Green and Yampa Rivers:
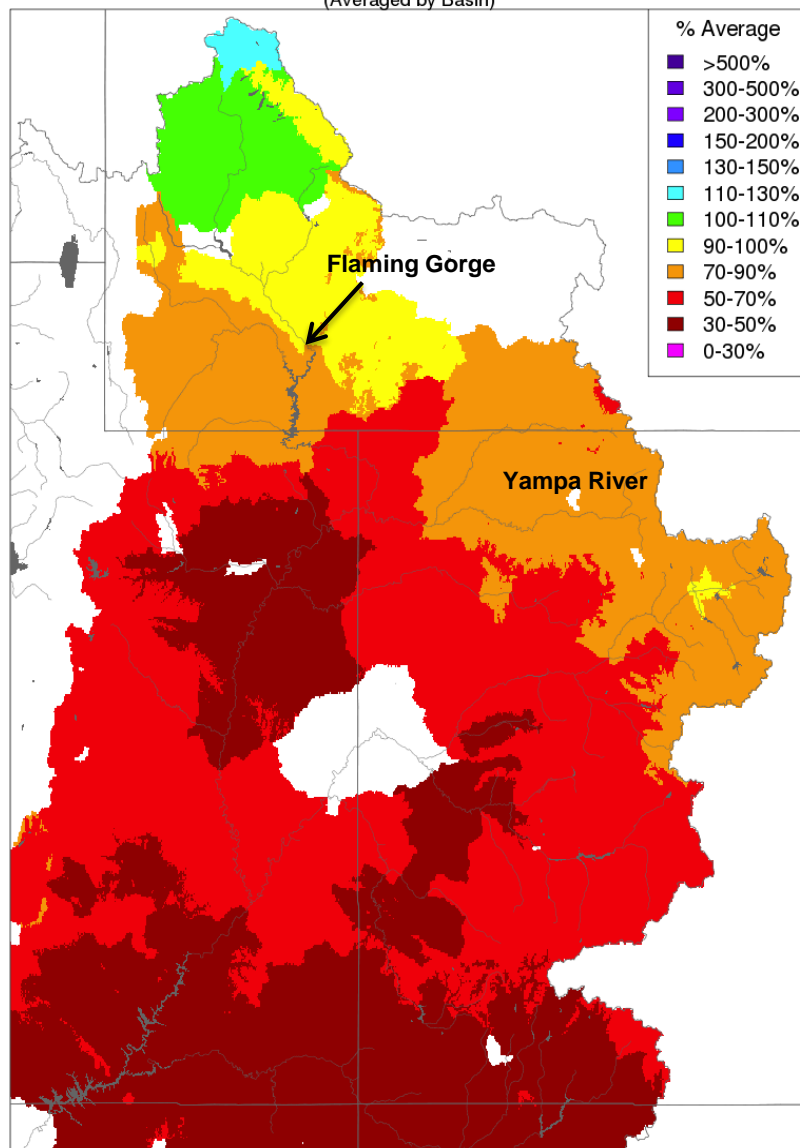## Spring Forecast and Runoff Review

August 27th, 2018
Flaming Gorge Working Group Meeting

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Colorado Basin River Forecast Center

National Weather Service/NOAA

2018 Water Year and Monthly Precipitation

Water Year Precipitation, October 2017 - July 2018
(Averaged by Basin)

% Average
- >500%
- 300-500%
- 200-300%
- 150-200%
- 130-150%
- 110-130%
- 100-110%
- 90-100%
- 70-90%
- 50-70%
- 30-50%
- 0-30%

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

Basin Mean Precipitation as a % of Average		
	Upper Green Flaming Gorge/Fontenelle	Yampa River
Water Year	**90/105**	**75**
October	35	85
November	130/160	65
December	90/105	55
January	85	75
February	95/115	100
March	110	85
April	85/95	110
May	120/135	45
June	65/110	40
July	55	25

May precipitation in the Upper Green and April precipitation in the Yampa impacted the water supply forecasts.

2018 Snow Conditions

Colorado Basin River Forecast Center — Upper Green Group. Peak Snow: 113 %. Created 08/13.17:04 G MT, NOAA/CBRFC, 2018. Median 1981-2010, 2018, 2017.
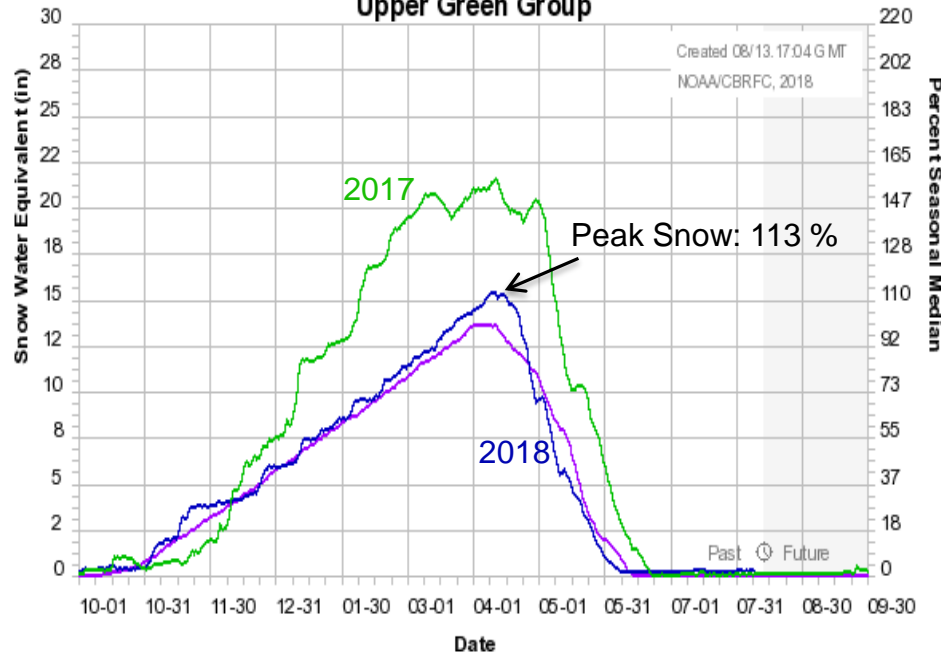
Colorado Basin River Forecast Center — Yampa abv Deerlodge Group. Peak Snow: 87%. Early melt. Created 08/13.17:22 G MT, NOAA/CBRFC, 2018. Median 1981-2010, 2018, 2017.

- Slightly above normal snow pack above Flaming Gorge
  - Majority of snow was above Fontenelle Reservoir
  - Below normal snow conditions in the Uintas
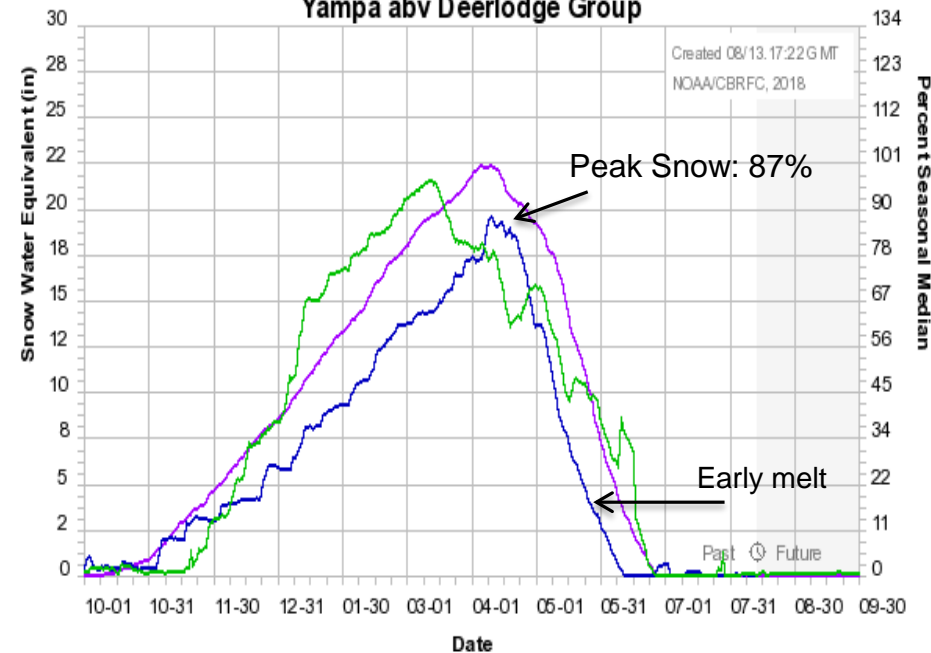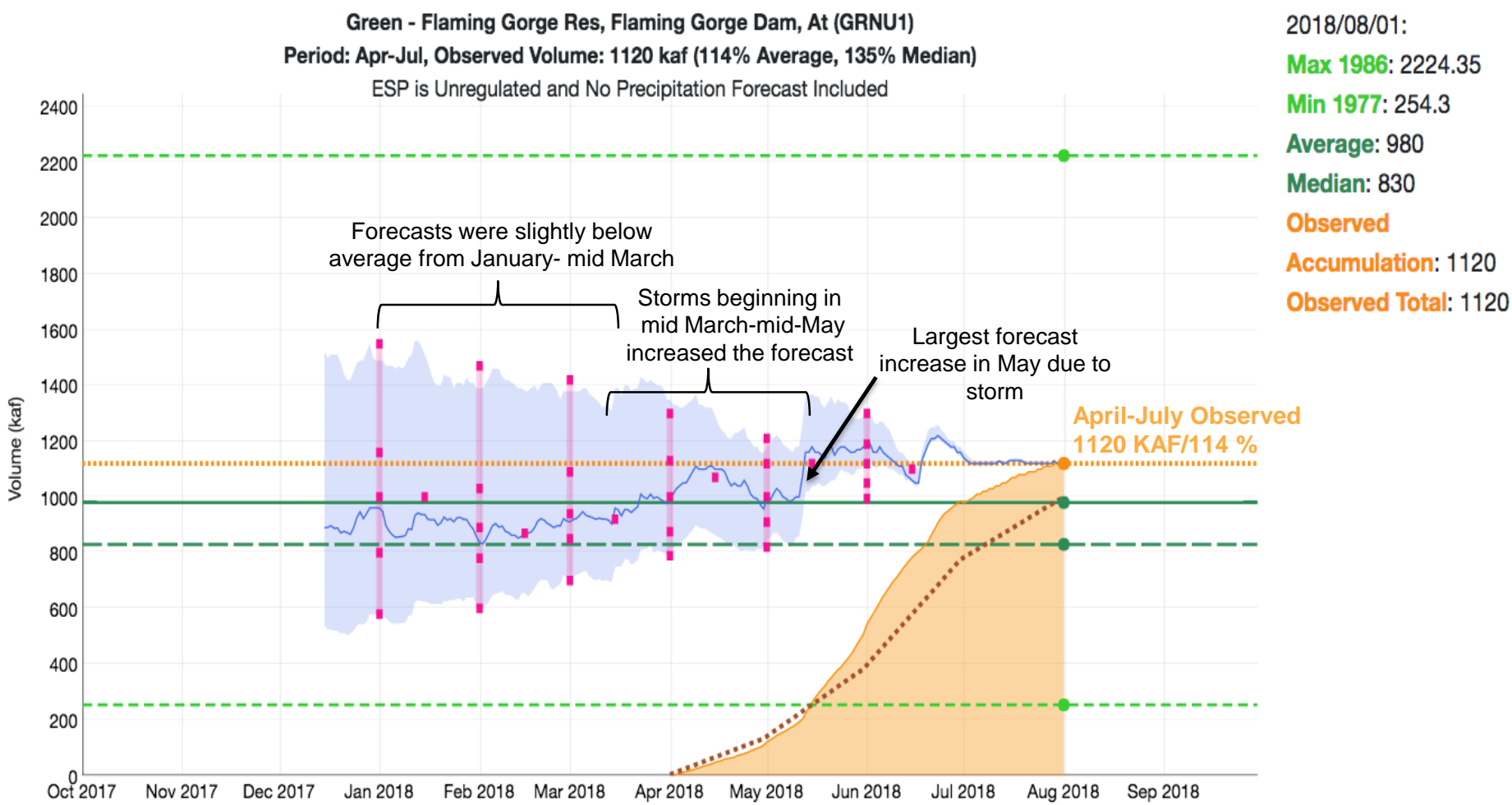
- Below normal snowpack in the Yampa
  - Early melt

Flaming Gorge Inflow Forecast Review

Breaking down the Forecast: Seasonal Forecast Progression for Flaming Gorge Inflow


Water Supply Forecast

Green - Flaming Gorge Res, Flaming Gorge Dam, At (GRNU1)
Period: Apr-Jul, Observed Volume: 1120 kaf (114% Average, 135% Median)
ESP is Unregulated and No Precipitation Forecast Included

2018/08/01:
Max 1986: 2224.35
Min 1977: 254.3
Average: 980
Median: 830
Observed
Accumulation: 1120
Observed Total: 1120

Forecasts were slightly below average from January- mid March

Storms beginning in mid March-mid-May increased the forecast

Largest forecast increase in May due to storm

April-July Observed 1120 KAF/114 %

April-July observed volume fell within the range of forecast possibilities for all forecast months.

Widespread precipitation event in the Upper Green from May 11th-13th
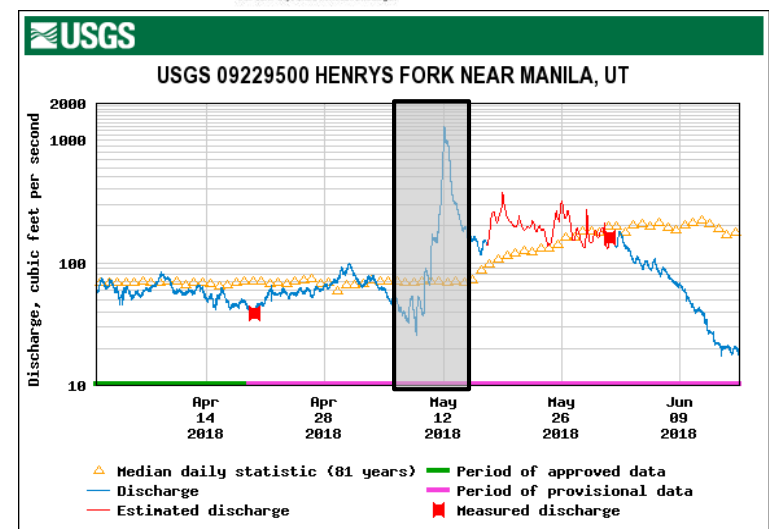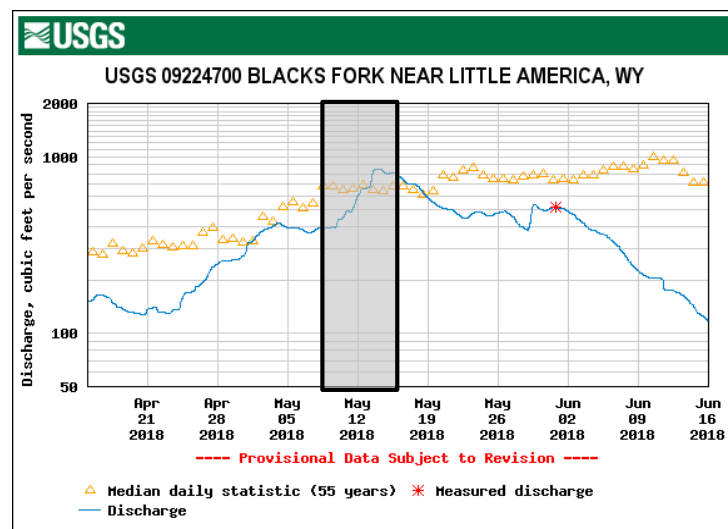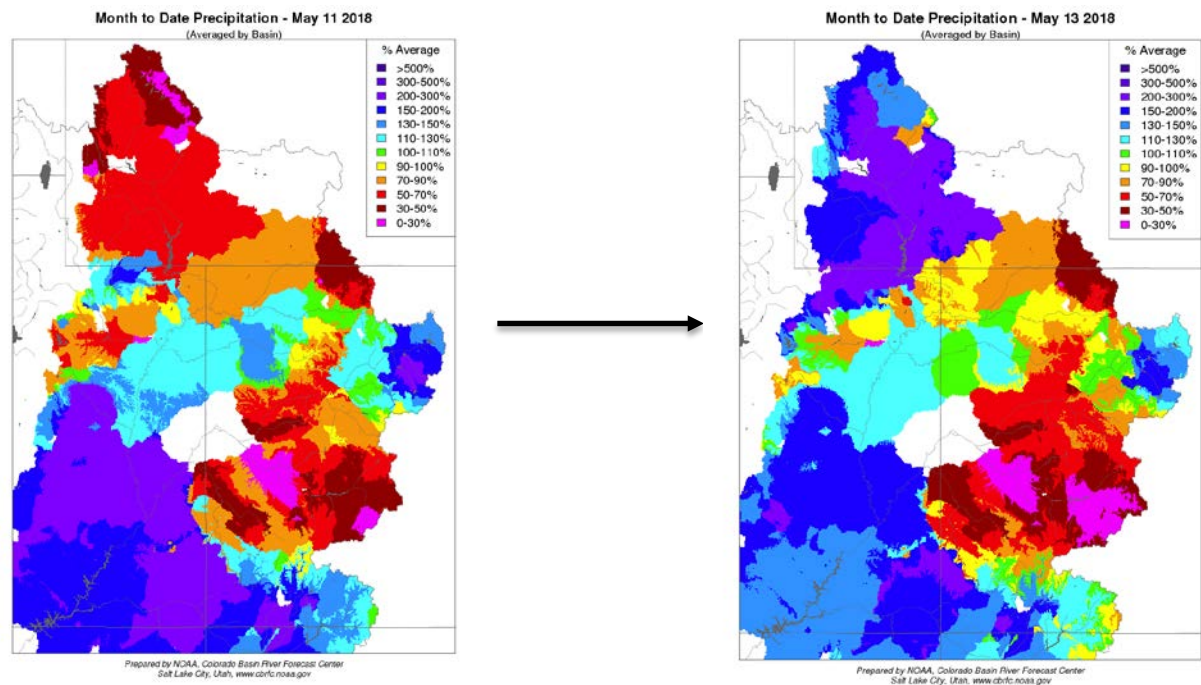
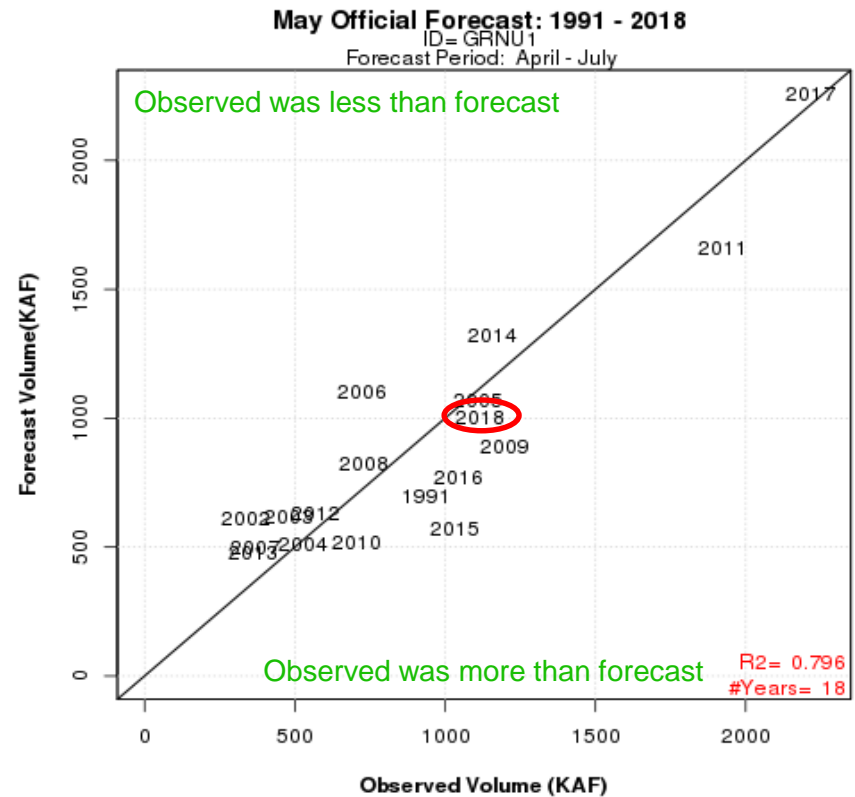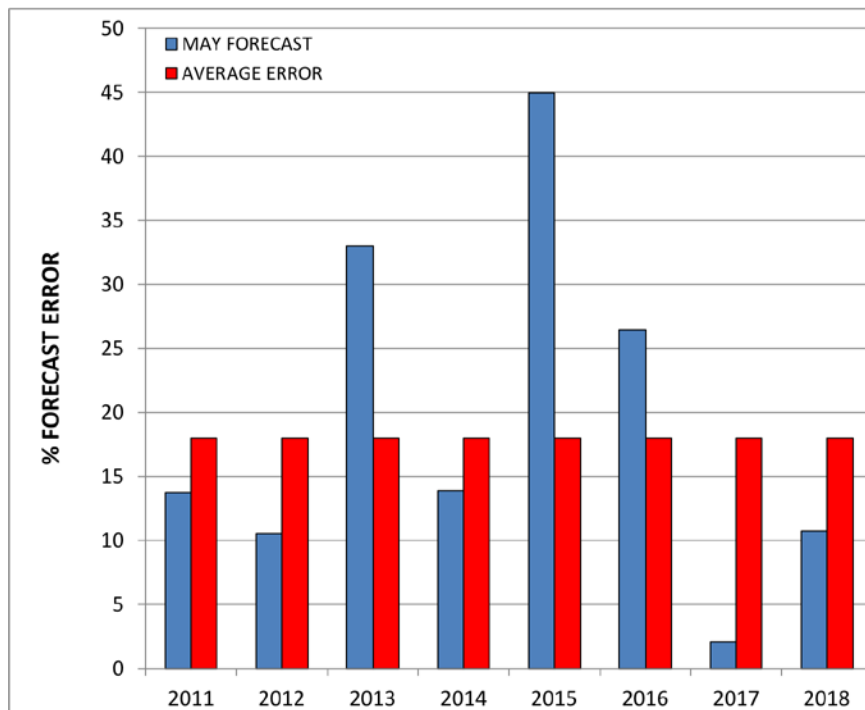# Forecast Verification: Flaming Gorge Inflow

Flaming Gorge Average Historical Model Error vs 2018 Forecast Error
50% Exceedance Forecast
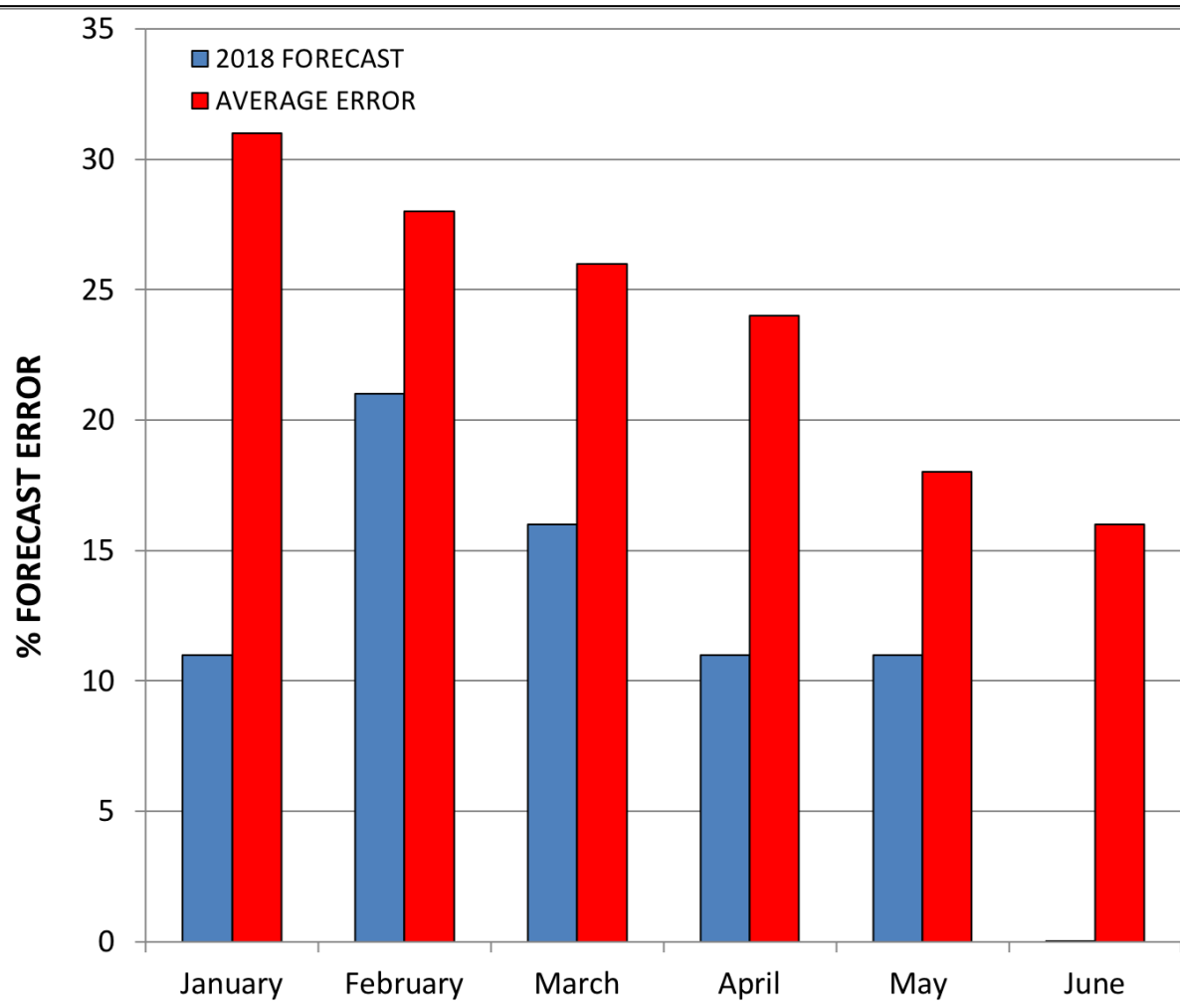
- Forecast error decreases through the season as we learn more about conditions.

- 2018 forecast error was less than typical error due "average" weather conditions and the model representing the snow/soil moisture conditions correctly.

Forecast Verification: Flaming Gorge Inflow
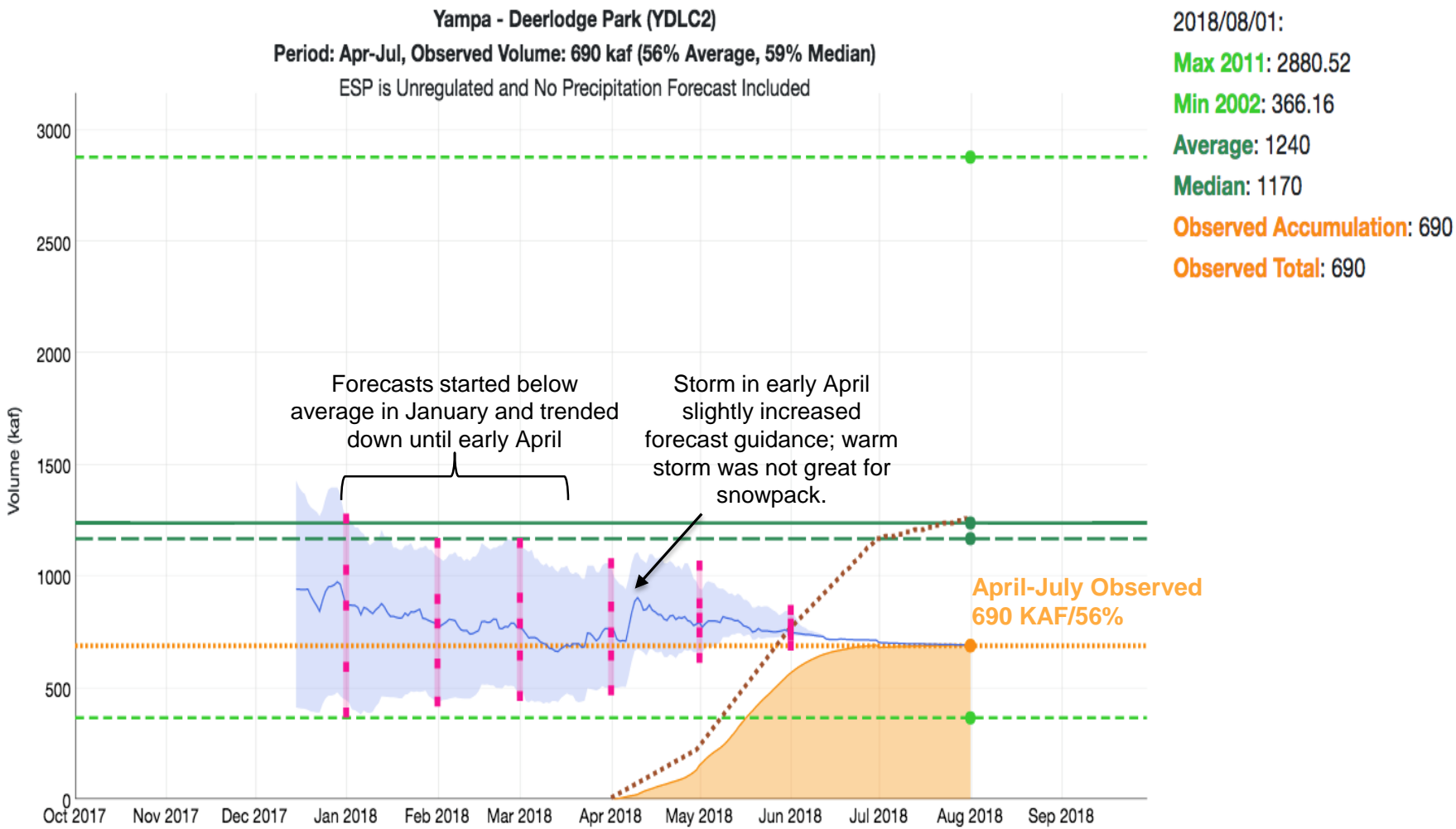
May Forecast Errors 2011-2018

Forecast errors depend on year. Errors from May forward depend on spring weather and the model's representation of current snow conditions.

Yampa River Forecast Review

# Breaking down the Forecast: Seasonal Forecast Progression for the Yampa River

Water Supply Forecast

Yampa - Deerlodge Park (YDLC2)
Period: Apr-Jul, Observed Volume: 690 kaf (56% Average, 59% Median)
ESP is Unregulated and No Precipitation Forecast Included

2018/08/01:
Max 2011: 2880.52
Min 2002: 366.16
Average: 1240
Median: 1170
Observed Accumulation: 690
Observed Total: 690

Forecasts started below average in January and trended down until early April

Storm in early April slightly increased forecast guidance; warm storm was not great for snowpack.

April-July Observed 690 KAF/56%

April-July observed volume fell near the 70-90% exceedance probabilities.

Forecast Verification: Yampa River-Deerlodge

Yampa River Average Historical Model Error vs 2018 Forecast Error
50% Exceedance Forecast
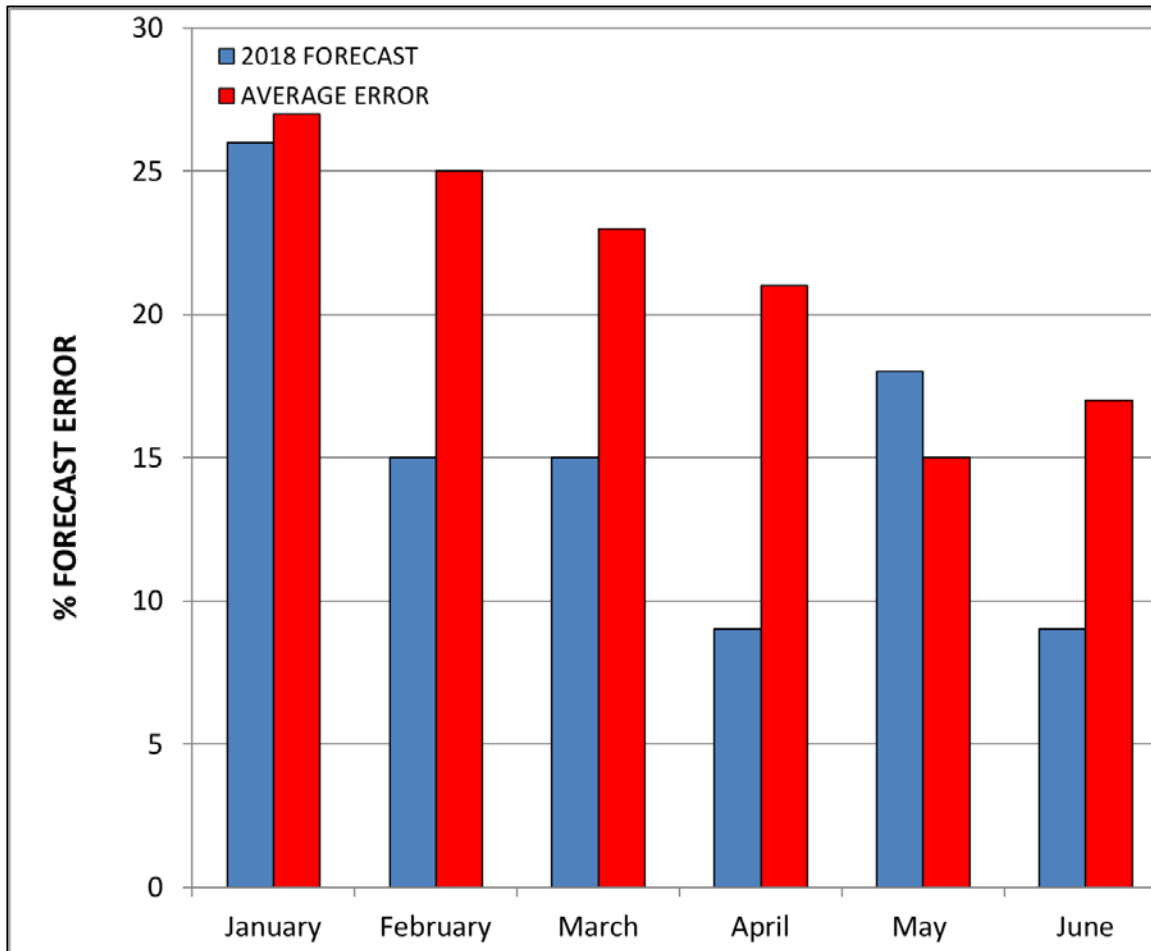
- Model forecast error decreases from January-May with a slight increase in June.

- 2018 forecast error was more than typical error except in May. Increase to May 1st forecast from April storm was not warranted.
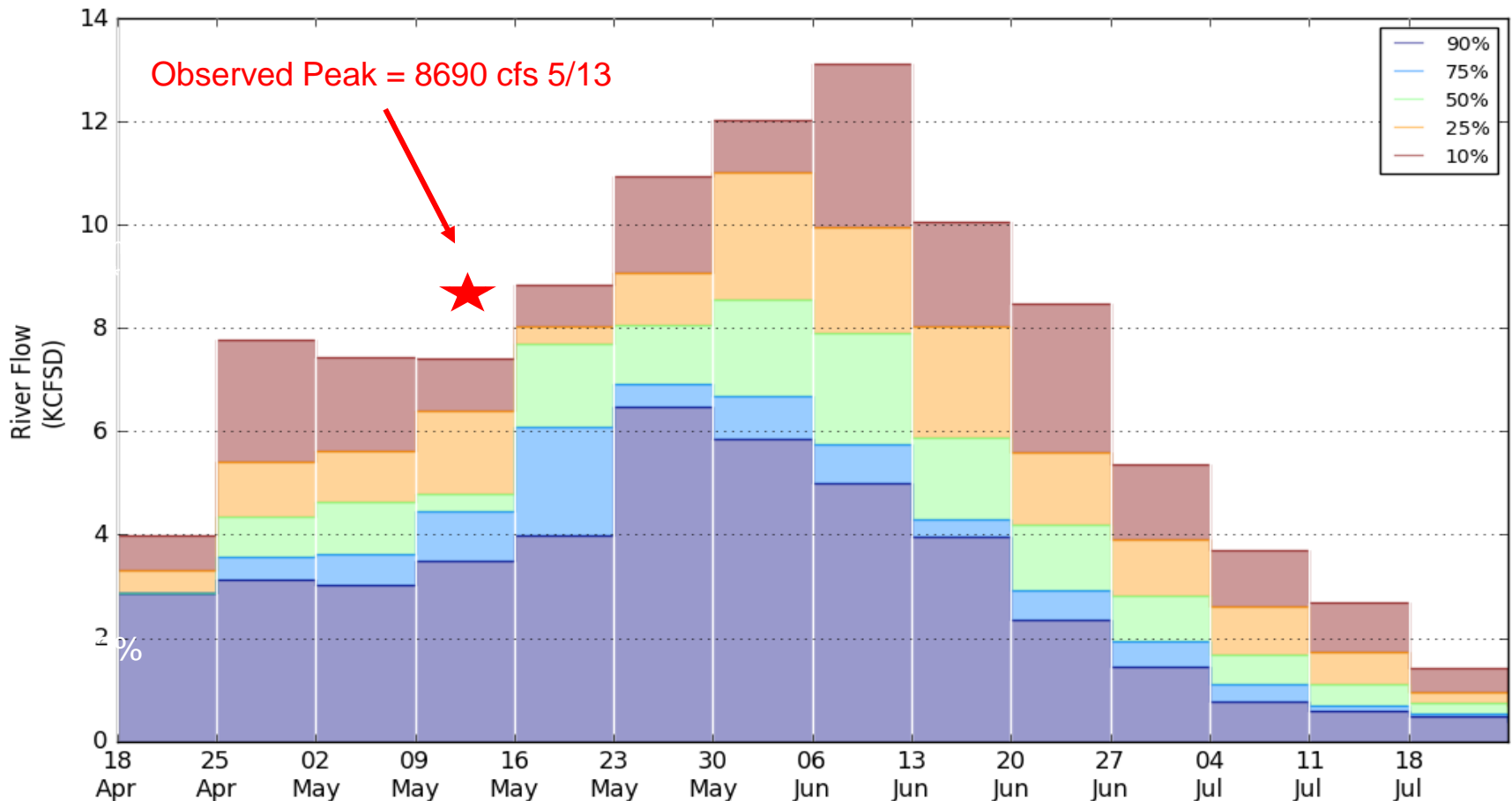
Peak Flow Forecast: Yampa River-Deerlodge

Peak flow probabilities to support Flaming Gorge spring release operations.
Early outlook graphic from mid April

Weekly exceedance probability histogram for Yampa River - Deerlodge

Chance of Exceeding River Levels for:
YDLC2L_F
Forecast Period: 2018-04-18 - 2018-07-31 Simulation date: 2018-04-18

Observed Peak = 8690 cfs 5/13

Peak Flow Forecast: Yampa River-Deerlodge

CBRFC 15 day Daily Forecast for Yampa River Peak May 2018

Forecasts correctly timed the peak that occurred the 13th of May. The forecasts did not forecast the magnitude well until about 5-6 days before the peak. Magnitude errors were due to changing temperature forecasts and a snow adjustment in the model.
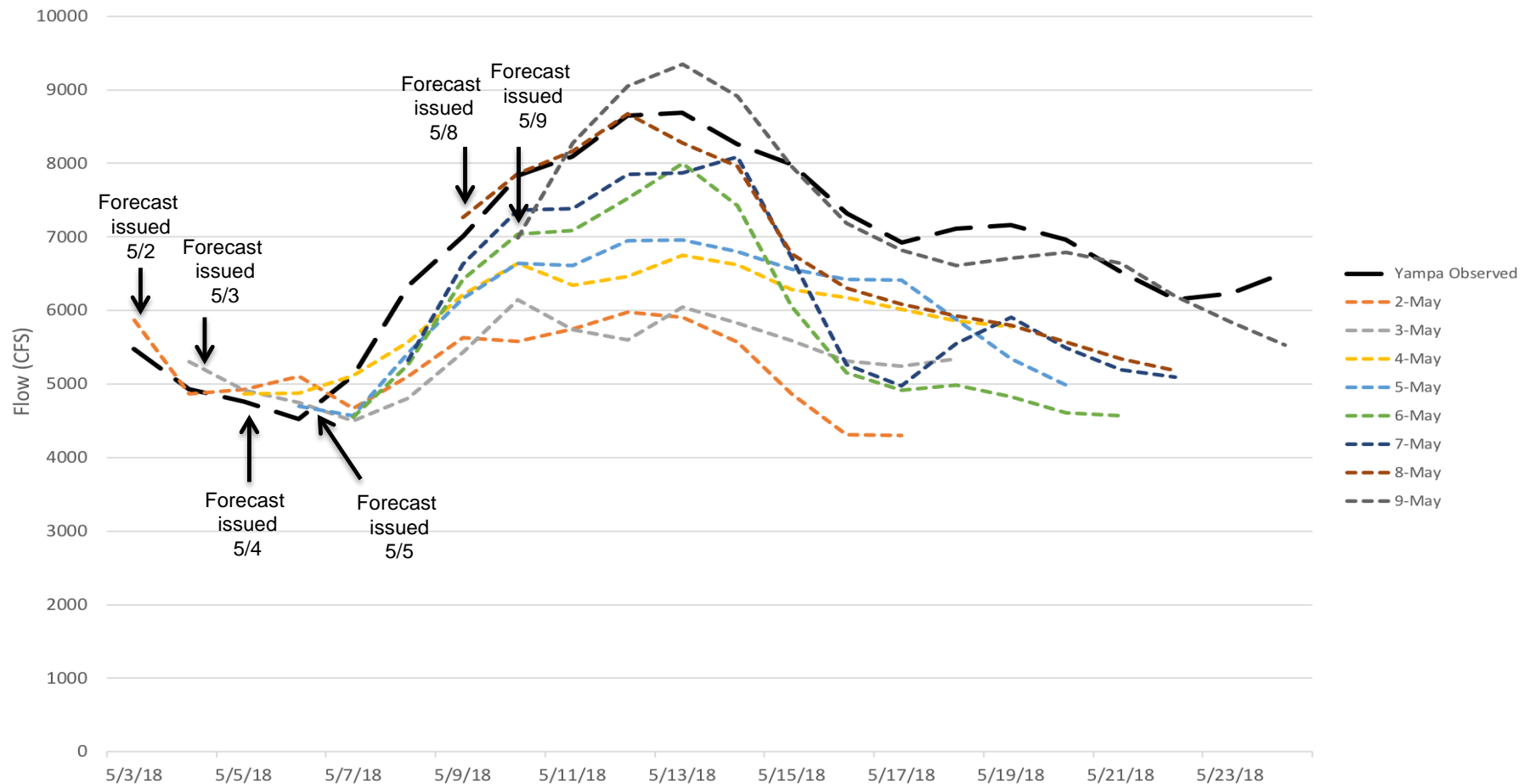
What are the forecast challenges for the Flaming Gorge Inflow?

Challenge #1: Knowledge of the future weather

Solution #1: More accurate medium to long range weather forecasts

Challenge #2*: Inadequate modeled streamflow resolution*

Solution #2: Add more model simulation points *(in progress)*

Greatest potential for improving FG forecast:
-Blacks Fork nr Lyman (new USGS gage)
-Muddy Creek nr Hampton (new USGS gage)
-Smith's Fork Creek at Mountain View (WYSEO)
*-Ham's Fork at Granger (WYSEO)*
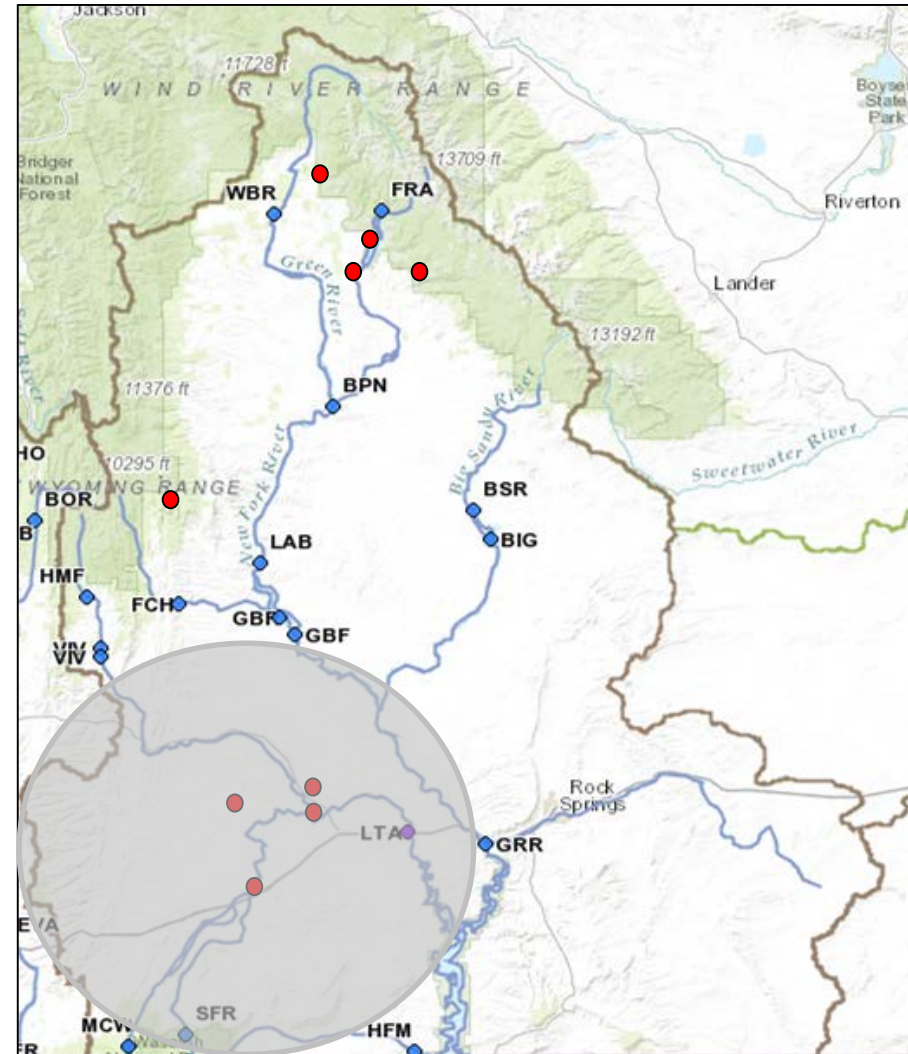
Map of existing model points (blue) and possible new model points (red)

What are the forecast challenges for the Flaming Gorge Inflow?

Challenge #3: Irrigation issues; model makes assumptions about irrigation uses

Solution #3: Incorporate new historical and real-time diversion data from WYSEO in the Flaming Gorge local to replace assumptions *(in progress).*

This area can impact the Flaming Gorge forecast significantly in wet springs. Model doesn't currently handle this area well.
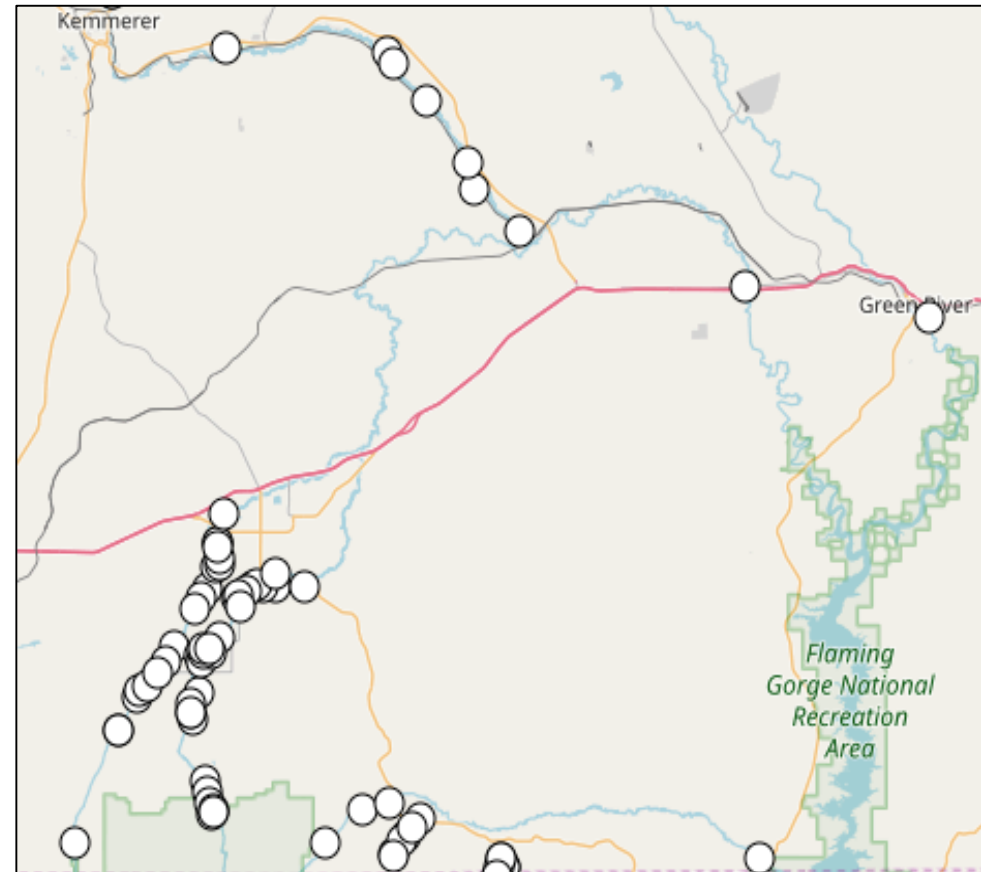
WYSEO diversion data locations on the Black's Fork and Hams Fork rivers.

What are the forecast challenges for the Flaming Gorge Inflow?

Challenge #4: Density of real-time SNOTELS; only 9 locations above Fontenelle that are all < 10,000 ft

Solution #4: Add new SNOTELS to fill spatial and elevational gaps. We propose filling spatial gaps first due to wilderness/access issues. Model does a decent job interpolating snow above 10,000 ft.

Challenge #5: Lack of precipitation data; data sparse and poor radar coverage

Solution #5: Add new precipitation gages to current stream gages (USGS/WYSEO)
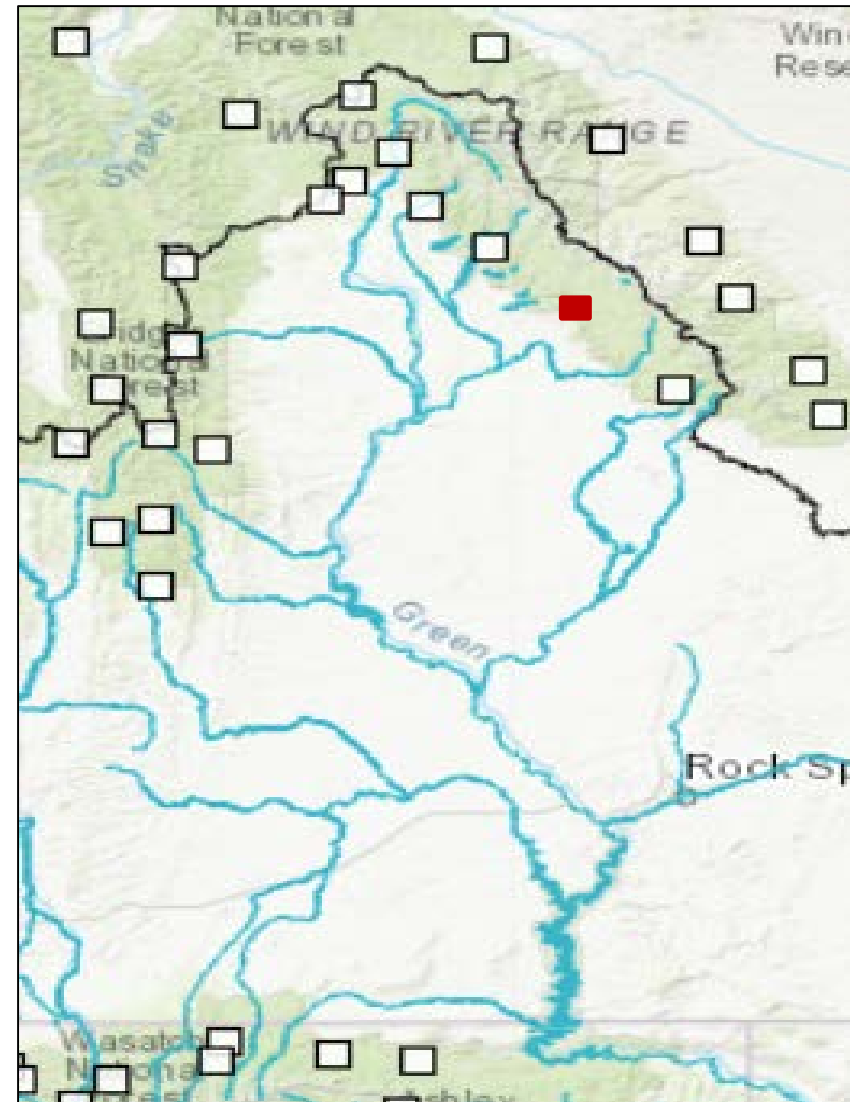
Map of existing SNOTEL and possible new location (red)

Summary

Flaming Gorge
- Above average (114%) April-July streamflow volume
- Forecast increase in mid-May due to precipitation event
- Forecasts performed well and had errors less than "average" error

Yampa River
- Below average (56%) April-July streamflow volume
- May forecast was slightly too high; April storm had a negative impact on snow rather than positive

Potential Forecast Improvements: Flaming Gorge
- Better weather forecasts
- Additional model/forecast points (CBRFC)
- Improve modeled irrigation assumptions by incorporating diversion data (CBRFC)
- More SNOTELS
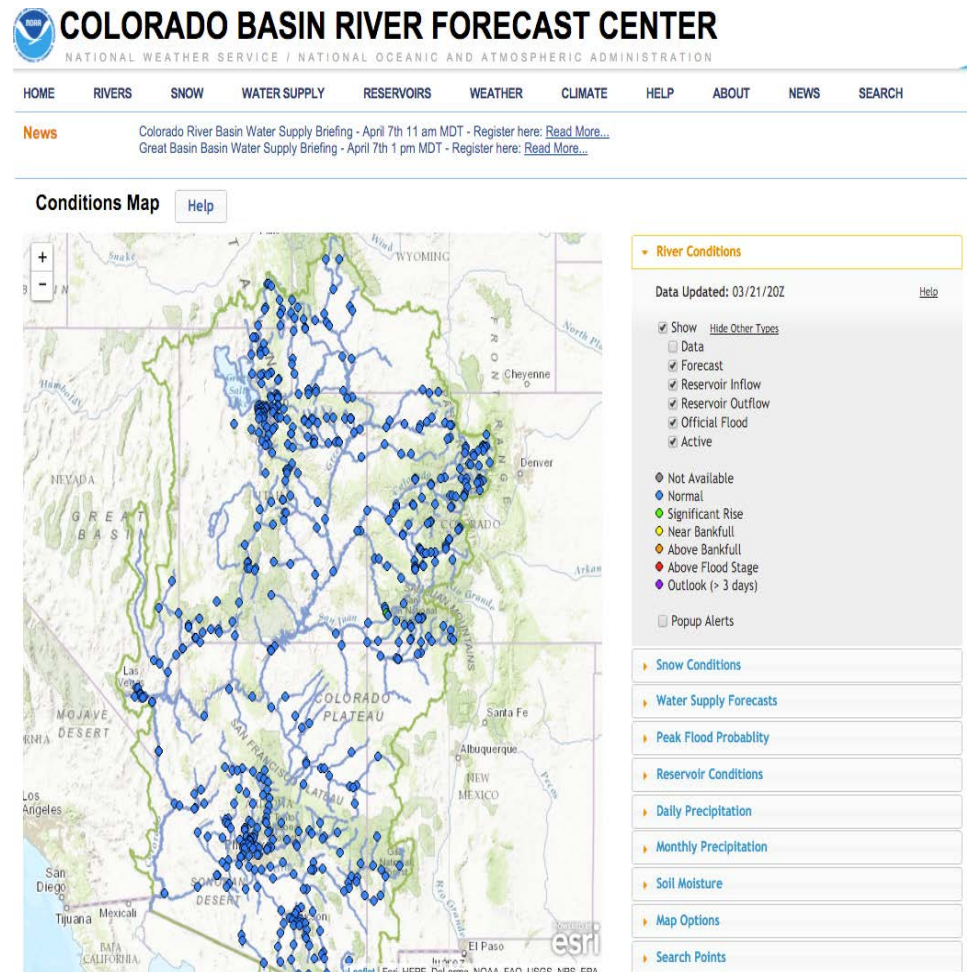- More precipitation gages

Upcoming CBRFC Activities
- Upper Colorado Stakeholder Engagement Meeting (October 25th)
- 2018 Year in Review/Verification Webinar (late Fall)
- 2019 Early Outlook Webinar (December)
- Peak Flow Forecast changes for next year

Questions?

Contact Information

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