days QPF***
  - ***Regulated without QPF***

Daily ESP Forecast



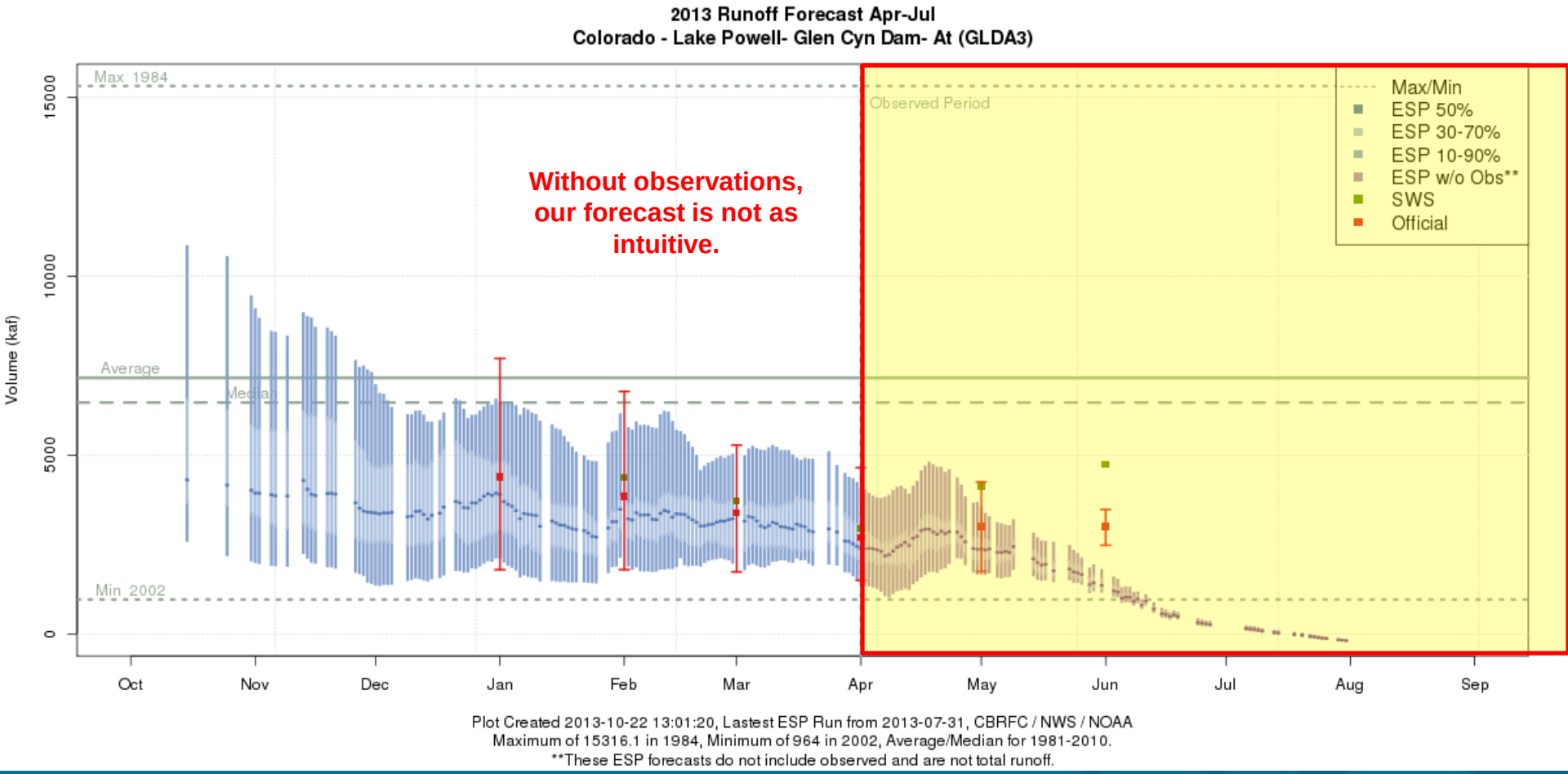


Click here to start web demonstration

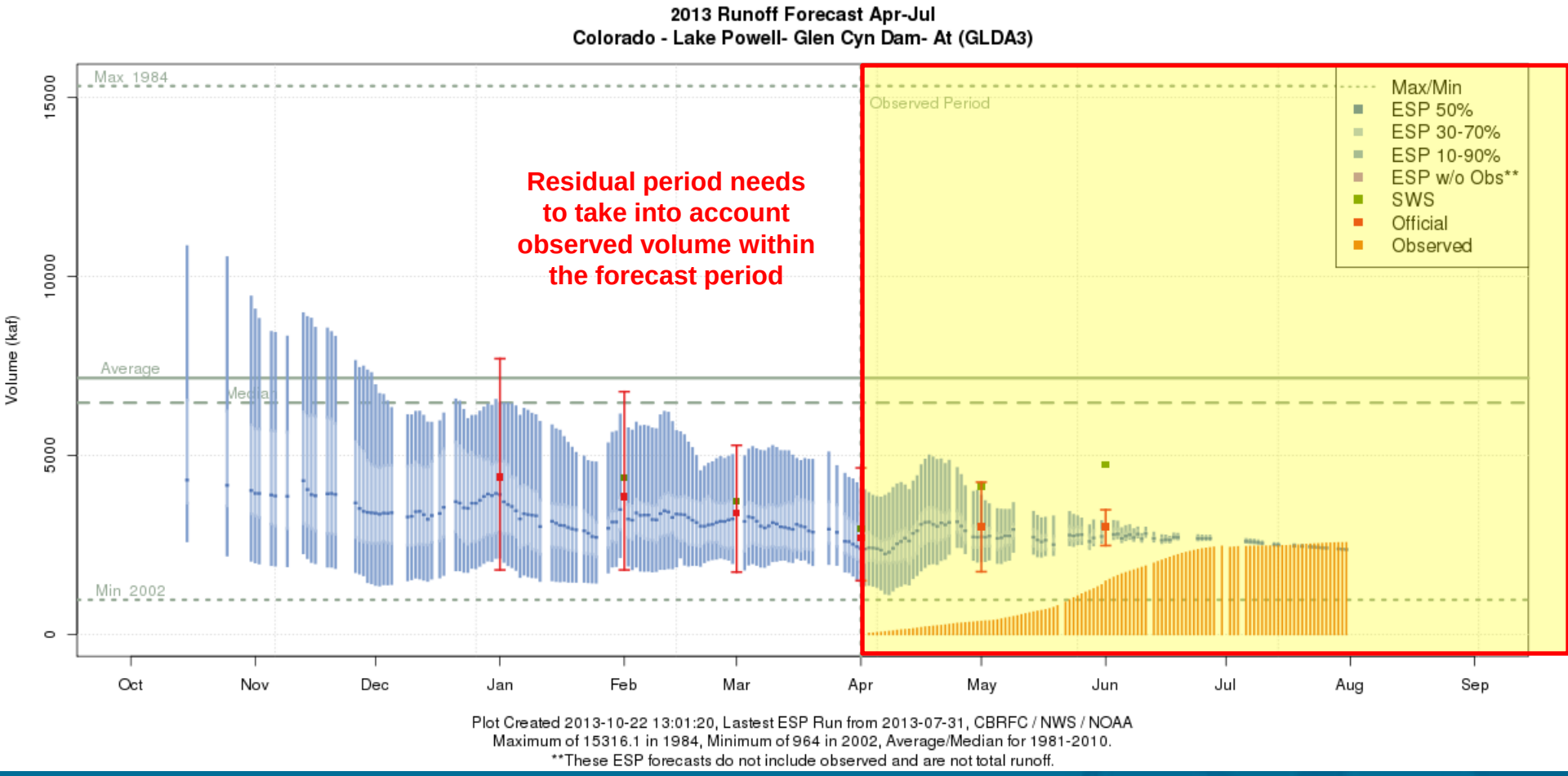
Daily ESP Forecast

- *The daily ESP forecast period changes depending on whether or not we are in the forecast period*
  - *For example, in the Upper Colorado River Basin, we forecast for the April through July runoff volume*
  - *After April 1st, we forecast from the current day through July*
- *It is important to account for the observed volume when we are in the forecast period*

Daily ESP Forecast



Daily ESP Forecast



Daily ESP Forecast

Current Day	What Daily ESP Forecast Evolution Plot Shows
Early November through April 1st (January 1st in the Lower Colorado River Basin)	Daily ESP forecast for April through July (January through May* in the LCRB)
After April 1st (January 1st in the LCRB)	Observed streamflow volume for Apr 1 (Jan 1 in LCRB) to current day + Forecasted streamflow for the current day through July 31st (May 31st in the LCRB)

*Seasonal forecast for LCLA3 is January through June.

So….

What does our daily ESP water supply forecasts tell us?

They give us a forecast of (usually) April – July unregulated volume at specific forecast points. They give us an idea of the trend the forecasts are taking in response to current conditions.

When does it tell us?

Every day, shortly after the beginning of the water year, through July.

Part 3:

Seasonal Water Supply Forecasts

Seasonal Water Supply Forecasts

- *Water supply forecasts are issued monthly by the CBRFC, near the beginning of each month.*
- *Forecasters rely on a combination of guidance from an analysis of ESP output, Statistical Water Supply (SWS) output, and expertise to develop water supply products*
- *Water Supply Forecasts are typically **UNREGULATED** flow volume forecasts.*
- *In the Upper Colorado River and Great Basins, forecasts are for the April through July season. In the Lower Colorado River Basin, forecasts are for the January through May season.*

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Water Supply Forecasts

Search Points

Forecast Group

CBRFC

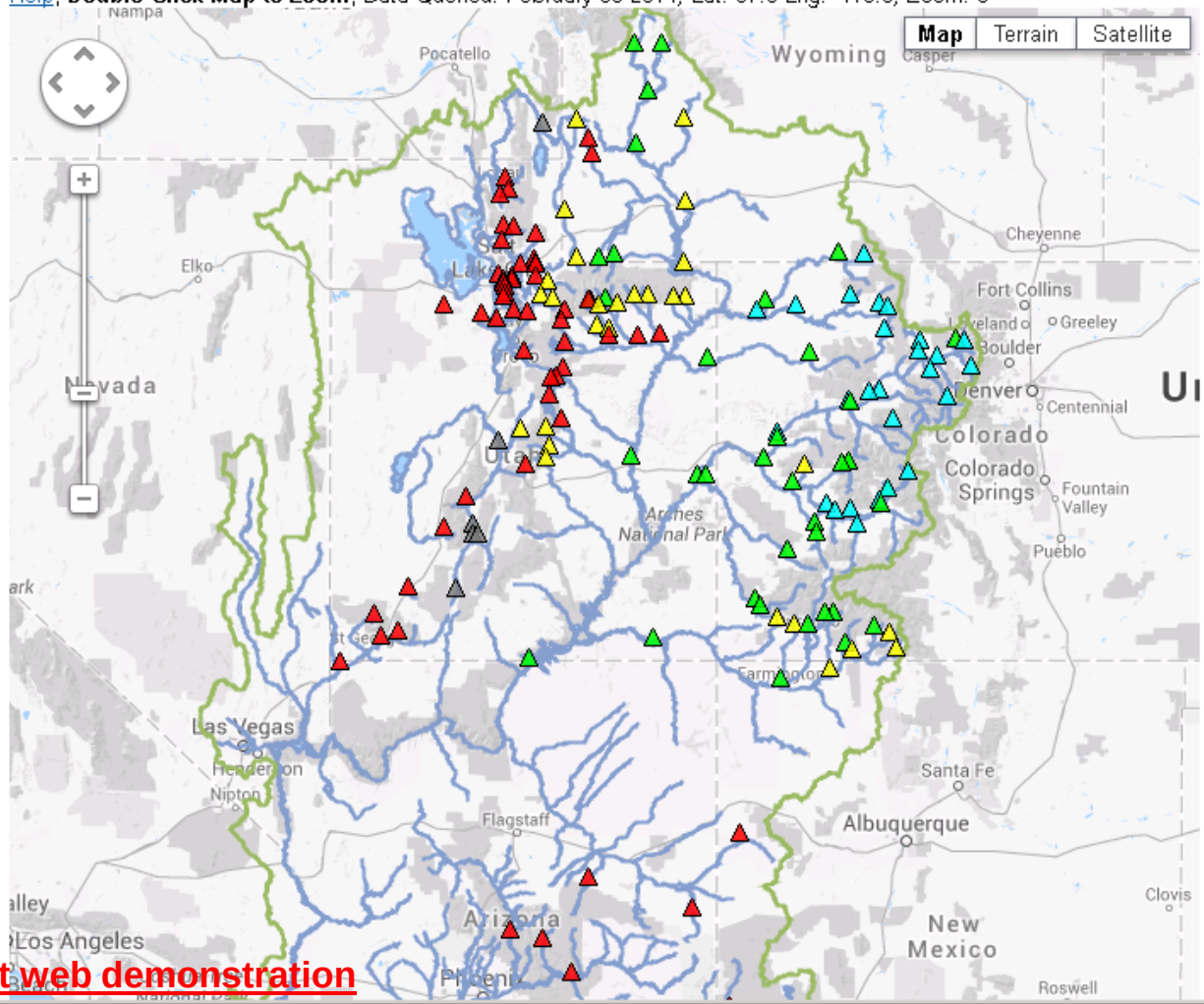
Overlays

- [x] Rivers
- [x] RFC Boundary
- [ ] Forecast Groups
- [ ] Basins

Snow Sites

- [ ] All
- [ ] No Data
- [ ] No Average
- [ ] < 7000 ft
- [ ] 7000-8000 ft
- [ ] 8000-9000 ft
- [ ] 9000-10000 ft
- [ ] > 10000 ft

Help, **Double Click Map to Zoom**, *Data Queried: February 06 2014, Lat: 37.6 Lng: -110.5, Zoom: 6*



Water Supply Forecasts

- (•) Official Percent Average
- ( ) Official Percent Median
- ( ) ESP Percent Average
- ( ) ESP Percent Median
- ▲ < 70%
- △ 70-90%
- ▲ 90-110%
- △ 110-130%
- ▲ >130%
- ▲ Regulated
- △ No Forecast

Snow

- ( ) Percentiles
- ( ) Percent Average
- (•) Percent Median
- □ No Data
- ■ < 25%
- ■ 25-50%
- ■ 50-75%
- ■ 75-90%
- ■ 90-110%
- ■ 110-125%
- ■ 125-150%
- ■ 150-175%
- ■ >175%

Click here to start web demonstration

Seasonal Water Supply Forecasts

- *On a day to day basis, ESP is approved by a forecaster; however, a detailed examination of model states and conditions is not done.*
- *"Jumps" in daily ESP could be due to a number of factors.*
  - **Recent storm activity**
  - **Update to model states (e.g., snow, soil moisture, etc…)**

So….

What do water supply forecasts tell us?

They give us a seasonal forecast of (usually) unregulated inflow volume at specific forecast points. They are based on guidance from SWS and ESP tools, as well as forecaster expertise.

When does it tell us?

Typically monthly. April – July forecasts are typically available from January through July.

Part 5:

Peak Flow Forecasts

Peak Flow Forecasts

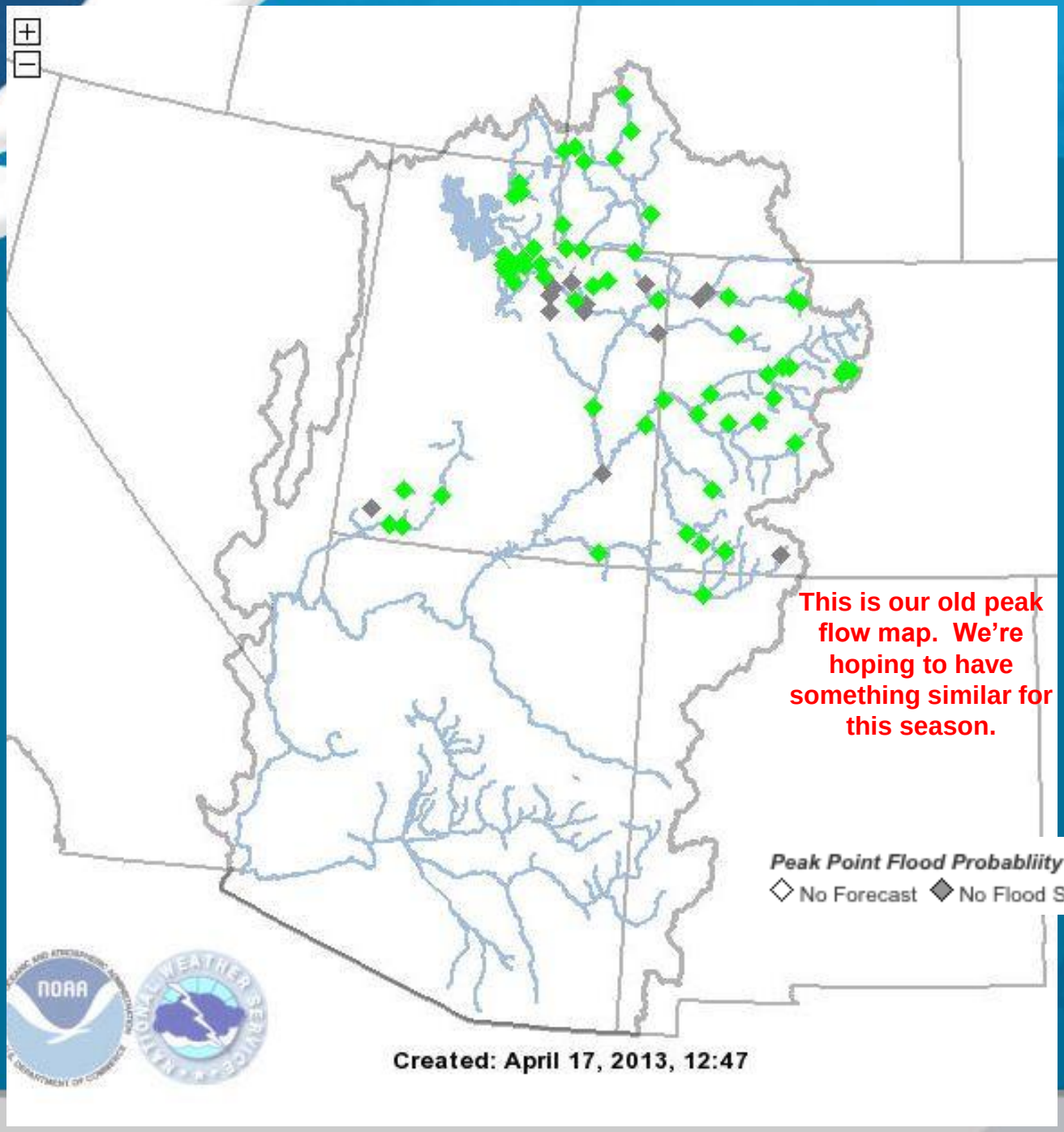
- *The CBRFC generates peak flow forecasts throughout the snowmelt runoff season, as needed from March to end of runoff season*
- *Represents mean daily peak flow during the April – July runoff period*
- *Presented in terms of exceedance probabilities*
- *Developed using ESP*
- *Most applicable to headwater basins, for recreationalist, flood control, and wildlife managers*

Peak Flow Forecasts

- *Probabilistic forecast*
  - *Issued monthly*
  - *10%, 25%, 50%, 75%, 90% exceedance probabilities*
- *Approximately 80 points*
- *Accounts for diversions and reservoir regulation, similar to daily forecasts*

Spring Weather Really Matters

- ***Runoff characteristics are largely determined by the day-to-day spring weather.***
  - ***While large snow pack years increase chances for flooding, it is not an inevitability (dodged a bullet at many sites in 2011)***
  - ***Small snow pack years can flood with the right sequence of spring temperatures and with flows enhanced by precipitation.***
  - ***Rain events may play a larger role in the magnitude of the peak flow during very low snow years.***
  - ***Keep an eye on our web page / daily forecasts***


This is our old peak flow map. We're hoping to have something similar for this season.
Peak Point Flood Probabliity
No Forecast
No Flood Stage
<10
>10
>25
>50
Created: April 17, 2013, 12:47

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Peak Flow Forecast List

Help | Notes | Download Data | Requery | Rebuild Plots

Peak Flood Probability Legend

◇ No Forecast ◆ No Flood Stage ◆ <10 ◆ >10 ◆ >25 ◆ >50

Click here to start web demonstration

Options (on/off): Plot
Area: CBRFC Green Colorado San Juan Great Sevier Virgin Low Col

Click column heading to sort by that data. Click ID to view point info.

	Area	Sub Area	NWS ID	DS	Note	River	Location	Flood Probability	Mean Daily 90	MD 75	MD 50	MD 25	MD 10	Instantaneous 90	I 75	I 50	I 25	I 10	Issue Date	Observed Peak to Date	Observed Date	Historic Peak	Average Peak	Flood	Last Year Peak	Last Year Date	Norm Earlie Da
1	Green	Upper	WBRW4	17		Green	Daniel- Nr-Warren Bridge- At	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	1960	2013-06-13	5620	2695	6100	2740	2013-06-08	2013-05-
	Peak has already occurred, see Current Hydrograph of WBRW4 for Forecast.																										
2	Green	Upper	BPNW4	18		New Fork	Big Piney- Nr	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	2000	2013-05-18	9110	4730	8850	4020	2013-06-08	2013-05-
	Peak has already occurred, see Current Hydrograph of BPNW4 for Forecast.																										
3	Green	Upper	LABW4	19		Green	La Barge- Nr	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	3880	2013-05-18	18800	8000	11500	6480	2013-06-09	2013-05-
	Peak has already occurred, see Current Hydrograph of LABW4 for Forecast.																										
4	Green	Upper	GRRW4	20		Green	Green River- Wy- Nr	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	841	2013-05-09	15400	5790	11050	3060	2013-06-27	2013-05-
	Peak has already occurred, see Current Hydrograph of GRRW4 for Forecast.																										
5	Green	Upper	HFMW4	21		Henrys Fork	Manila- Nr	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	236	2013-05-27	3780	750	5720	269	2013-04-28	2013-05-
	Peak has already occurred, see Current Hydrograph of HFMW4 for Forecast.																										
6	Green	Upper	HMFW4	22		Hams Fork	Frontier- Nr-Pole Ck- Blo	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	394	2013-05-15	2000	710	1790	391	2013-04-28	2013-05-
	Peak has already occurred, see Current Hydrograph of HMFW4 for Forecast.																										
7	Green	Upper	BNRU1	23		Blacks Fork	Robertson- Nr	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	1055	2013-05-16	2860	1380	2920	473	2013-05-16	2013-05-
	Peak has already occurred, see Current Hydrograph of BNRU1 for Forecast.																										
8	Green	Yampa/White	STMC2	24		Yampa	Steamboat Springs	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	2550	2013-05-27	5870	3070	5930	1460	2013-04-28	2013-05-
	Peak has already occurred, see Current Hydrograph of STMC2 for Forecast.																										
9	Green	Yampa/White	ENMC2	25		Elk	Milner- Nr	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	3050	2013-05-17	7000	3865	5750	1630	2013-05-07	2013-05-
	Peak has already occurred, see Current Hydrograph of ENMC2 for Forecast.																										
10	Green	Yampa/White	MBLC2	26		Yampa	Maybell- Nr	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	7350	2013-05-18	24400	10300	21200	4220	2013-04-29	2013-05-
	Peak has already occurred, see Current Hydrograph of MBLC2 for Forecast.																										
11	Green	Yampa/White	YDLC2	27		Yampa	Deerlodge	◆	NA	NA	**NA**	NA	NA	NA	NA	**NA**	NA	NA	2013-06-17	9540	2013-05-19	32300	13470	NA	5360	2013-04-30	2013-05-

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News: Recording: How to use this web page webinar

RIVERS SNOW WATER SUPPLY RESERVOIRS WEATHER

Conditions Map Active Points Peak Map Peak List Peak Pub Recreational Forecasts

Peak Flow List

New 1981-2010 Averages being used this year.

Click point type or enter search to change points displayed. Click column heading to sort by that data. Click ID to show plot for point.
Download pipe-delimited file of displayed points.

Help: Introduction Definitions River Permits Additional Information

Area: CBRFC Upper Colorado Green San Jaun Great Basin Sevier Virgin Lower Colorado

SEARCH POINTS

Plots: Auto Off On

Peak Flood Probability

◇ No Forecast ◆ No Flood Stage ◆ <10 ◆ >10 ◆ >25 ◆ >50

Previous years show probabilistic distribution of peak flows.

	NWS ID	River	Location	Flood Probability	Mean Daily 90%	75%	50%	25%	10%	Instantaneous 90%	75%	50%	25%	10%	Issue Date	Historic Peak	Average Peak	Flood	Last Year Peak	Last Year Date	Normal Earliest Date	Normal Latest Date	Observed Peak	Observed Date
1	ALEC2	East	Almont	◆	560	630	750	900	1100	570	650	790	960	1200	04-16	5000	2000	2980	2580	06-08	05-21	06-11		-
2	ARFN5	Animas	Farmington	◆	2100	2300	2700	3200	3700						04-16	11000	4710	8810	4860	06-08	05-20	06-09		-
3	BCTU1	Big Cottonwood Ck	Salt Lake City Nr	◆	210	240	270	290	340						04-17	925	430	800	698	06-24	05-18	06-07		-
4	BERU1	Bear	Utah	◆	800	920	1020	1120	1310	950	1100	1200	1400	1600	04-17	3030	1600	3670	3030	07-01	05-15	06-14		-
5	BFFU1	San Juan	Bluff Nr	◆	6100	6600	6900	7200	7600	7100	7700	8000	8300	8700	04-16	15200	7340	33838	4300	06-01	05-15	06-28		-
6	BPNW4	New Fork	Big Piney Nr	◆	3100	3400	4100	4800	5500	3200	3500	4200	4900	5700	04-16	9110	4730	8850	7750	07-03	05-26	06-23		-
7	BRUU1	Big Brush Ck	Vernal Nr Red Fleet Res Abv	◆	80	100	120	150	210						04-01	414	235		245	06-22	05-04	06-01		-
8	BSWC2	Blue	Dillon Nr	◆	140	160	200	260	340						04-16	1160	505	1770	955	07-20	05-27	06-25		-
9	BUEC2	Blue	Blue River	◆	60	70	90	120	160						04-16	580	185	835	410	07-20	05-28	07-05		-
10	CAMC2	Colorado	Cameo Nr	◆	5000	6000	7500	9500	12500	5500	6600	8100	10000	13000	04-16	38000	17000	26000	29200	06-09	05-24	06-12		-
11	CCSU1	City Ck	Salt Lake City Nr	◆	35	40	50	60	75						04-17	262	80	210	167	06-16	05-13	06-01		-
12	CCUC2	Colorado	Co	◆	4500	6500	9000	12000	15000	5100	7100	9700	13000	16000	04-16	68300	25500	46200	46800	06-10	05-19	06-11		-

Peak Flow Forecast List

Help | Notes | Download Data | Requery | Rebuild Plots

Peak Flood Probability Legend

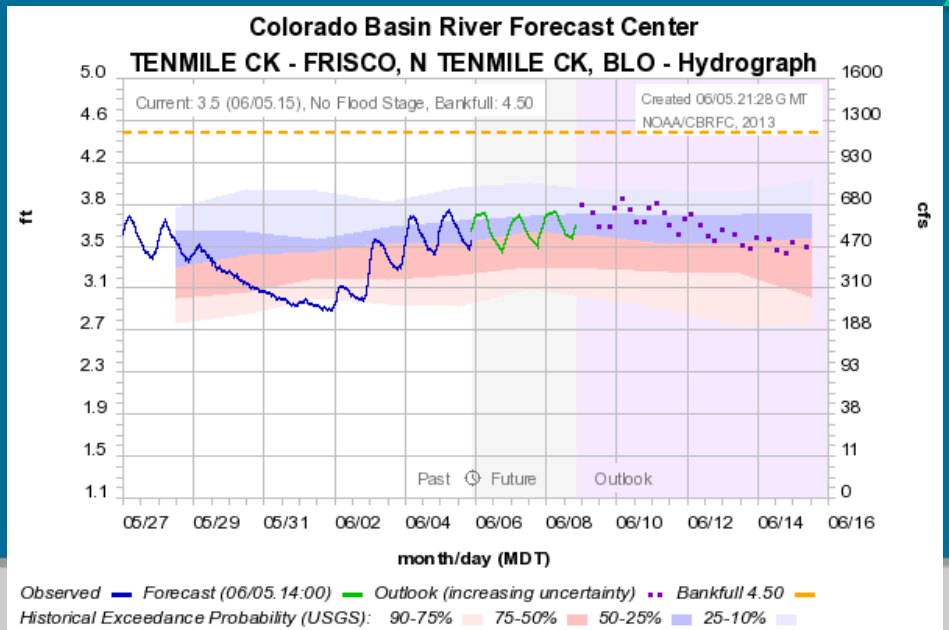
◇ No Forecast ◆ No Flood Stage ◆ <10 ◆ >10 ◆ >25 ◆ >50

Options (on/off): Plot

Area: CBRFC Green Colorado San Juan L Powell Great Sevier Virgin Low Col

Click column heading to sort by that data. Click ID to view point info.

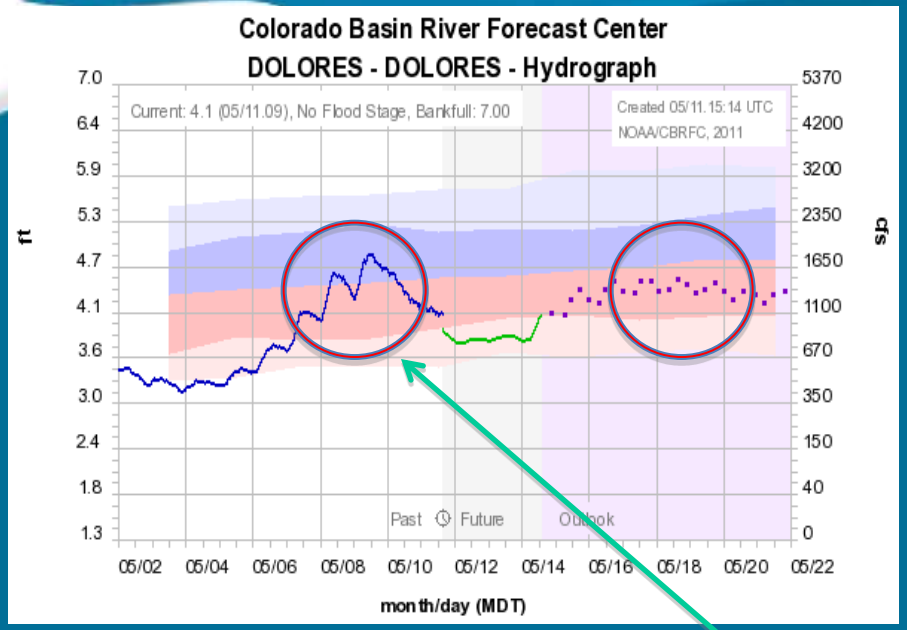
	Area	Sub Area	NWS ID	DS	Note	River	Location	Flood Probability	Mean Daily 90	MD 75	MD 50	MD 25	MD 10	Instantaneous 90	I 75	I 50	I 25	I 10	Issue Date	Observed Peak to Date	Observed Date
1	Colorado	Mainstem	EGLC2	1		Colorado	Dotsero- Nr	◆	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2013-06-01	5620	2013-05-18
								Peak has already occurred, see Current Hydrograph of EGLC2 for Forecast.													
2	Colorado	Mainstem	SKEC2	2		Snake	Montezuma- Nr	◆	NA	NA	NA	375	450	NA	NA	NA	490	580	2013-06-01	230	2013-05-27
								Peaking soon, see Current Hydrograph of SKEC2 for Forecast.													
3	Colorado	Mainstem	TCFC2	3		Tenmile Ck	Frisco- N Tenmile Ck- Blo	◆	NA	NA	NA	700	850	NA	NA	NA	890	1100	2013-06-01	495	2013-05-27
								Peaking soon, see Current Hydrograph of TCFC2 for Forecast.													

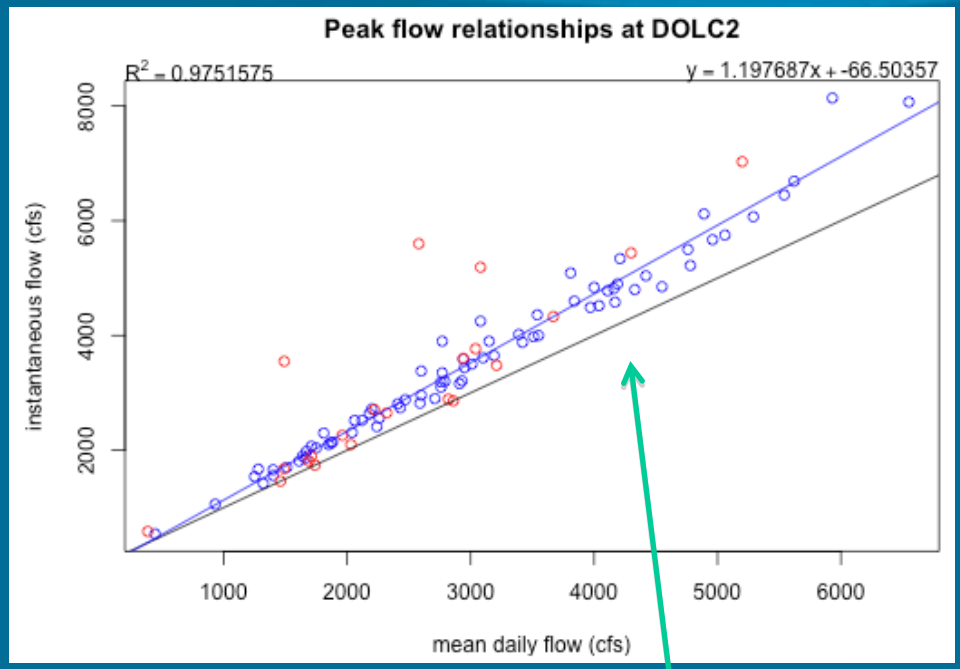


When a peak nears occurrence, DO NOT use the peak flow list. Instead, look at the daily hydrograph.

Accounting for diurnal variation

daily mean to instantaneous peak adjustment





- some rivers have predictable diurnal melt variations
- instantaneous peak exceeds daily mean
- RFC ESP forecasts simulate the daily mean (from 6 hr models)
- we now use the ***observed relationship*** between daily mean and instantaneous peak to relate our daily mean peak forecast percentiles to instantaneous peaks

Dolores												
Dolores												
Mean Daily Flow	6,950	2,980	7,820	2,700	5/30	1900	2100	2300	2500	2900	5/9 - 6/4	5/10
Instantaneous Flow						*2200*	*2400*	*2700*	*2900*	*3400*		

So….

What do peak flow forecasts tell us?

They tell us the highest expected daily mean flow value during the spring runoff period.

When does it tell us?

Monthly (or more as needed), between March and the end of the runoff period.

Discussion

Some thoughts…

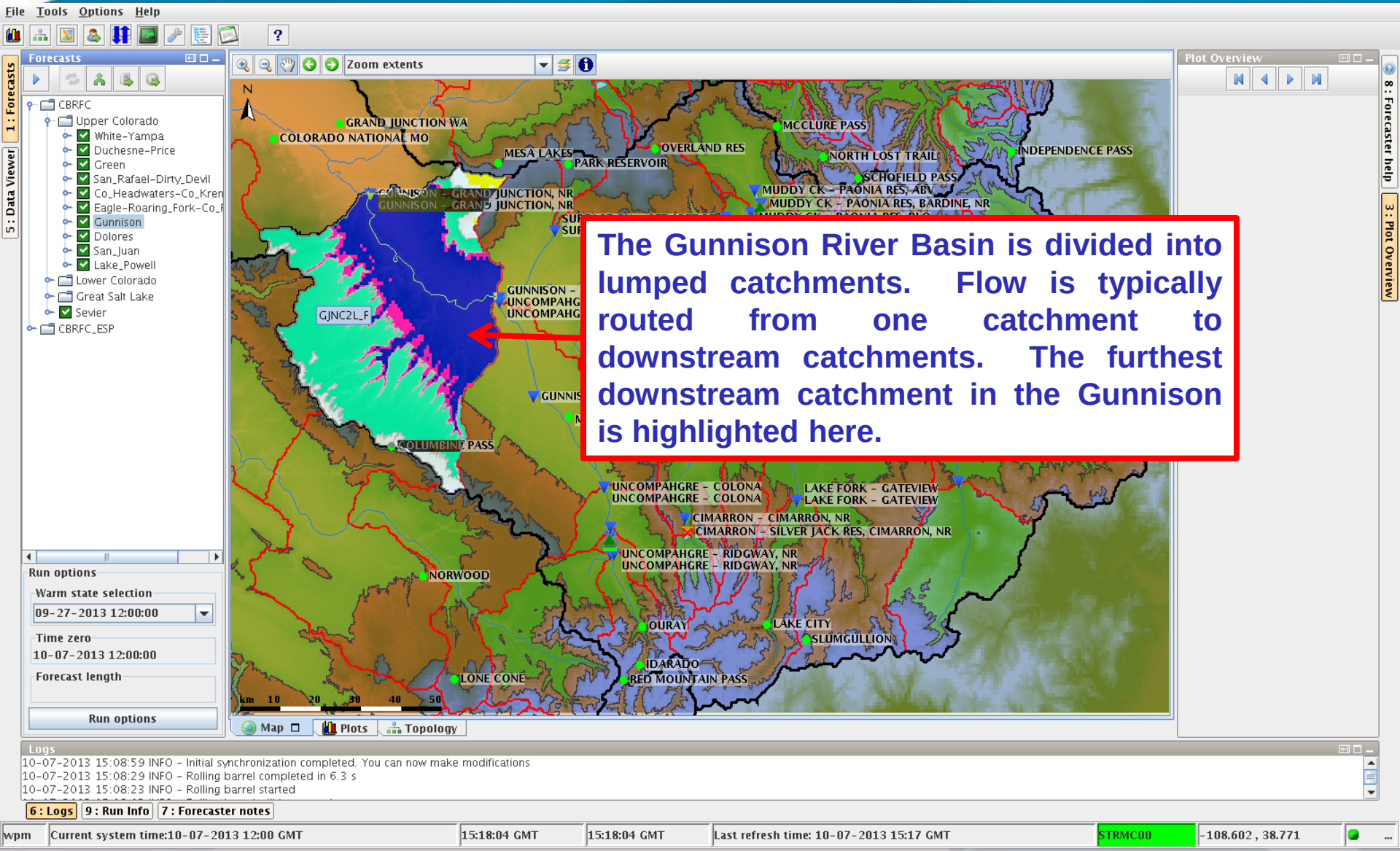
Do you access the daily ESP graphics on the CBRFC website? Are they informative?

How do you receive CBRFC forecasts? How do you want to receive them?

Is the difference clear between what drives the short term deterministic vs. the long range probabilistic forecasts?

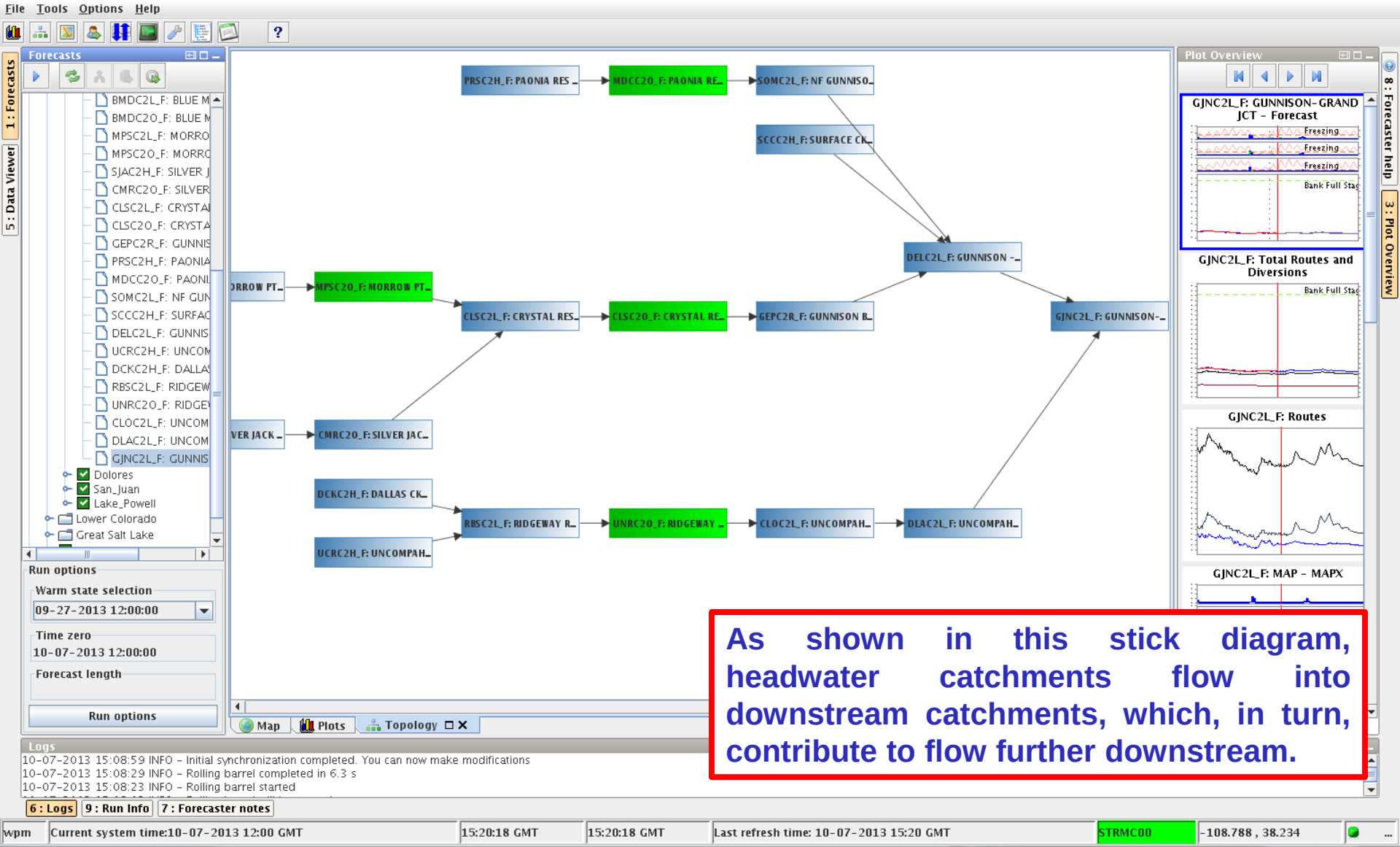
Extra Slides

Daily Model



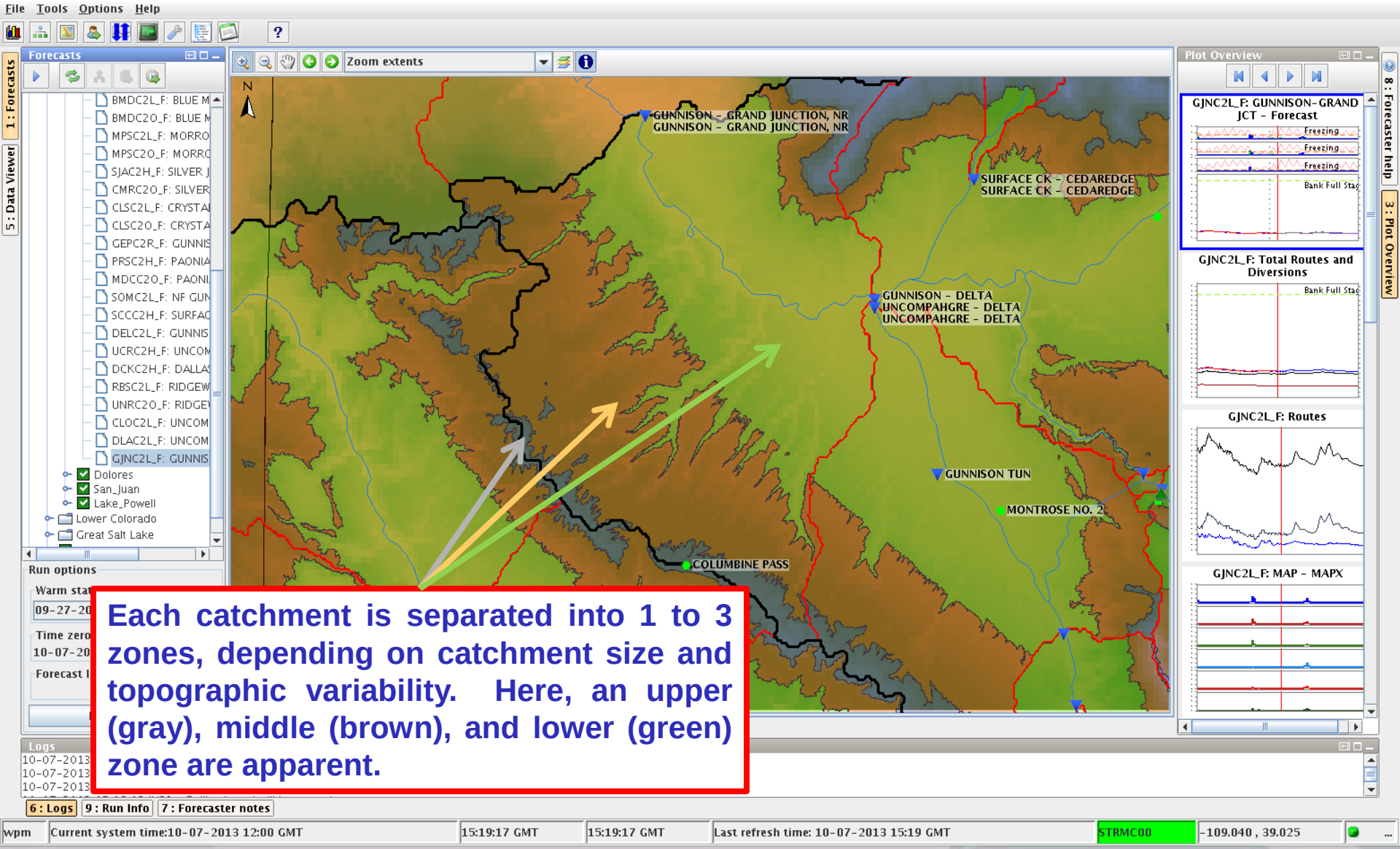
The Gunnison River Basin is divided into lumped catchments. Flow is typically routed from one catchment to downstream catchments. The furthest downstream catchment in the Gunnison is highlighted here.

Daily Model



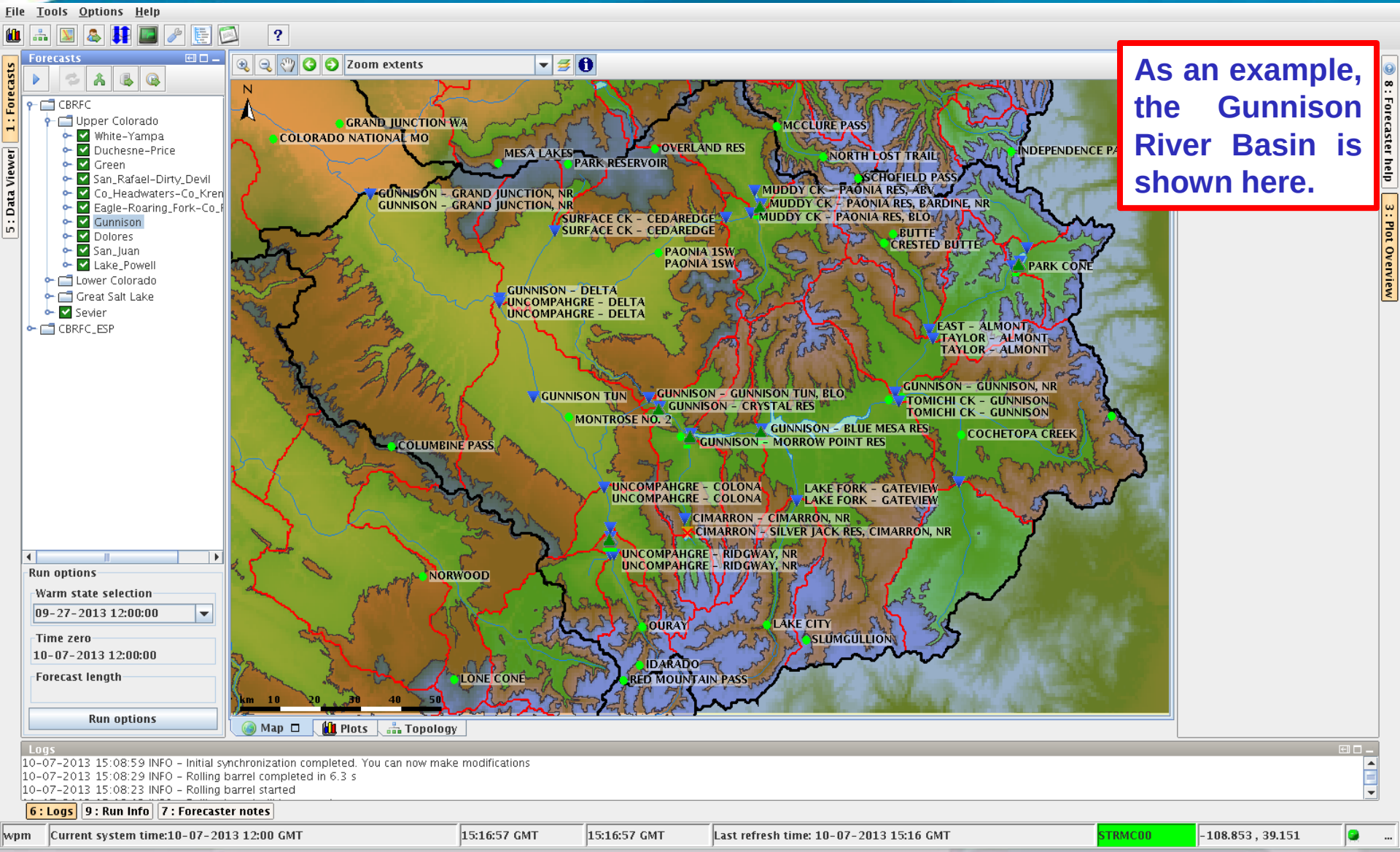
As shown in this stick diagram, headwater catchments flow into downstream catchments, which, in turn, contribute to flow further downstream.

Daily Model



Each catchment is separated into 1 to 3 zones, depending on catchment size and topographic variability. Here, an upper (gray), middle (brown), and lower (green) zone are apparent.

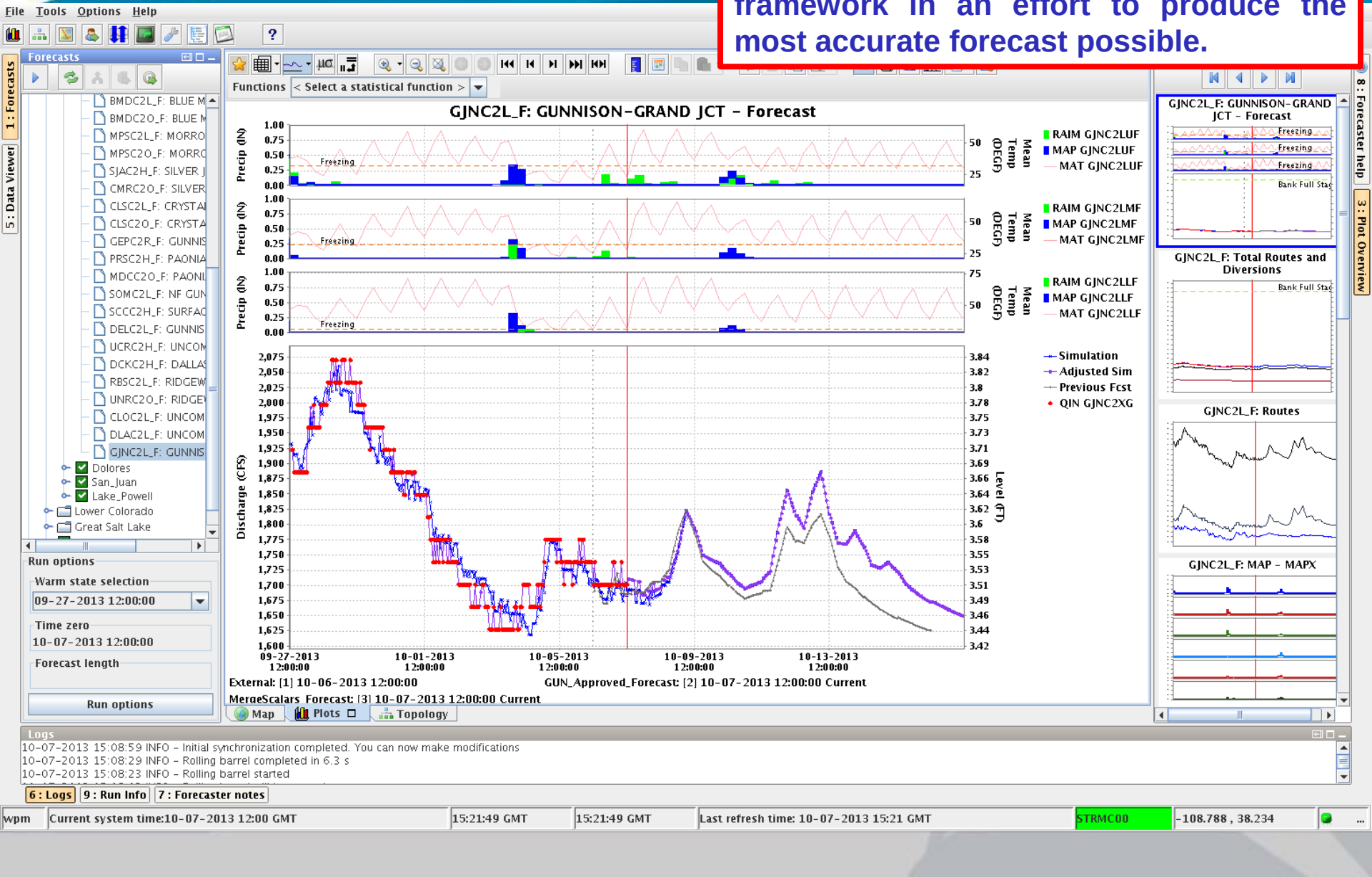
Daily Model



As an example, the Gunnison River Basin is shown here.

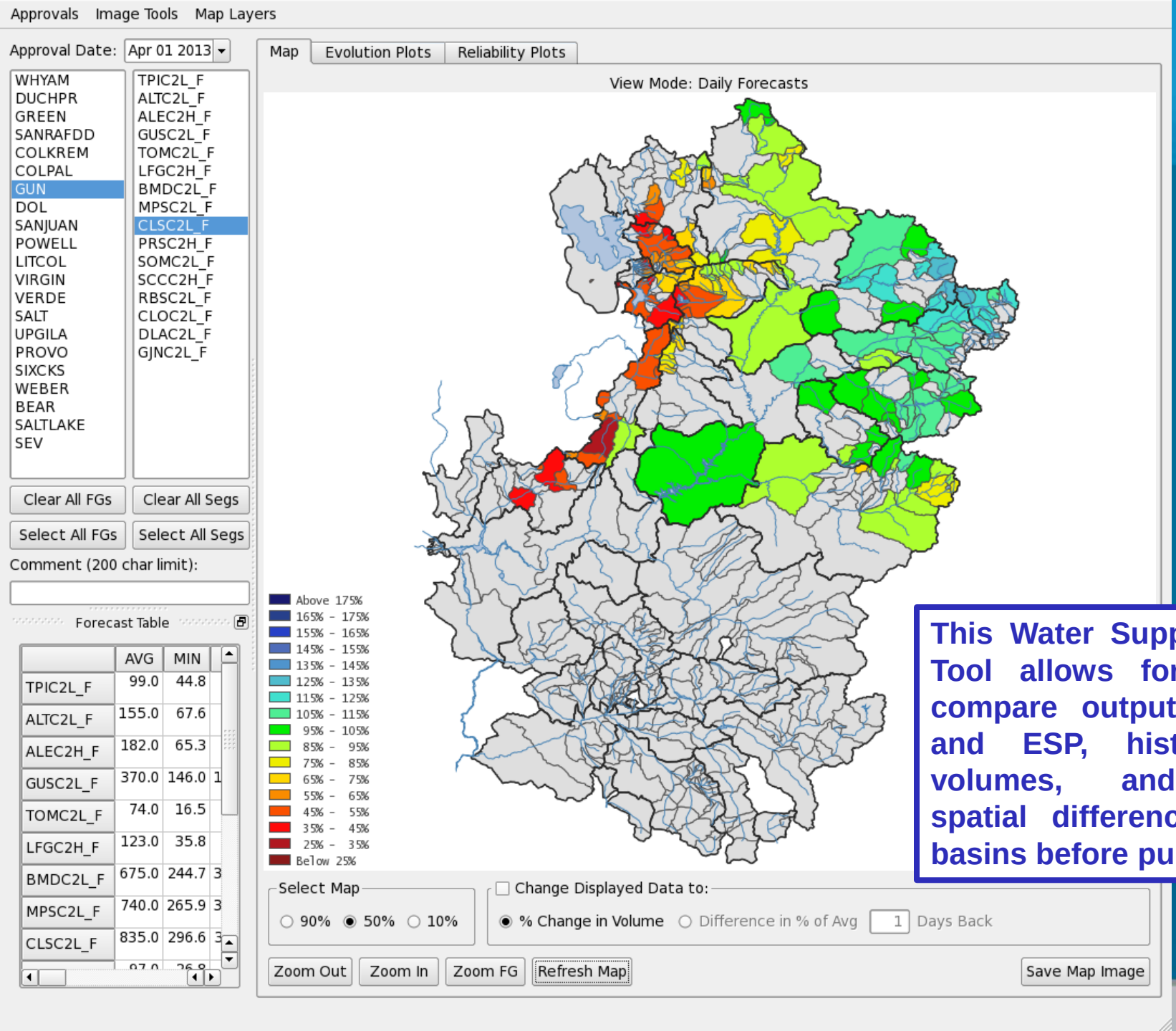
Daily Model

Forecasters adjust SAC-SMA and SNOW-17 input parameters within the CHPS framework in an effort to produce the most accurate forecast possible.

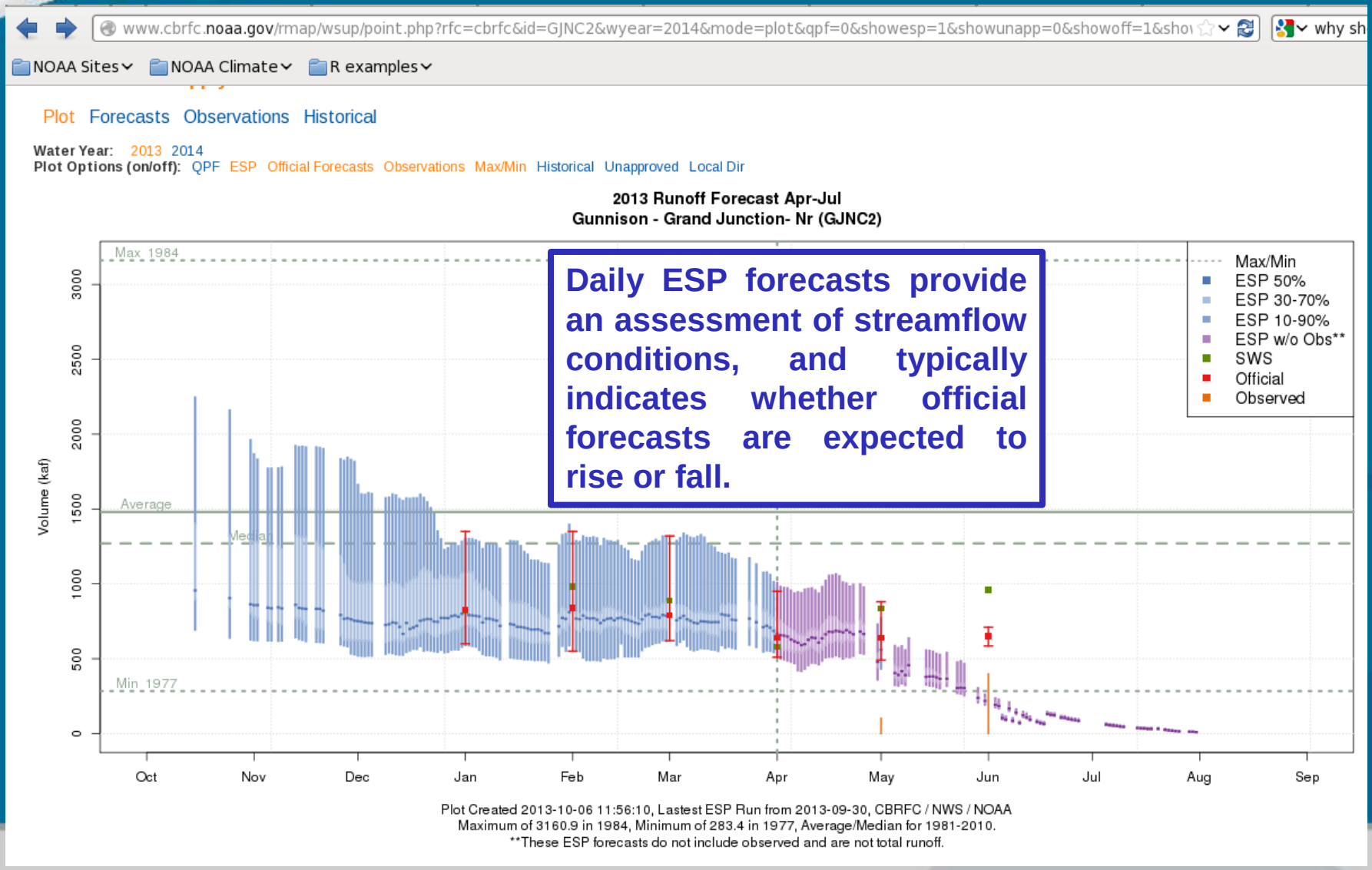


ESP Forecast Traces

- *ESP Forecast Traces are not equivalent to Daily ESP output. The traces are adjusted*
- *It is important to note that the adjustment is solely done for the benefit of stakeholders in their modeling efforts*
  - *Allows Reclamation to compare 24 Month Study to MTOM output more directly*
  - *Adjustment factors are not representative of an ESP bias or error*
- *Adjustment is done more for numerical or statistical purposes than for physical reasons*


Approvals
Image Tools
Map Layers
Approval Date: Apr 01 2013
WHYAM
DUCHPR
GREEN
SANRAFDD
COLKREM
COLPAL
GUN
DOL
SANJUAN
POWELL
LITCOL
VIRGIN
VERDE
SALT
UPGILA
PROVO
SIXCKS
WEBER
BEAR
SALTLAKE
SEV
TPIC2L_F
ALTC2L_F
ALEC2H_F
GUSC2L_F
TOMC2L_F
LFGC2H_F
BMDC2L_F
MPSC2L_F
CLSC2L_F
PRSC2H_F
SOMC2L_F
SCCC2H_F
RBSC2L_F
CLOC2L_F
DLAC2L_F
GJNC2L_F
Clear All FGs
Clear All Segs
Select All FGs
Select All Segs
Comment (200 char limit):
Forecast Table
AVG
MIN
TPIC2L_F 99.0 44.8
ALTC2L_F 155.0 67.6
ALEC2H_F 182.0 65.3
GUSC2L_F 370.0 146.0
TOMC2L_F 74.0 16.5
LFGC2H_F 123.0 35.8
BMDC2L_F 675.0 244.7
MPSC2L_F 740.0 265.9
CLSC2L_F 835.0 296.6
Map
Evolution Plots
Reliability Plots
View Mode: Daily Forecasts
Above 175%
165% - 175%
155% - 165%
145% - 155%
135% - 145%
125% - 135%
115% - 125%
105% - 115%
95% - 105%
85% - 95%
75% - 85%
65% - 75%
55% - 65%
45% - 55%
35% - 45%
25% - 35%
Below 25%
Select Map
90%
50%
10%
Change Displayed Data to:
% Change in Volume
Difference in % of Avg
1
Days Back
Zoom Out
Zoom In
Zoom FG
Refresh Map
Save Map Image
This Water Supply Approval Tool allows forecasters to compare output from SWS and ESP, historical flow volumes, and compare spatial differences between basins before publication.

Monthly and Seasonal Water Supply Forecasts



Seasonal Water Supply Forecasts

```
ZCZC SLCESPSTR CSW
TTAA00 KSTR DDHHMM
:National Weather Service, Colorado Basin River Forecast Center, SLC, Utah

:October final Forecast      October 01, 2013

"product_issuance=final"
:
:Other Reservoir Unregulated Inflow Forecasts
:
.B SLC 131031 M DH24/DC1310011800/QCMFEZ5/DRE+1/QCMFEZ5/DRE+2/QCMFEZ5
:                              Obs          sep     Forecast
:                        jun   jul   aug   sep   %Avg    oct    nov    dec
GLDA3:Lake Powell        939   143   273   857   210%:   550/   400/   290/
GBRW4:Fontenelle          91    67    32    47   102%:    46/    36/    28/
GRNU1:Flaming Gorge       91    66    22    67   122%:    54/    42/    29/
BMDC2:Blue Mesa          126    44    46    57   150%:    46/    31/    25/
MPSC2:Morrow Point       132    45    46    58   143%:    48/    33/    26/
CLSC2:Crystal            144    48    50    63   135%:    54/    37/    29/
TPIC2:Taylor Park         26   8.9   6.6   7.9   107%:   6.5/   4.8/   4.3/
VCRC2:Vallecito         19.3   7.9  12.9    45   258%:    20/    10/     7/
NVRN5:Navajo              40  1.88    43   151   350%:    65/    38/    25/
LEMC2:Lemon              4.1  1.70   2.8   9.5   234%:   3.7/   1.7/     1/
MPHC2:McPhee            13.6   6.4  11.6    26   229%:    13/     6/   3.7/
RBSC2:Ridgway           17.3   8.4  11.6  14.9   152%:     9/   5.5/   4.2/
:
.END
:
:Other
:
.B SLC 131031 M DH24/DC1310011800/QCMFEZ5/DRE+1/QCMFEZ5/DRE+2/QCMFEZ5
:                              Obs          sep     Forecast
:                        jun   jul   aug   sep   %Avg    oct    nov    dec
PRSC2:Paonia             5.6  1.92   2.7  2.0e   91%:   2.6/   2.2/   1.7/
:
.END

                      PRECIPITATION SUMMARY - % OF AVERAGE BY MONTH - CY 2013
RIVER BASIN:             JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP
GREEN
   ABV FLAMING GORGE      55   55   60  115   75   10  110   65  185
   ABV GRN RVR,UT(TOTAL)  70   55   65  135   75    5  110   80  190
COLORADO
   ABV  GRAND JUNCTION    75   70   90  145  110   10  140  105  210
   GUNNISON BASIN        105   75   70  120   95   15  160  120  195
   DOLORES BASIN         120   65   40   55   80   10  195  145  190
   ABV CISCO (TOTAL)      95   70   70  120  100   10  160  120  200
SAN JUAN
   ABV BLUFF (TOTAL)     130   65   40   65   50   15  130  125  205
ABV LAKE POWELL (TOTAL)   95   65   60  115   80   10  130  110  200
```

Unregulated Reservoir Inflow Forecasts issued approximately biweekly

3-Month Outlook, with Apr-Jul provided beginning in January

Precipitation summary provided as well

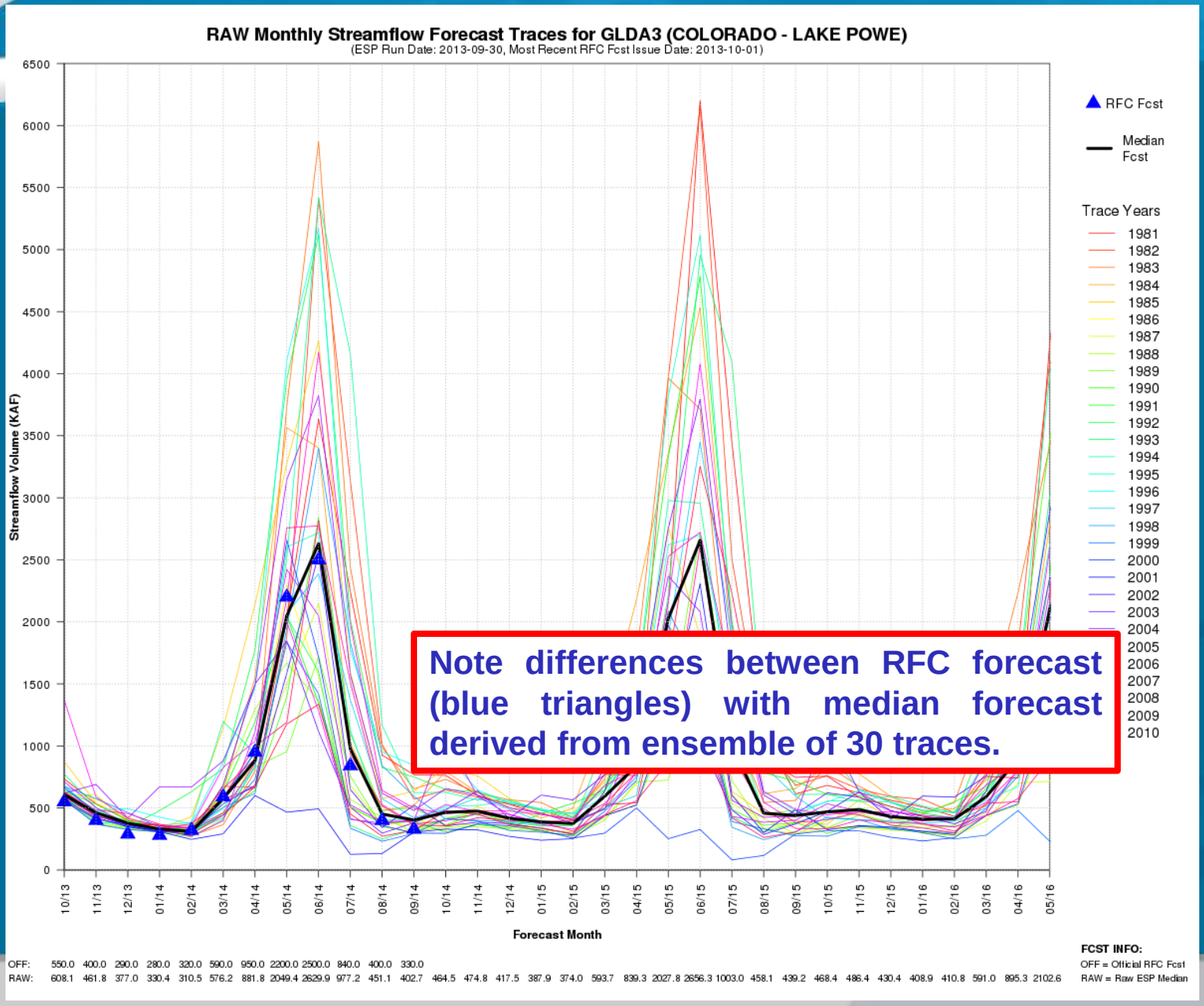
Part 4:

ESP Forecast Traces

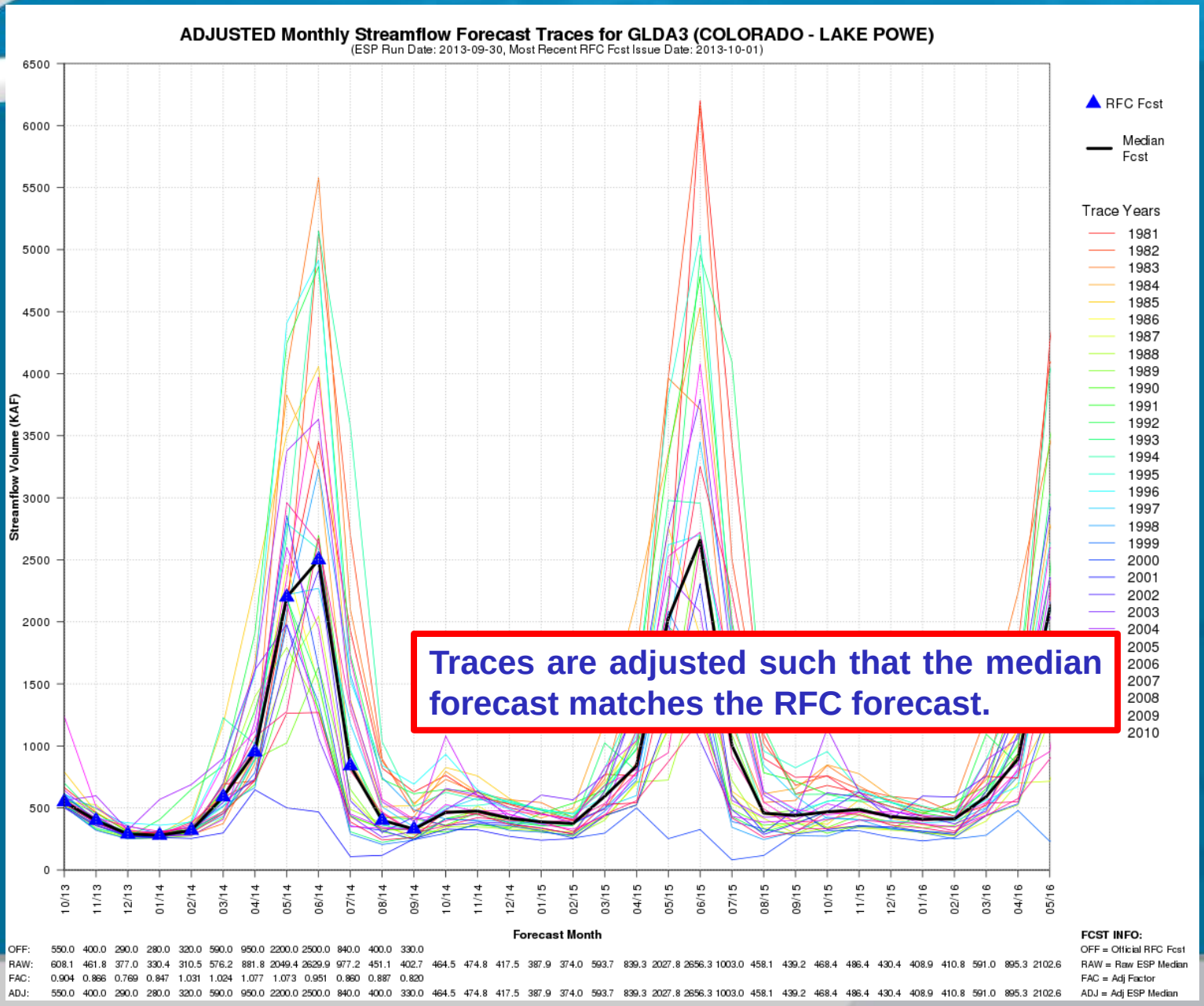
ESP Forecast Traces

- *32-Month ESP traces have been generated for use by stakeholders in the development of probabilistic, operational resource-management models*
- *Traces are adjusted such that the median of the traces is equivalent to the final forecast issued*
  - *This adjustment is applied so that the ensemble is comparable to the final forecast*

ESP Forecast Traces



ESP Forecast Traces



ESP Forecast Traces

- ***Currently, the raw traces are available via the CBRFC website in text form:***
  - ***http://www.cbrfc.noaa.gov/outgoing/32month/***

- ***Adjusted ESP traces and graphics will be available on the CBRFC website in the near future***

So….

What do ESP forecast traces tell us?

It is the entire ensemble of ESP output that we use in the determination of our water supply forecasts. They are typically scaled so that the median of the ensemble is equivalent to our final forecast. It is useful for probabilistic models.

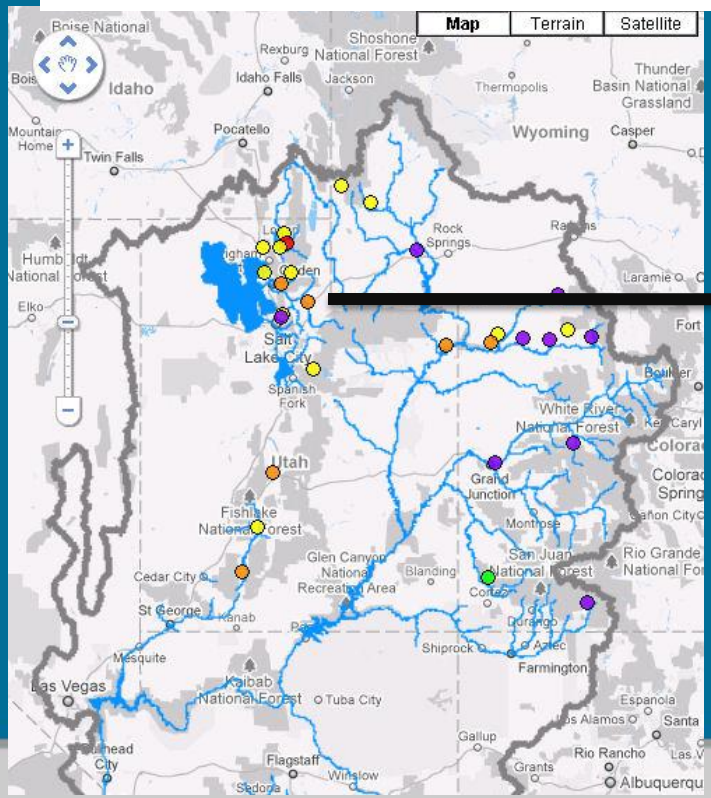
When does it tell us?

Each month during the water supply forecasting season.

Transition from peak flow publication to our active conditions main web page:

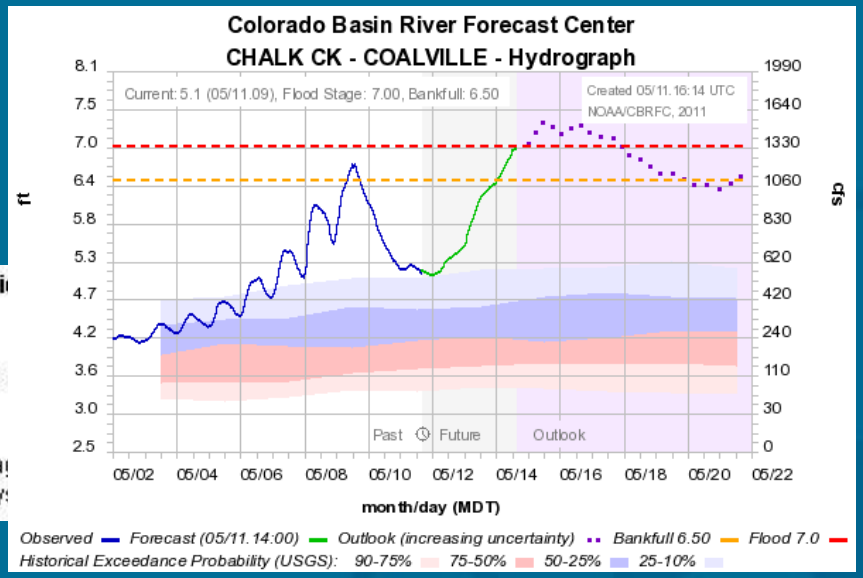
- S… looking at both at this time – focus on our active conditions map as the peak nears (not always obvious)
  - …requent updates using recent observations and short term meteorological forecasts (active quality control)
    - Multiple peaks that exceed critical levels may occur (not represented in mean daily forecast)
      - Known regulation changes will be accounted for on active web page hydrographs

	Historic Peak	Average Peak	Flood* Flow	2010 Peak	2010 Date	2011 Forecast Exceedance Probability 90%	75%	50%	25%	10%	Normal time of Peak	
Chalk Ck												
Coalville												
Mean Daily Flow	1,790	600	1,300	535	6/14	1550	1700	1900	2250	2800	5/5 - 5/31	5/10
Instantaneous Flow						*1800*	*2000*	*2200*	*2600*	*3300*		



Planning vs real time

River Point Conditi
- No Data
- Normal
- Significant Rise
- Near Bankfull
- Above Bankfull
- Above Flood Sta
- Outlook (> 3 days



Seasonal Water Supply Forecasts

- *SWS relates observed data to seasonal streamflow through regression equations*
- *Utilizes Monthly Data:*
  - *First of month SWE*
  - *Total precipitation (can be multiple months)*
  - *Flow volume*
  - *Climate indices (e.g., ENSO, PDO, SOI)*
- *Output*
  - **Seasonal volume (e.g. April-July)**
  - *Conditional probability distribution; the equation result is the 50% exceedance*

Seasonal Water Supply Forecasts

- ***Ensemble Streamflow Prediction (ESP)***
  - ***This is the CBRFC's primary model for water supply forecasting***
  - ***Run daily starting from current model snow and soil states***
  - ***Uses historical temperature and precipitation from the calibration history to derive an ensemble of future hydrologic traces (currently using 30 traces from 1981-2010)***
  - ***Daily timestep for 12 months into the future***
  - ***Median (or 50% exceedance) value is not equivalent to water supply forecasts***

Seasonal Water Supply Forecasts

SWS

Easy to calibrate, maintain and run.

Works only for seasonal volumes.

Equations are made to be run only at specific times (i.e. first of month and only for winter and spring).

ESP

Requires extensive calibration and maintenance.

Can compute many hydrologic variables over any period.

Can be run at any time.

Keeps track of soil moisture.

Seasonal Water Supply Forecasts

- ***Informed by SWS, ESP, and forecaster expertise***
- ***Uncertainty comes from:***
  - **Density of gage network**
  - **Errors in historical observations**
  - **Variations in consumptive use**
  - **Limitations of models used (SAC-SMA and SNOW-17)**