Green and Yampa Rivers: Current Conditions and Forecasts

April 19, 2018
Flaming Gorge Working Group Meeting

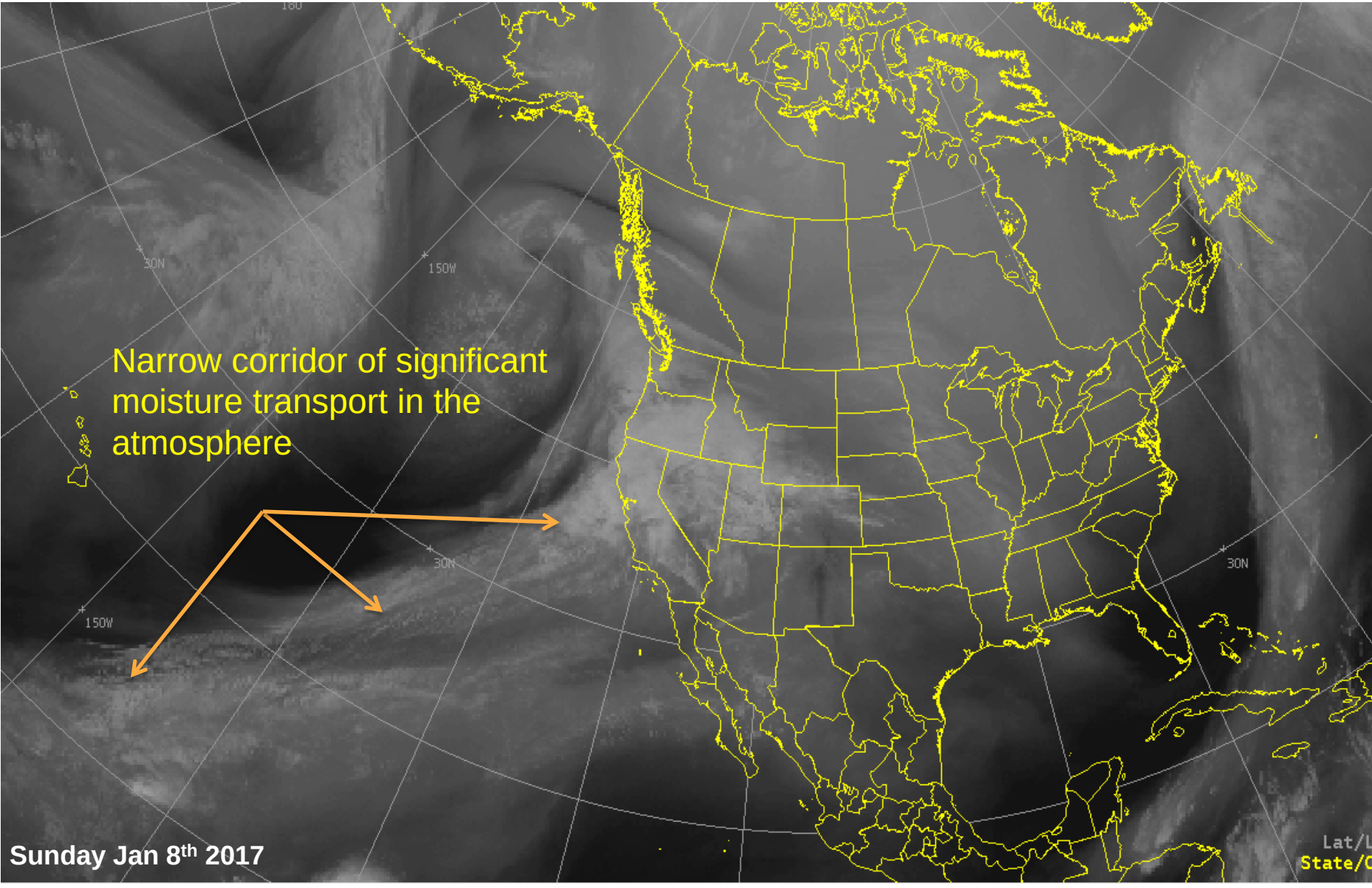
Ashley Nielson-Senior Hydrologist
Colorado Basin River Forecast Center
National Weather Service/NOAA

Today's Presentation

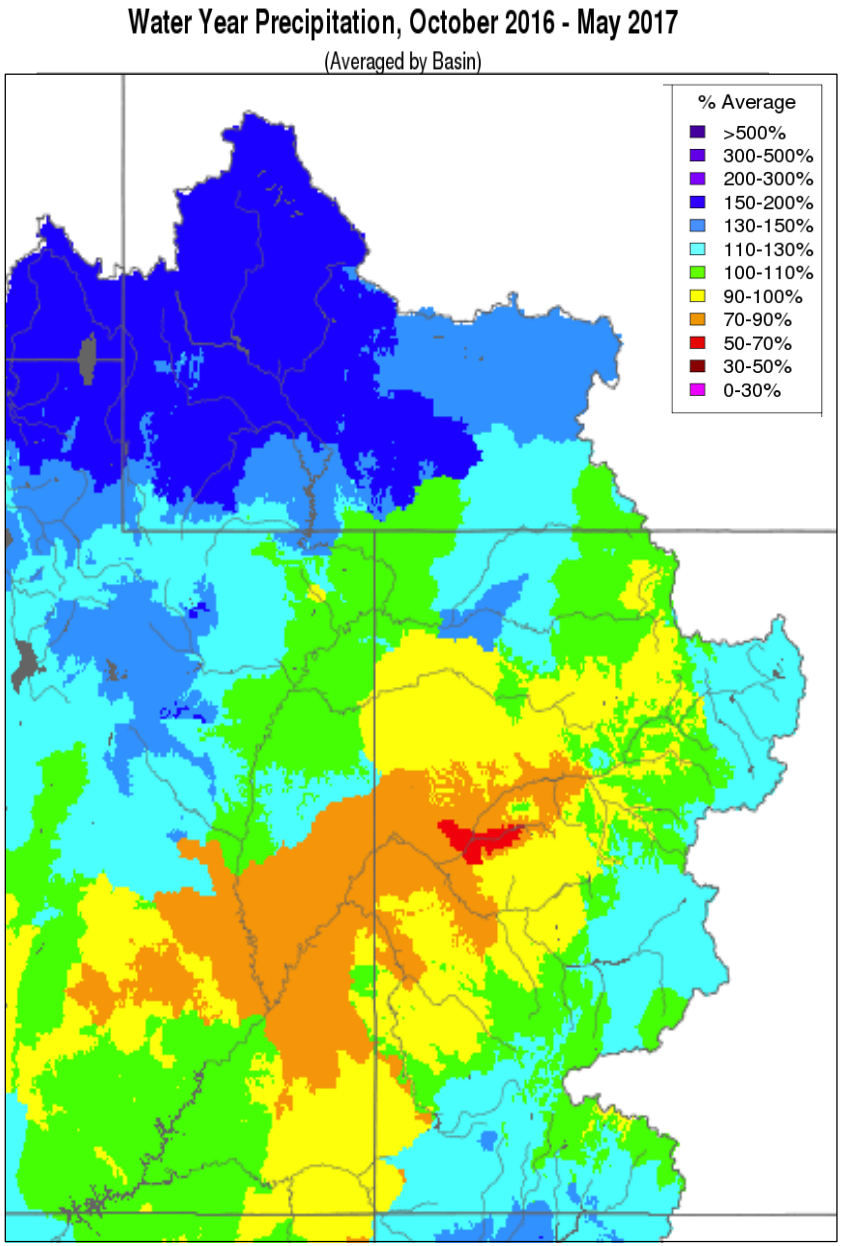
- Quick Review of 2017 Water Year
  - -Hydrology
  - -Forecasts
- 2018 Weather Review: Impacts to water supply conditions
  - -Precipitation
  - -Temperature
- Snowpack Evolution
- April 2018 Forecasts Overview
  - April-July Water Supply Volumes
    - -Flaming Gorge Reservoir
    - -Yampa River
  - Peak Flow Forecasts
    - -Yampa River
- Upcoming Weather

2017 Water Year Review

Mid December through February: “Atmospheric Rivers”



2017 Precipitation



Basin Mean Precipitation as a % of Average		
	Upper Green	Yampa River
Oct-May Total	150	100
October	195	70
November	65	70
December	225	140
January	205	190
February	228	95
March	145	40
April	120	110
May	55	95

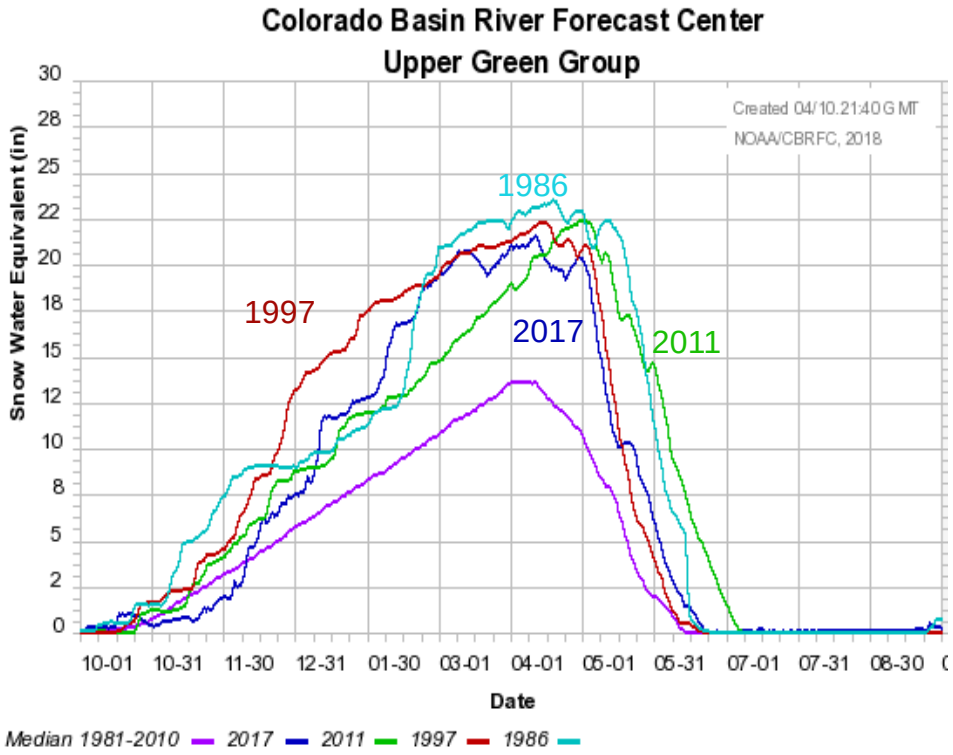
Upper Green

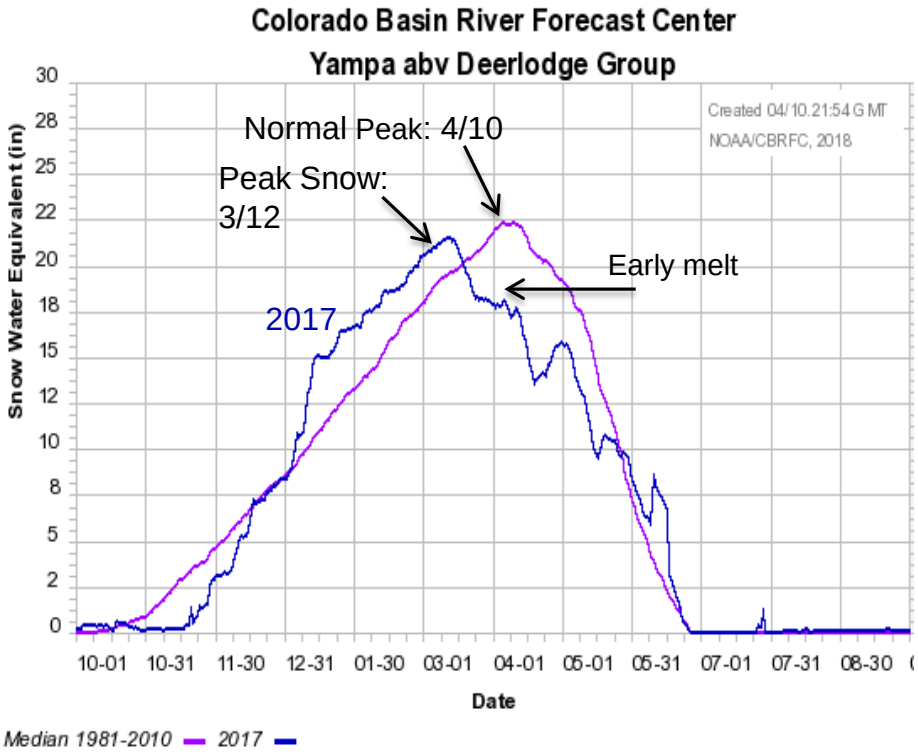
Record December-February precipitation was a game changer for water supply.

Yampa River

A dry and warm March had a significant negative impact to water supply.

2017 Snow Conditions



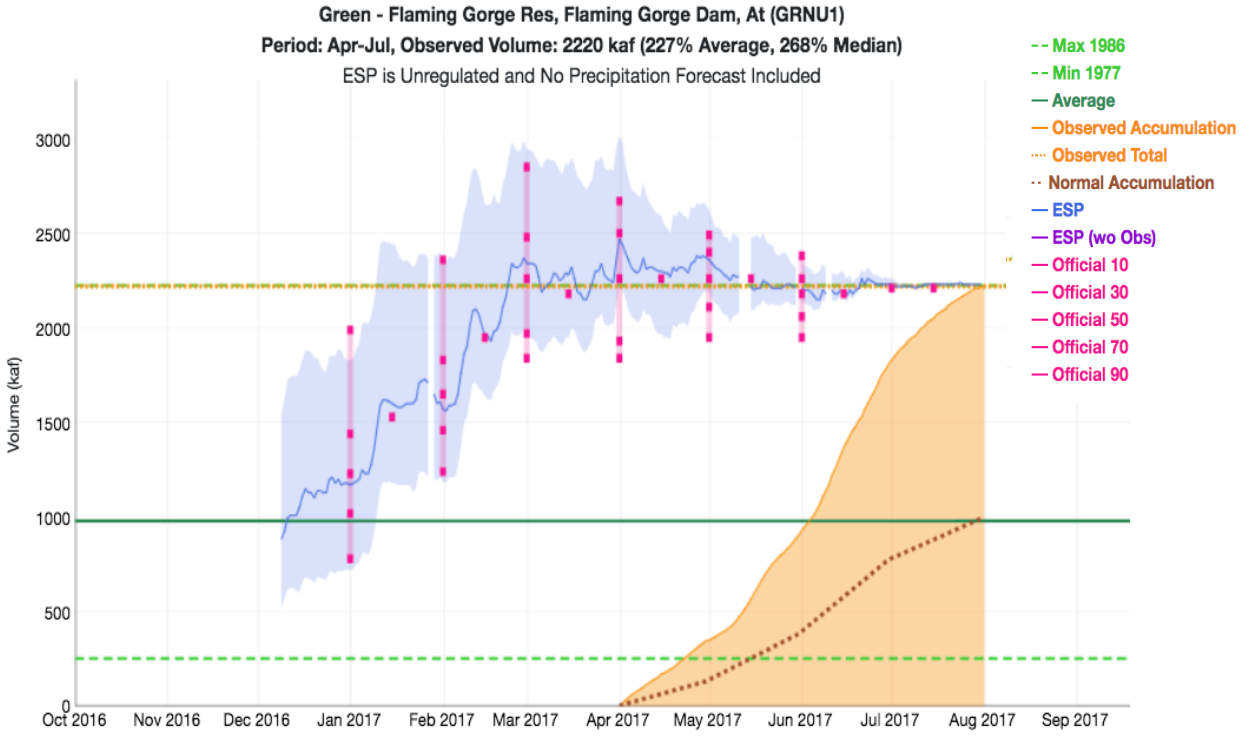


Significant snow accumulation December-March.

Peak snow was 4th highest on record (~35-40 years).

Snowed peaked earlier than normal. March weather resulted in early melt.

2017 Water Supply Forecasts: Flaming Gorge Inflow



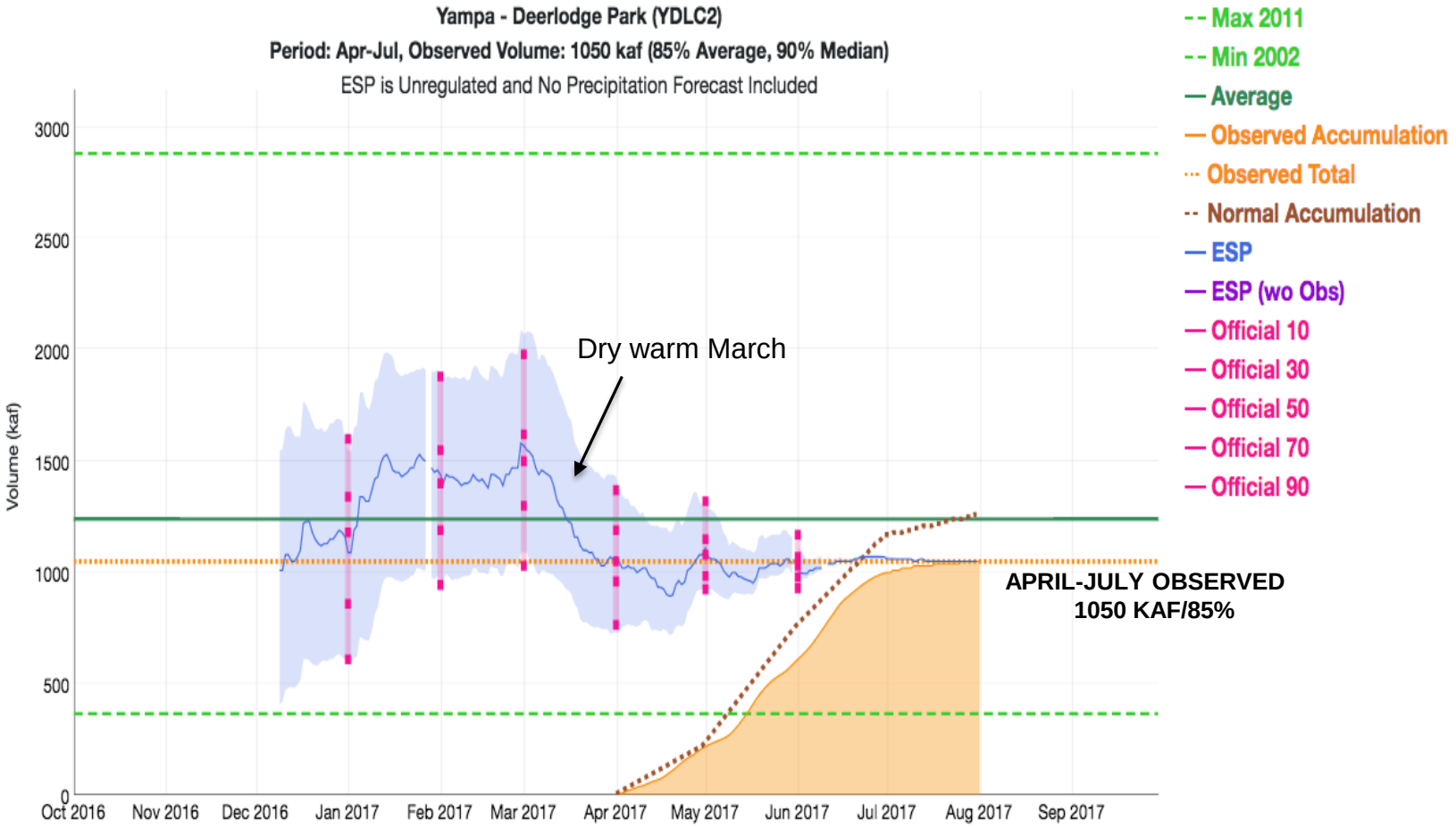
	Forecast (KAF)	% of Average	Percent Average Change
Jan 1	1230	126%	
Jan 15	1530	156%	+30%
Feb 1	1650	168%	+12%
Feb 15	1950	199%	+31%
Mar	2260	231%	+32%
Mar 15	2180	222%	-9%
Apr	2260	231%	+9%
Apr 15	2260	231%	0
May 1	2260	231%	0
May 15	2260	231%	0

Observed Apr-Jul Total: 2214 KAF (226%)
2nd Highest on record. 1986 = 2224 KAF

Key Points:

- Little change to forecast after March 1st
- Always uncertainty in spring weather and model states
- Spring weather was not extreme and the model represented snow/soil conditions accurately which resulted in lower than average forecast error.

2017 Water Supply Forecasts: Yampa River-Deerlodge

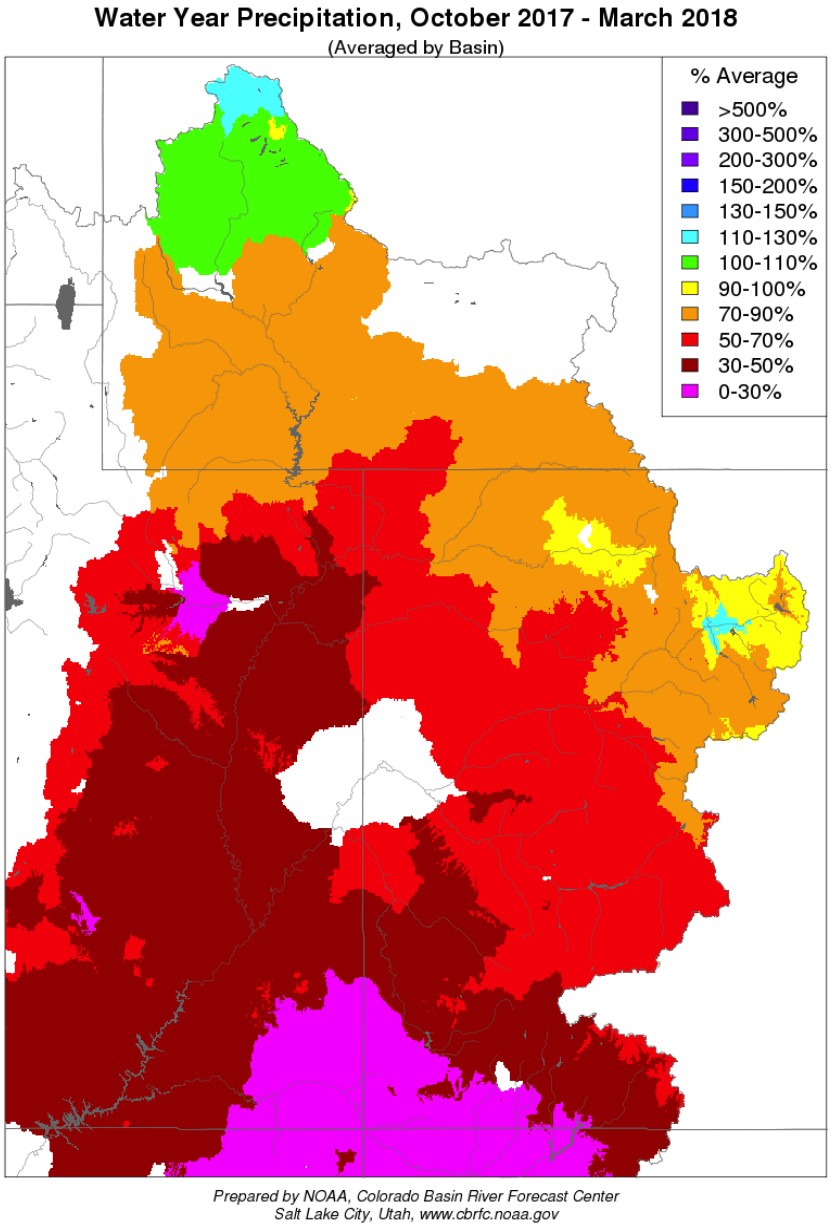


Key Points:

- Above normal snowpack early winter
- Near to above average forecasts January-March
- Warm dry March resulted in large decreases in forecasts

2018 Current Conditions and Water Supply Forecasts

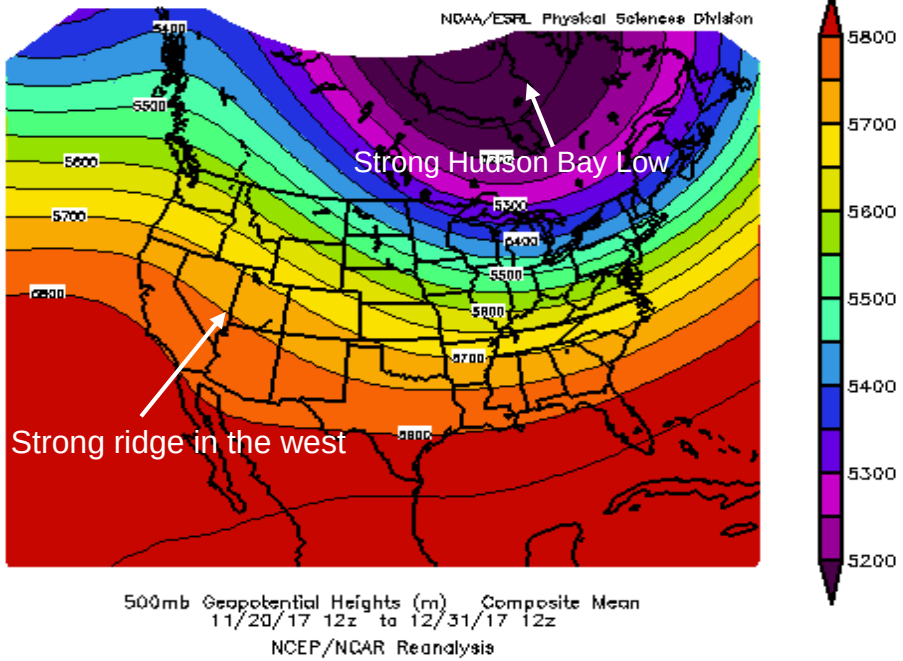
2018 Water Year and Monthly Precipitation



Basin Mean Precipitation as a % of Average		
	Upper Green	Yampa River
Water Year	90	80
October	35	85
November	130	65
December	90	55
January	85	75
February	95	105
March	110	85

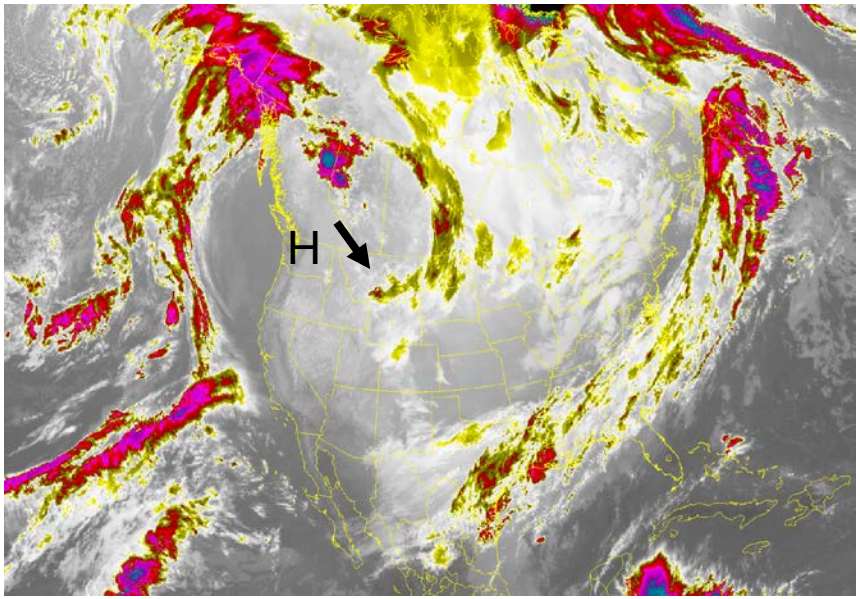
Fall/Early Winter Weather Pattern

Mean Atmospheric Pattern
Mid Nov –through December



Very dry pattern becomes established

December 7th 2017

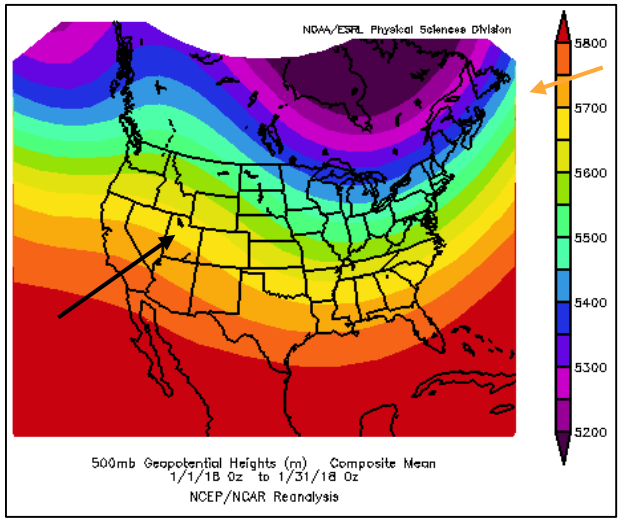


Storm system moving around the periphery of the high pressure ridge

January/February Weather Pattern

Mean Atmospheric Pattern

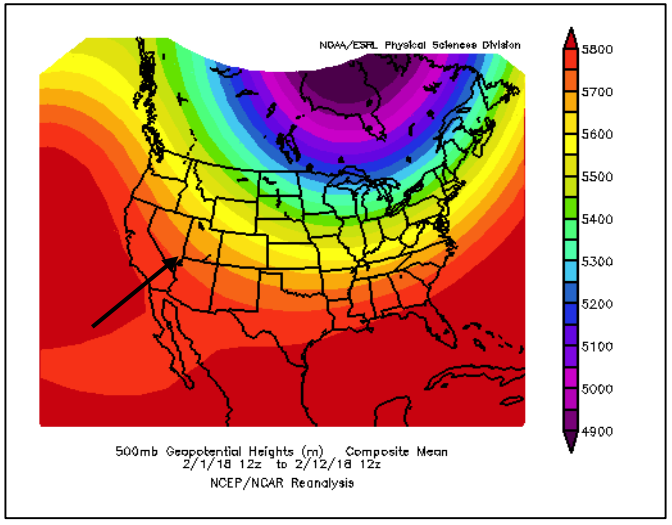
January:
Strong high pressure over the West.



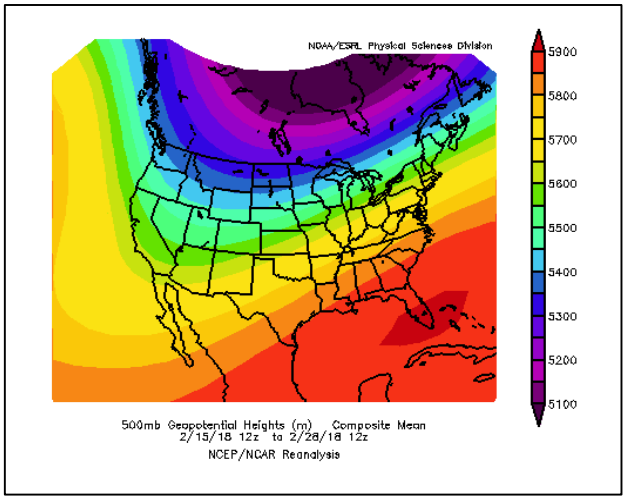
Green River above Fontenelle benefited from storms moving around the ridge and when the pattern changed in mid-February.

Yampa River and other areas of the Upper Green remained dry until the pattern change in February.

First Half of February:
Strong high pressure over the West.

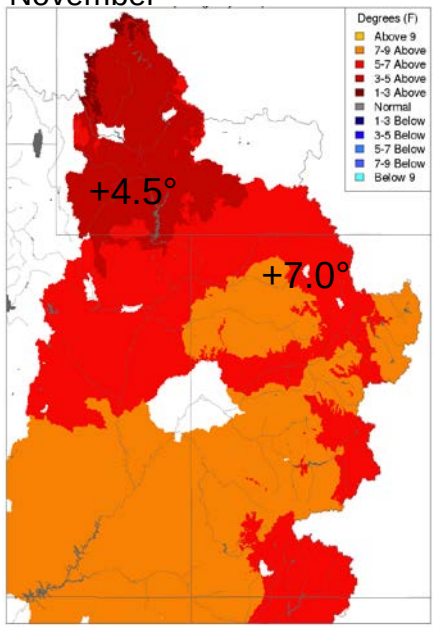


Second Half of February:
Ridge broke down; increase in storm activity.

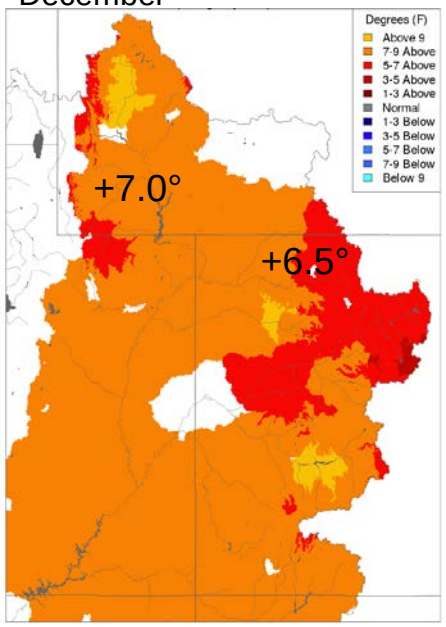


Weather Review: Temperatures - Mean Monthly Maximum Deviation

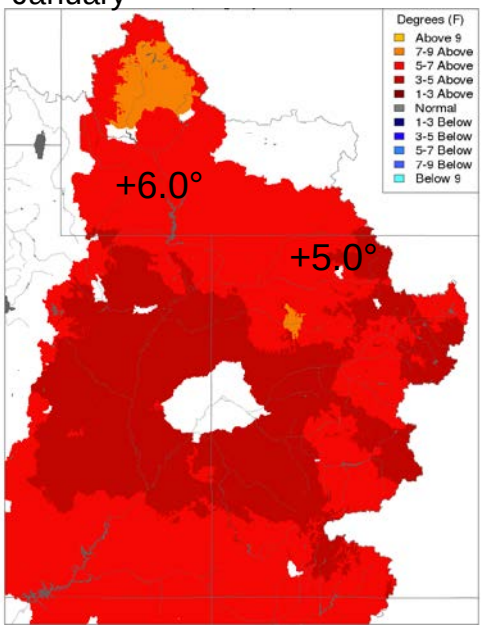
November



December

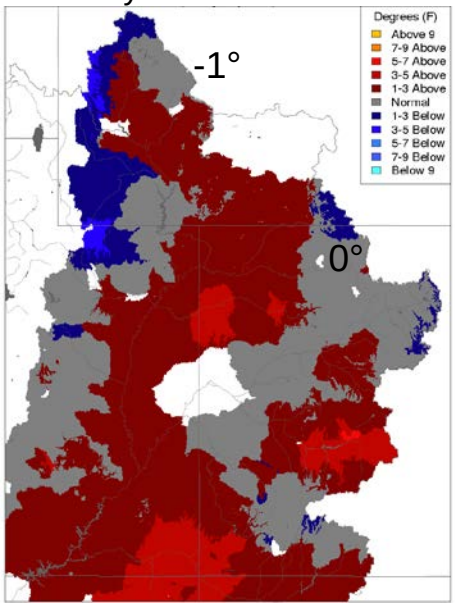


January

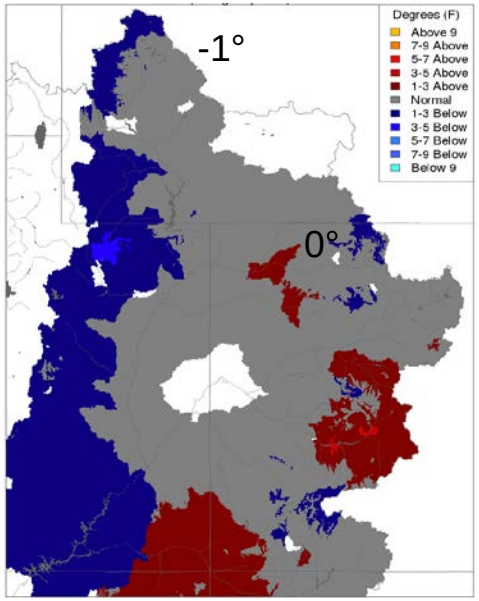


Above normal temperatures November-January

February



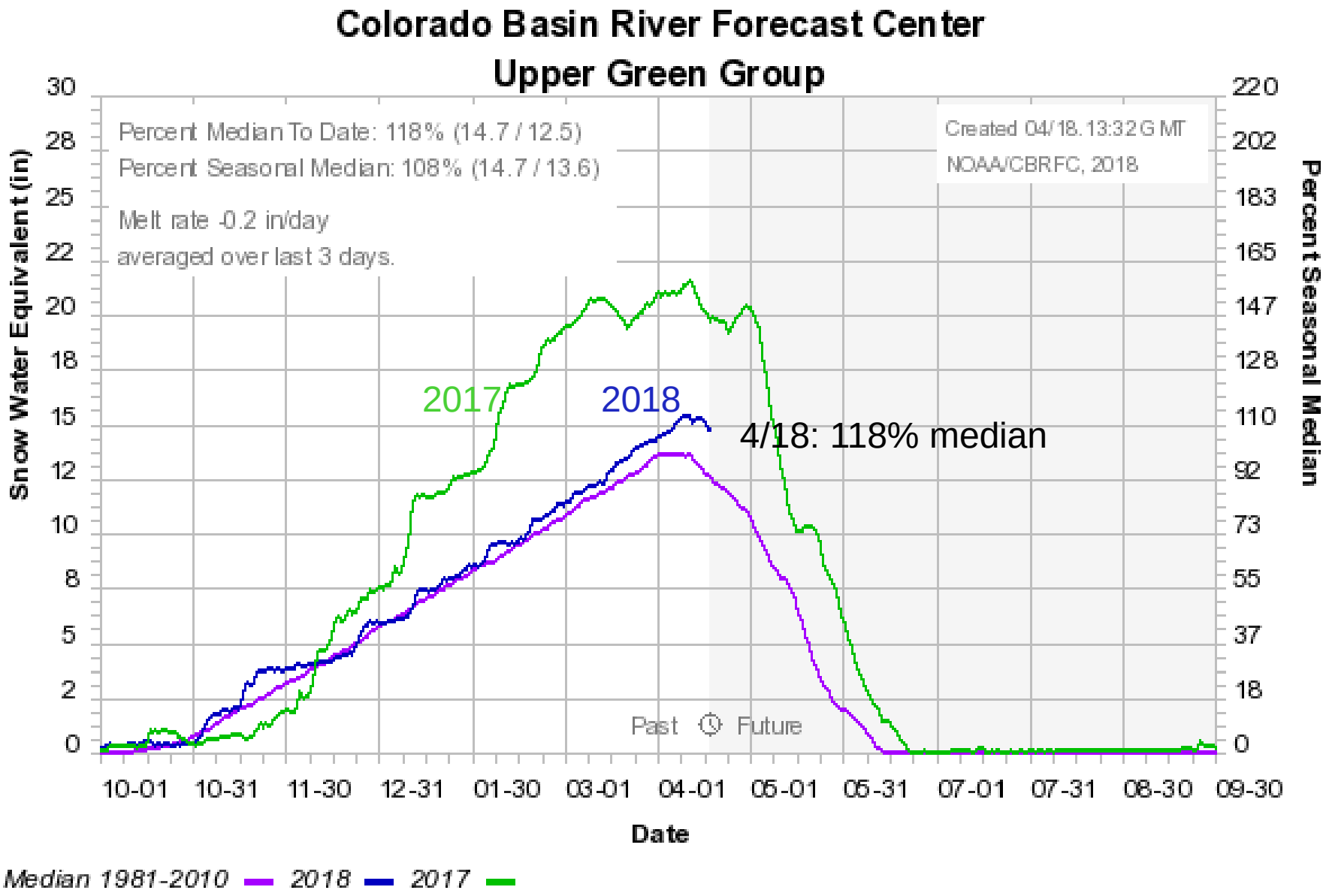
March



Near normal to slightly below normal temperatures in February-March.

No significant snowmelt in March like some previous years.

Snowpack Conditions: SNOTEL Snow Water Equivalent (1981-2010 % of median)



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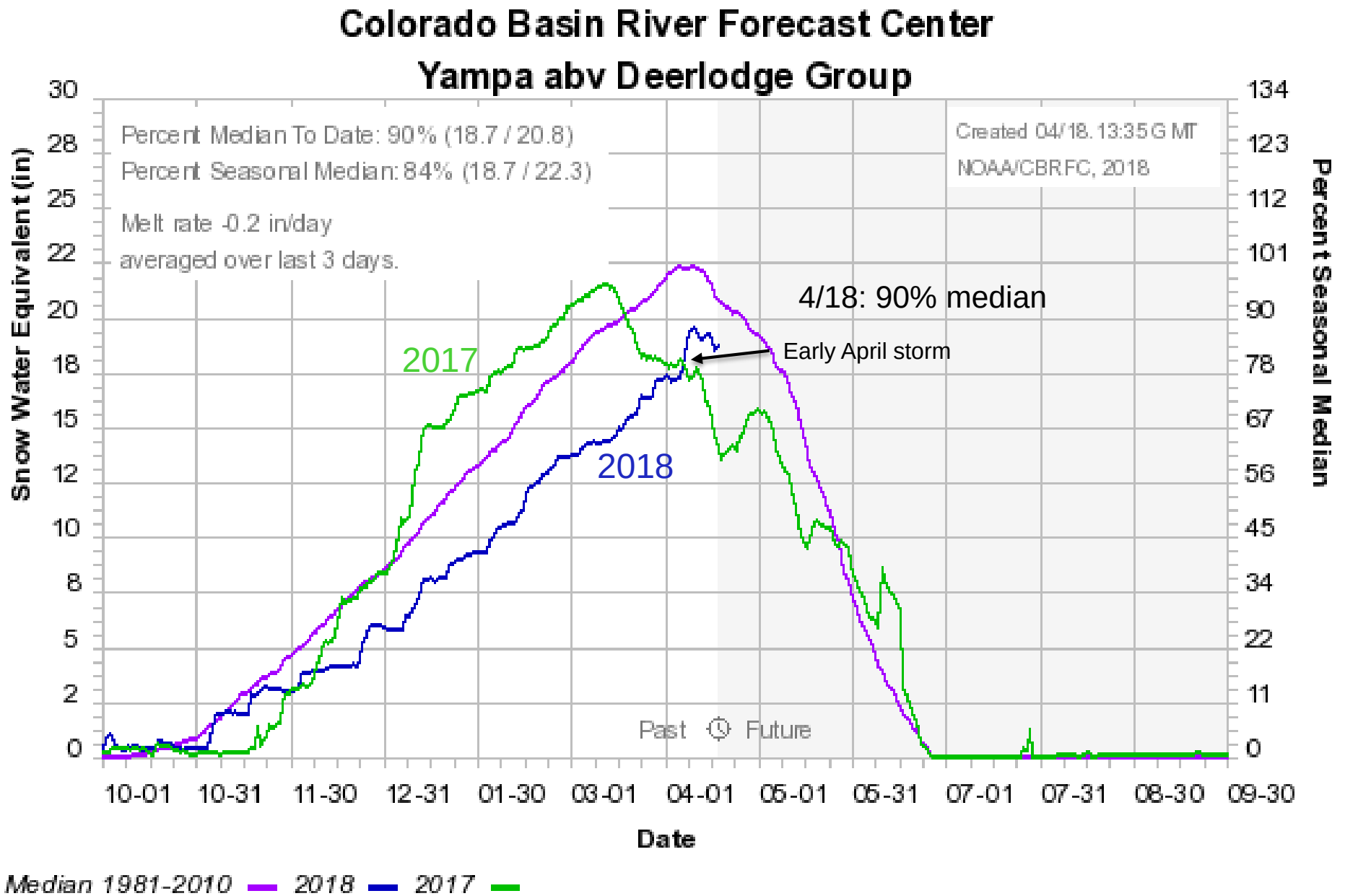
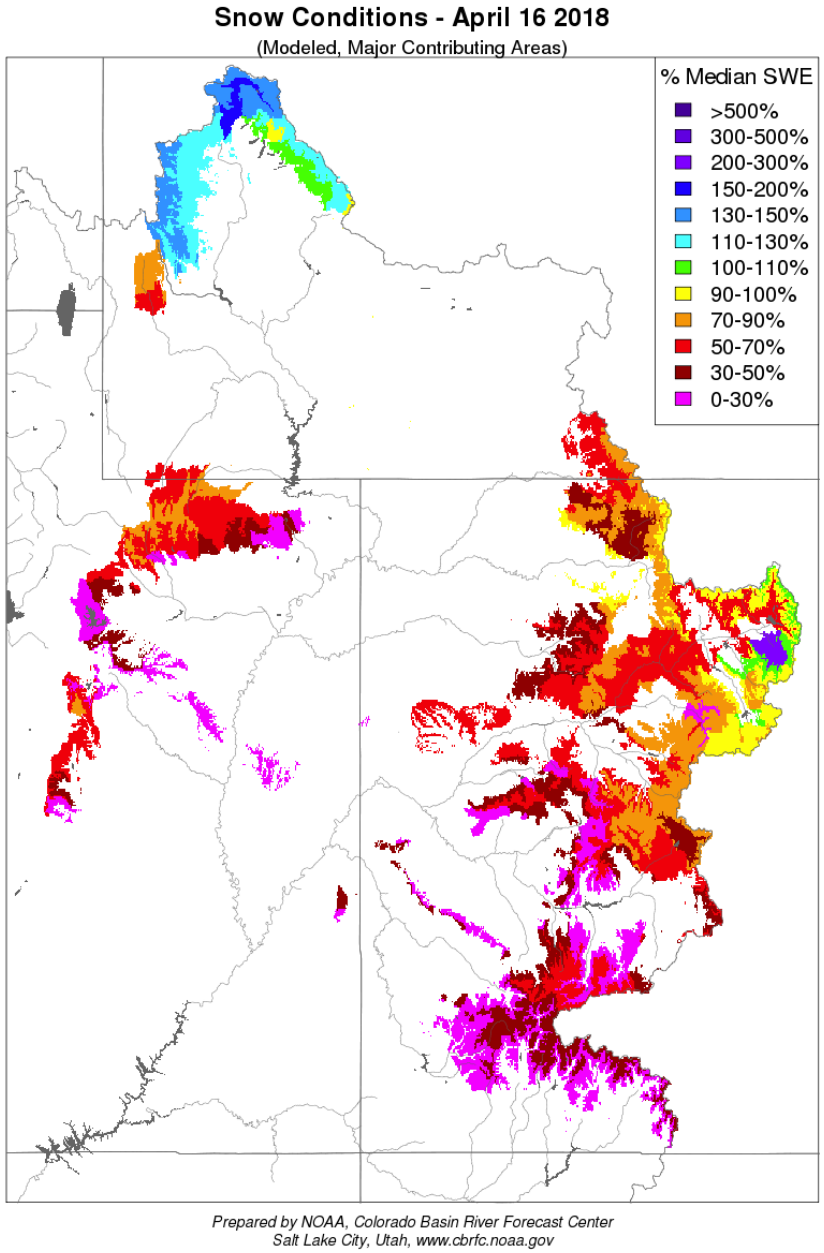


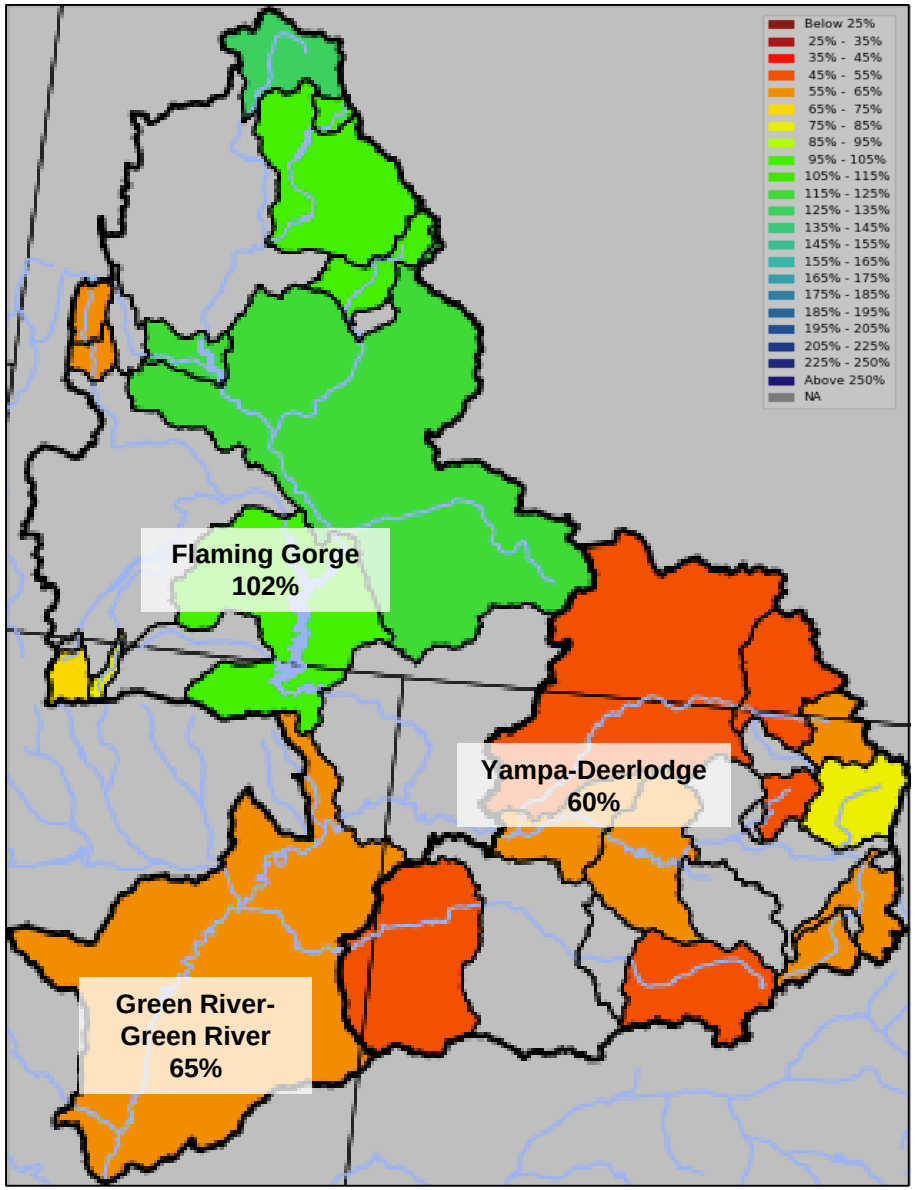
Snowpack Conditions: CBRFC Model



April 1st Water Supply Forecasts

Water Supply Forecasts: April – July Volumes

Most Probable Scenario (% of 1981-2010 average)



- CBRFC model makes assumptions about long range future weather
- Official forecasts provide a range of possible outcomes based on "dry", "average", and "wet" weather scenarios
- "Average" scenario is most commonly used forecast (50% exceedance probability)

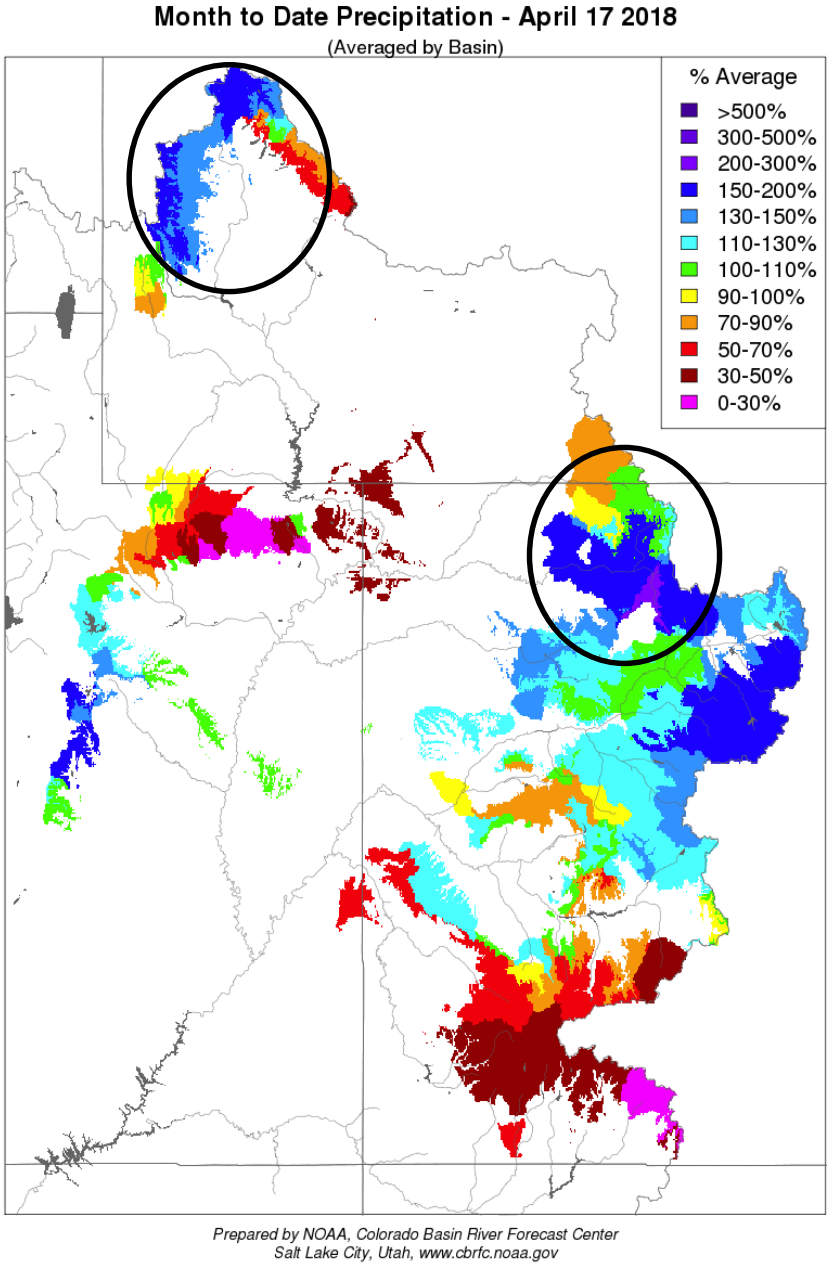
April 1st Flaming Gorge Forecasts:

Dry	→	790 KAF (79% average)
Average	→	1000 KAF (102% average)
Wet	→	1300 KAF (130% average)

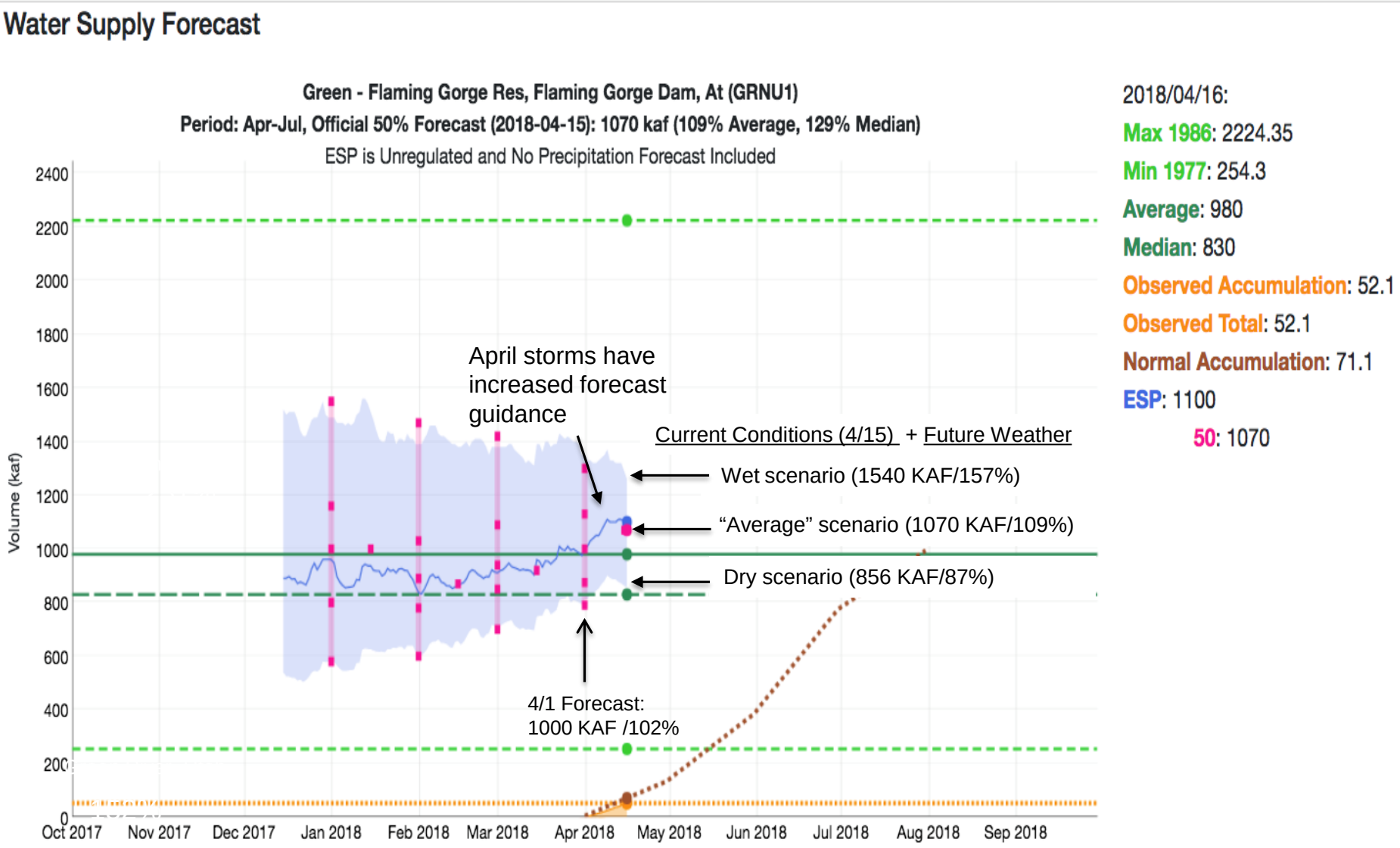
April 1st Yampa River Forecasts:

Dry	→	490 KAF (40% average)
Average	→	750 KAF (60% average)
Wet	→	1060 KAF (85% average)

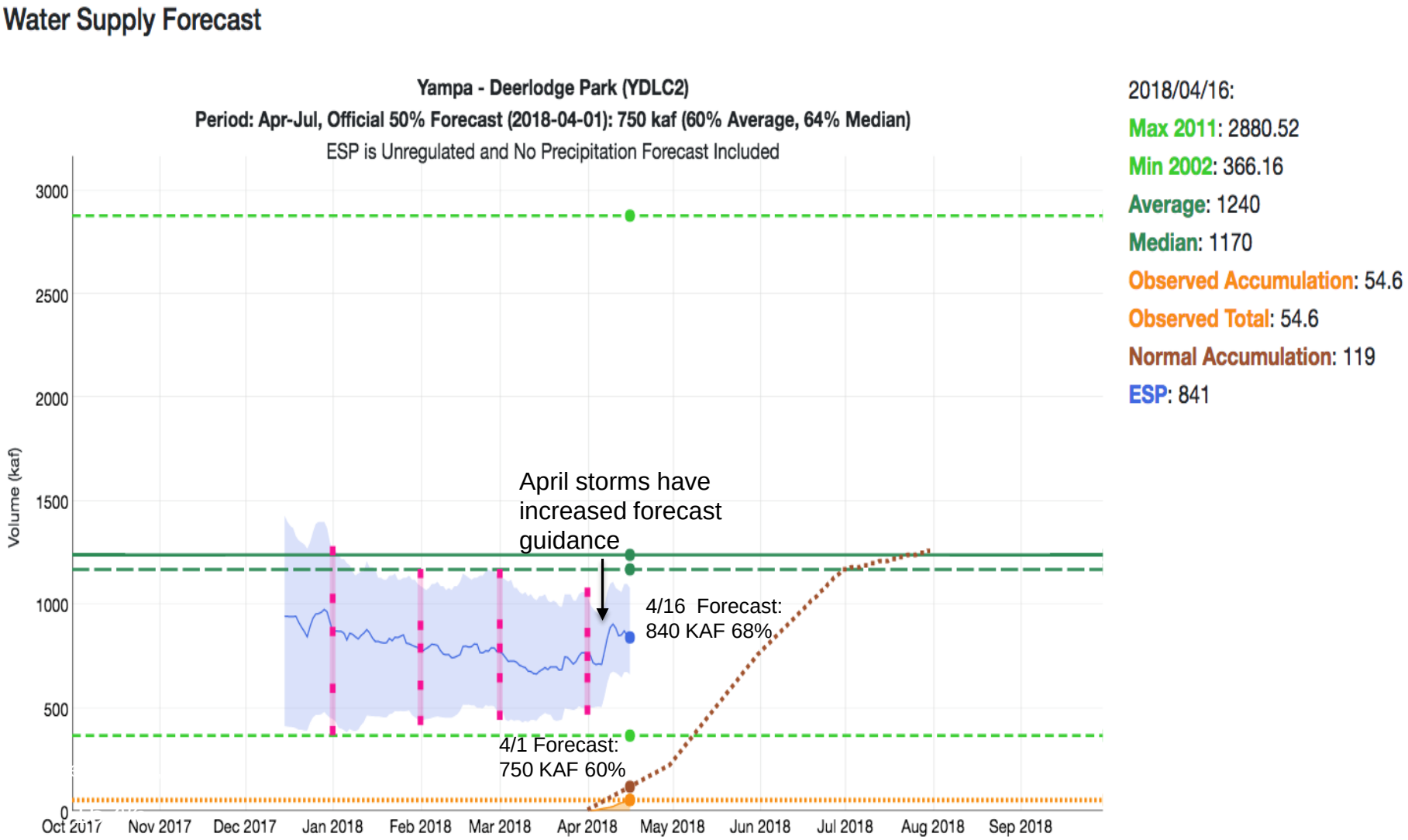
April Precipitation (Days 1-17)



Forecast Evolution Plot: Flaming Gorge Inflow



Forecast Evolution Plot: Yampa River-Deerlodge



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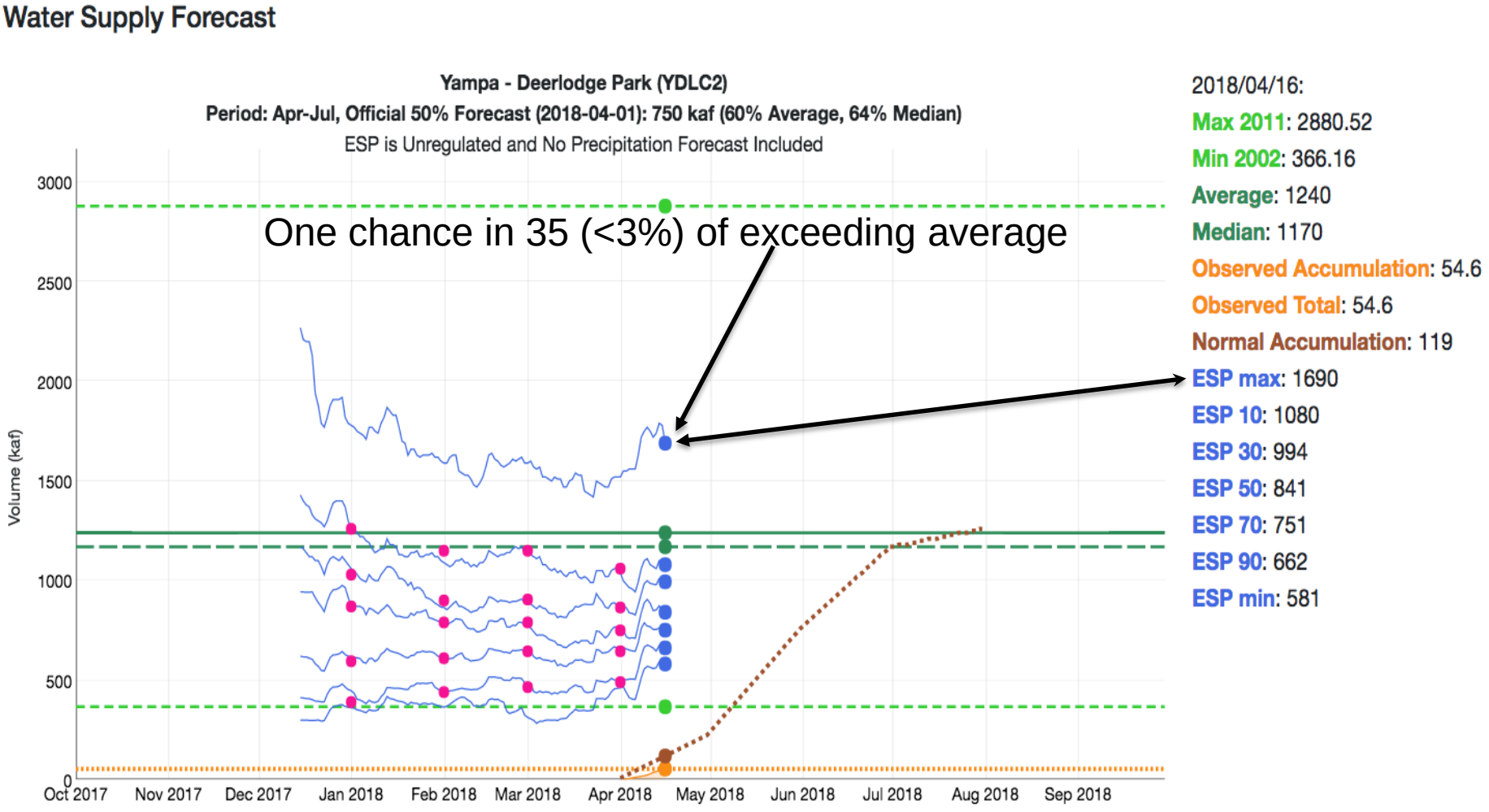
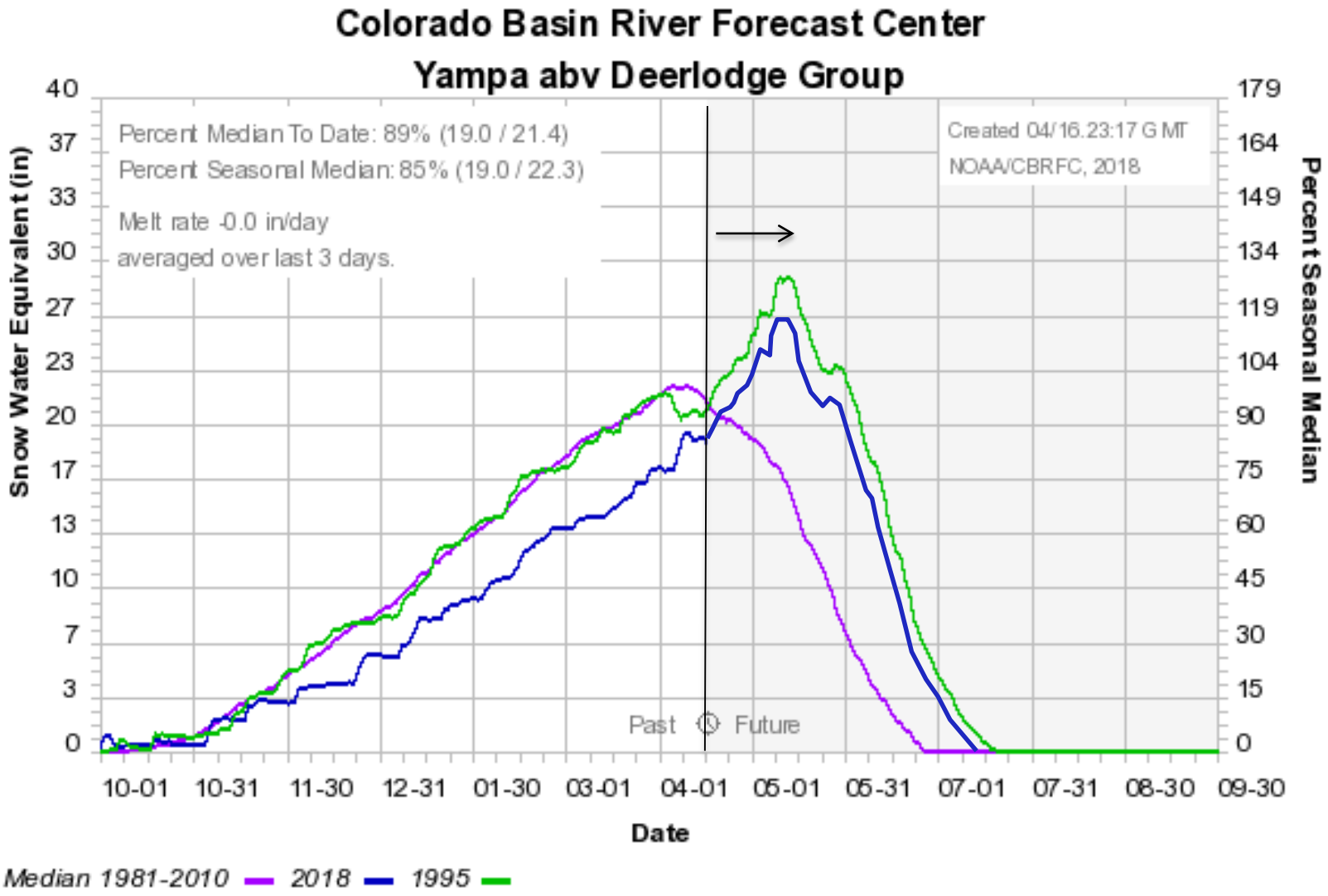


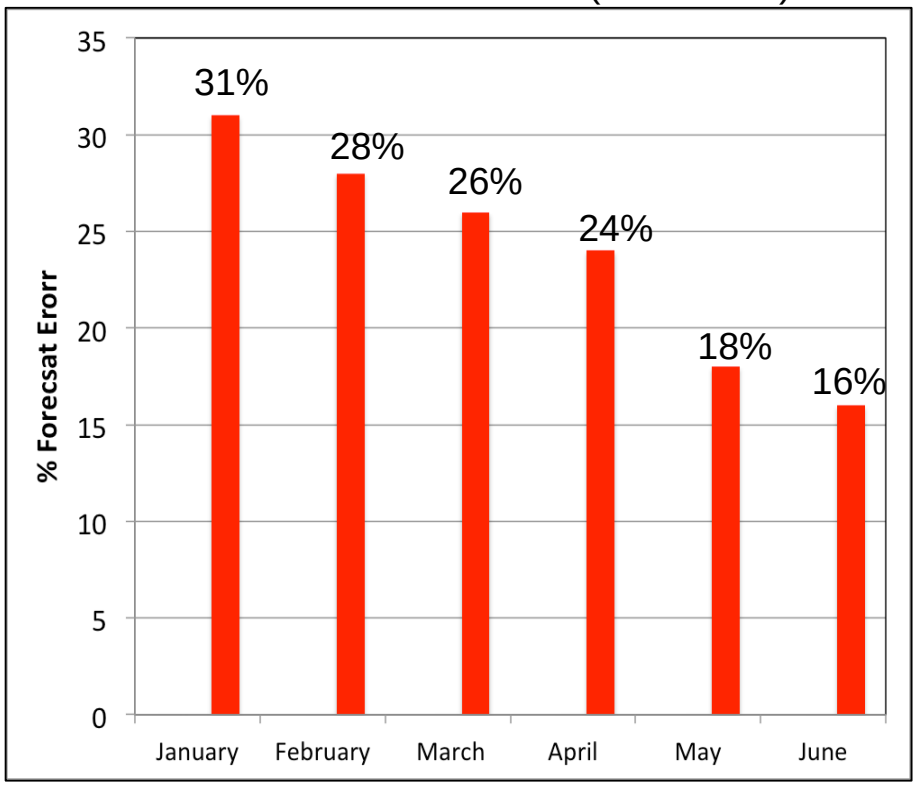
Model is calibrated on 35 years of data 1981-2015. If we treat all of those years as having an equal chance of occurring from this point forward – only one (1995) results in April-July runoff near above average.

What happened in 1995.....



How good are the April-July volume forecasts?

Flaming Gorge Average Historical Model Error
50% Exceedance Forecast (1981-2010)



- Higher forecast error early in the season
- Error decreases through out the season
- Largest errors were under-forecasts

January 1st Forecast:

What we know:

- ~40% of snowpack accumulation
- Fall soil moisture conditions

What we **DON'T** know:

- Jan-June weather (6 months)
- ~60% of snowpack accumulation

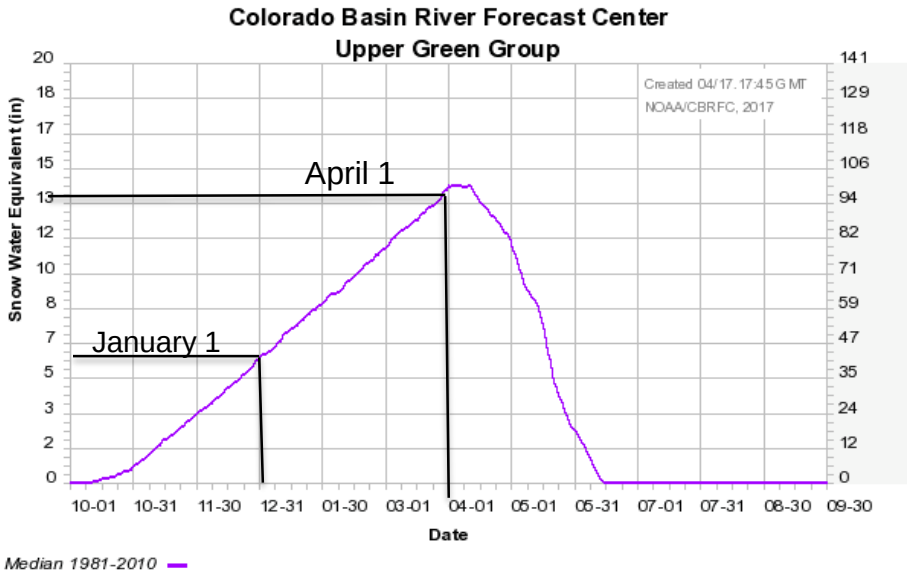
April 1st Forecast:

What we **KNOW**:

- ~98% of snowpack accumulation
- Dec-March weather

What we don't know:

- April-June weather (3 months)
- Snowmelt pattern



Primary sources of error from this point forward?

Future Weather

- Uncertainty in temperature and precipitation forecasts
- Extreme events (record wet/record dry) are rarely forecast

Model Snow States

- Is the model's representation (amount and extent) of the snowpack correct?

- Satellite images used to verify model snow extent.
  - Subject to cloud cover and not always available.

- SNOTEL's are utilized to verify snow amount / extent
  - SNOTEL's melt out prior to high elevation snow melting out completely.
  - How representative are these of surrounding area snow during melt?

Demands/Diversions Assumptions

- Model makes assumptions about future diversions/demands
- May be more or less than assumptions depending spring weather

2018 Peak Flow Outlooks

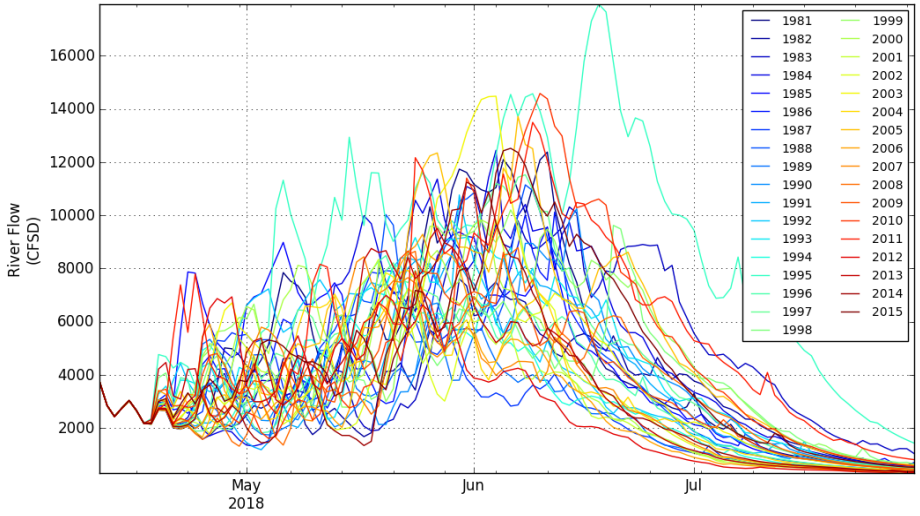
Long Range – Mean Daily Peak Flow at Yampa River-Deerlodge

Exceedance Probability	Mean Daily Peak CFS	# of Days > 10,000 CFS
90%	7,500	0
75%	8,500	0
50%	9,500	0
25%	11,000	5
10%	14,000	12

Most Likely Time Period 5/23-6/12
Average Peak : 13,000 CFS
Last Year: 10,700 CFS

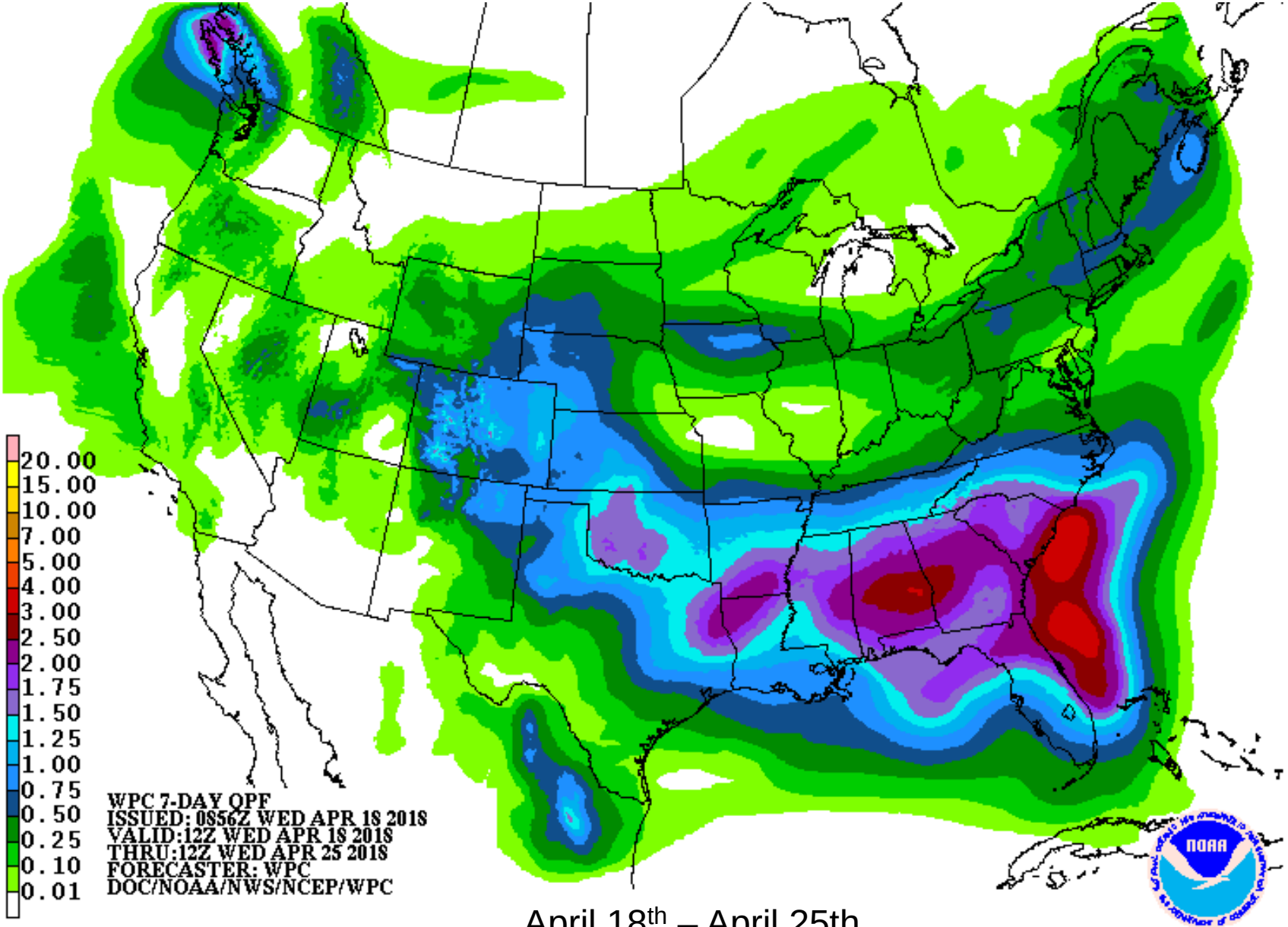
Peaks are highly dependent on Spring weather. Many possible hydrographs.

Current snow/soil/streamflow conditions
+
35 future weather scenarios



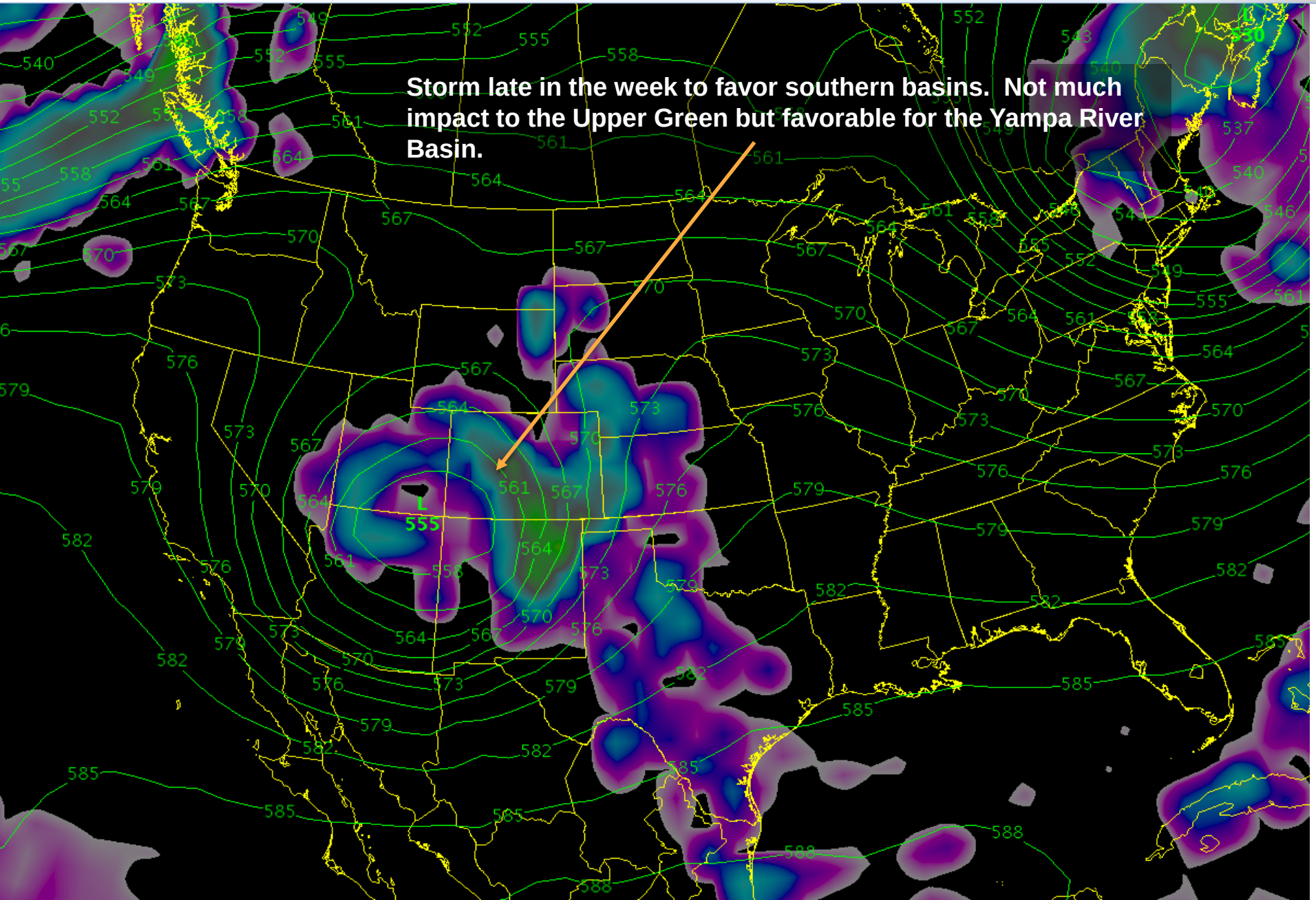
Upcoming Weather

Future weather impacts to water supply outlook – 7 day precipitation forecast

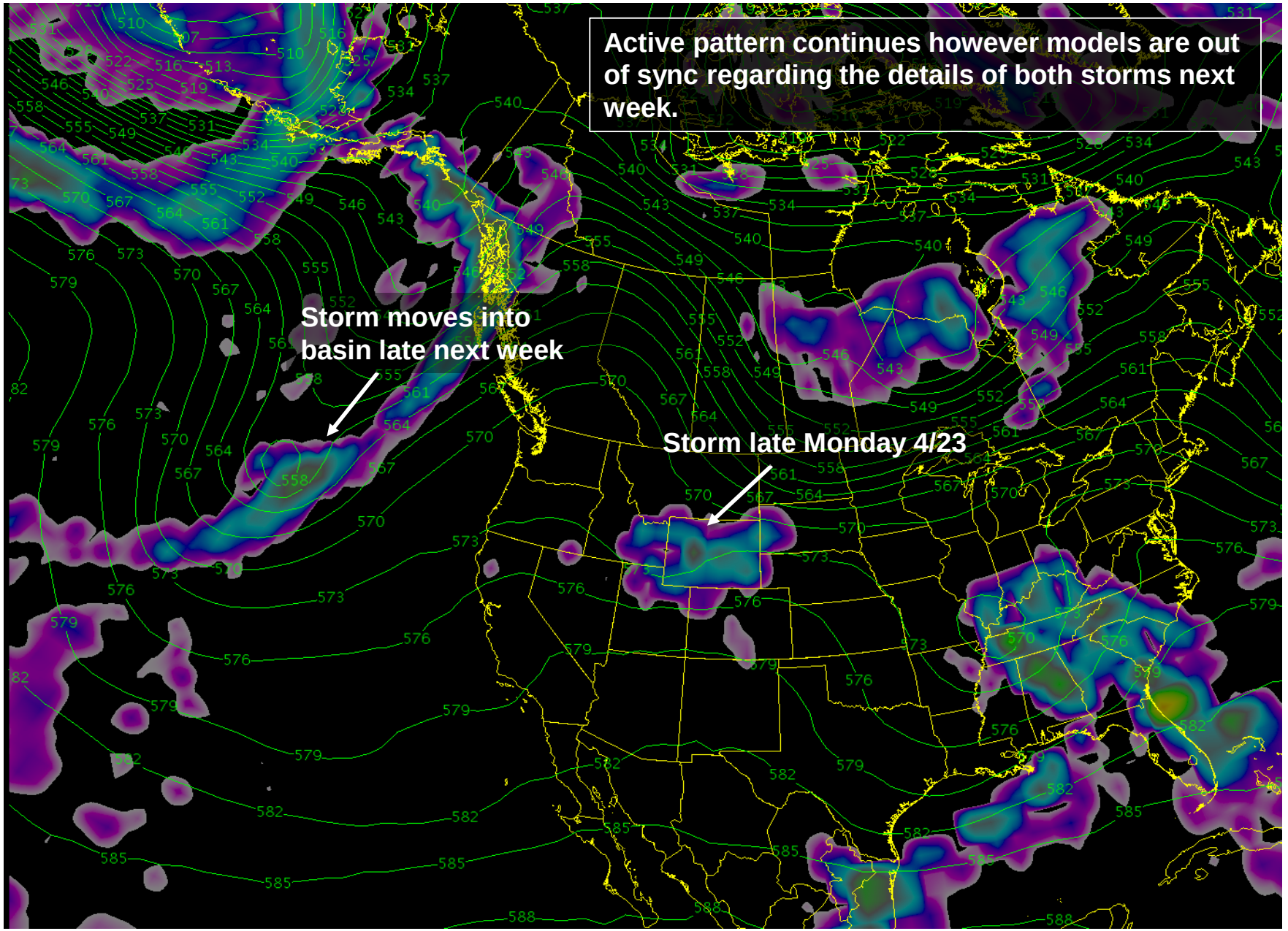


April 18th – April 25th

Future weather impacts to water supply outlook – Friday April 20th 2018



Future weather impacts to water supply outlook – Week of April 22th-29th



Key Points

Weather:

Pattern remains active. Periods of warm and cold; typical spring pattern. Some additional high elevation snow accumulations will most likely occur.

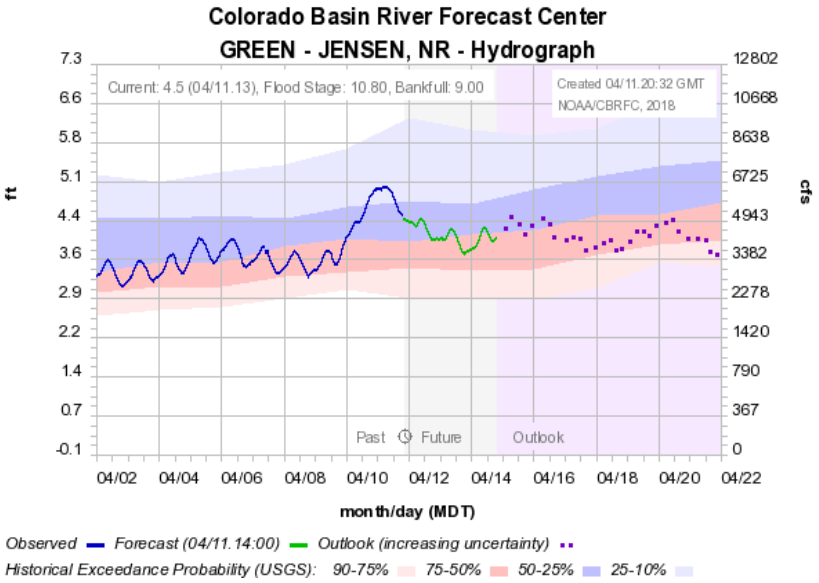
A persistent ridge of high pressure is not on the horizon. This will help preserve snow through April and into May. This would impact peak flow timing.

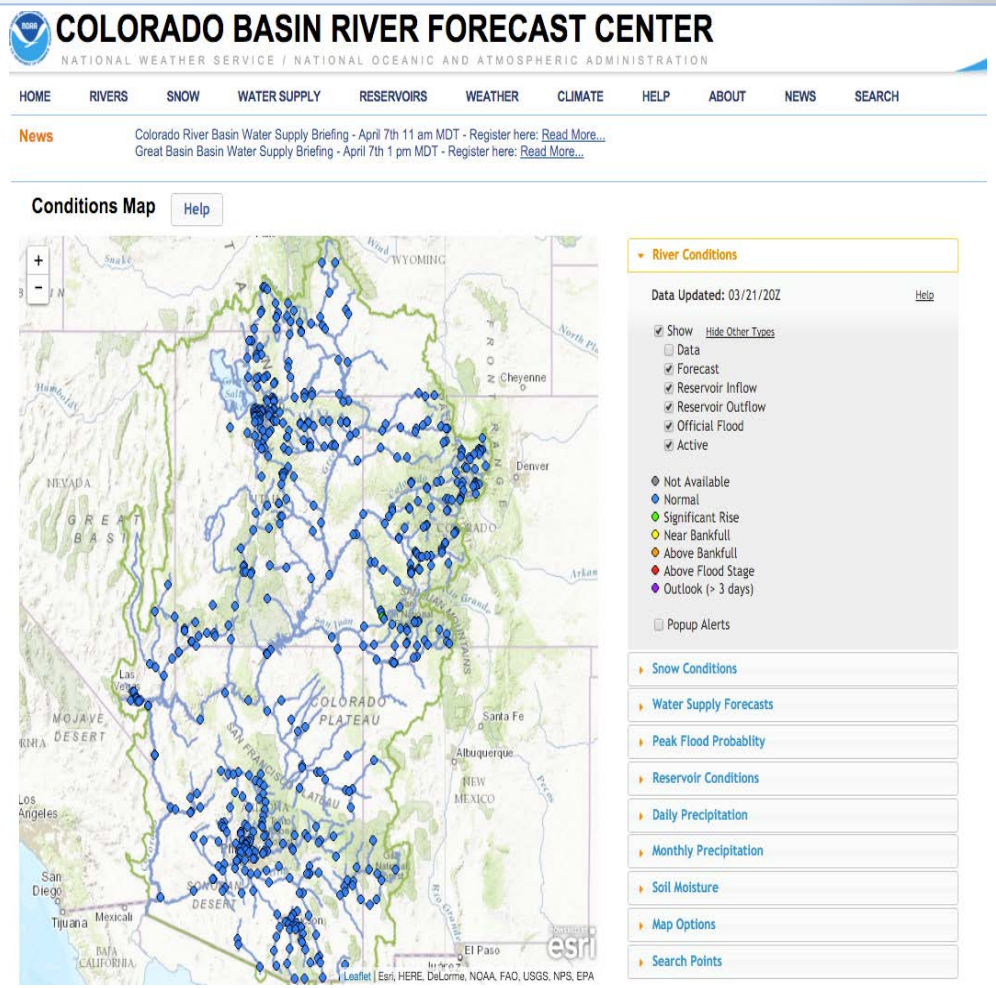
Water Supply Forecasts:

- Average (Green) and below average (Yampa) volume forecasts
- Above normal snow conditions
- Any change in forecasts will mostly likely be an increase if we see a wet May/June

Contact Us!

- Operational Hydrologist
  - 801-524-5130 x340
  - cbrfc.operations@noaa.gov
- Ashley Nielson-Green River Forecaster
  - ashley.nielson@noaa.gov
  - 801-524-5130 x333





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Questions?