

# Did The Model Get It Right?

## Assessing the Model Performance

### ***Inaccurate Forecasts Can Be Caused By Many Things:***

- Bad initial model states (snow, soil moisture, flows)

  - Incorrect or missing gage data

  - Data network density limitations (affects calibration)

  - Daily quality checking issues

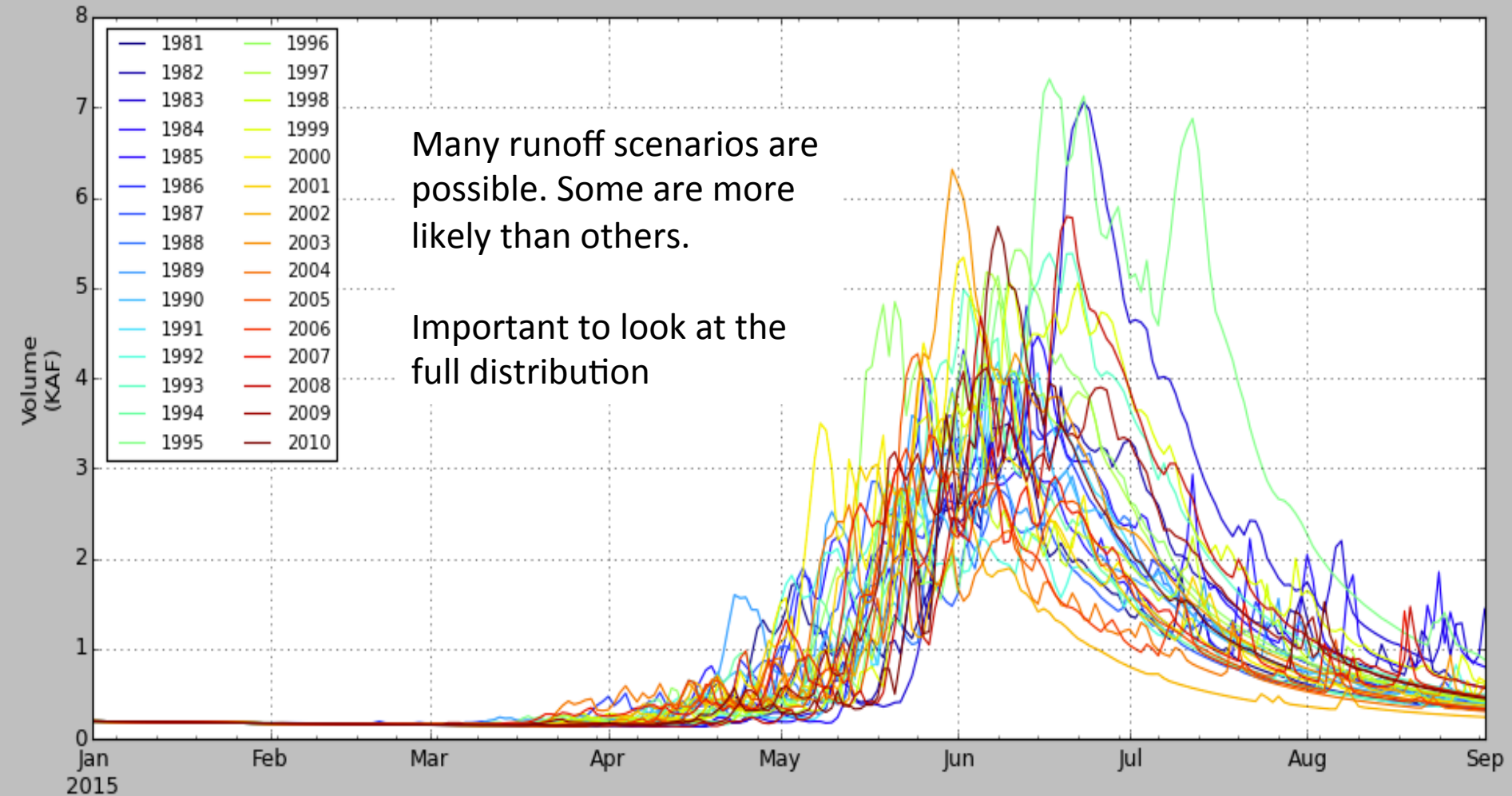
- Limited information about diversions (affects calibration)

- Extreme weather in the future (Precipitation and Temperature)

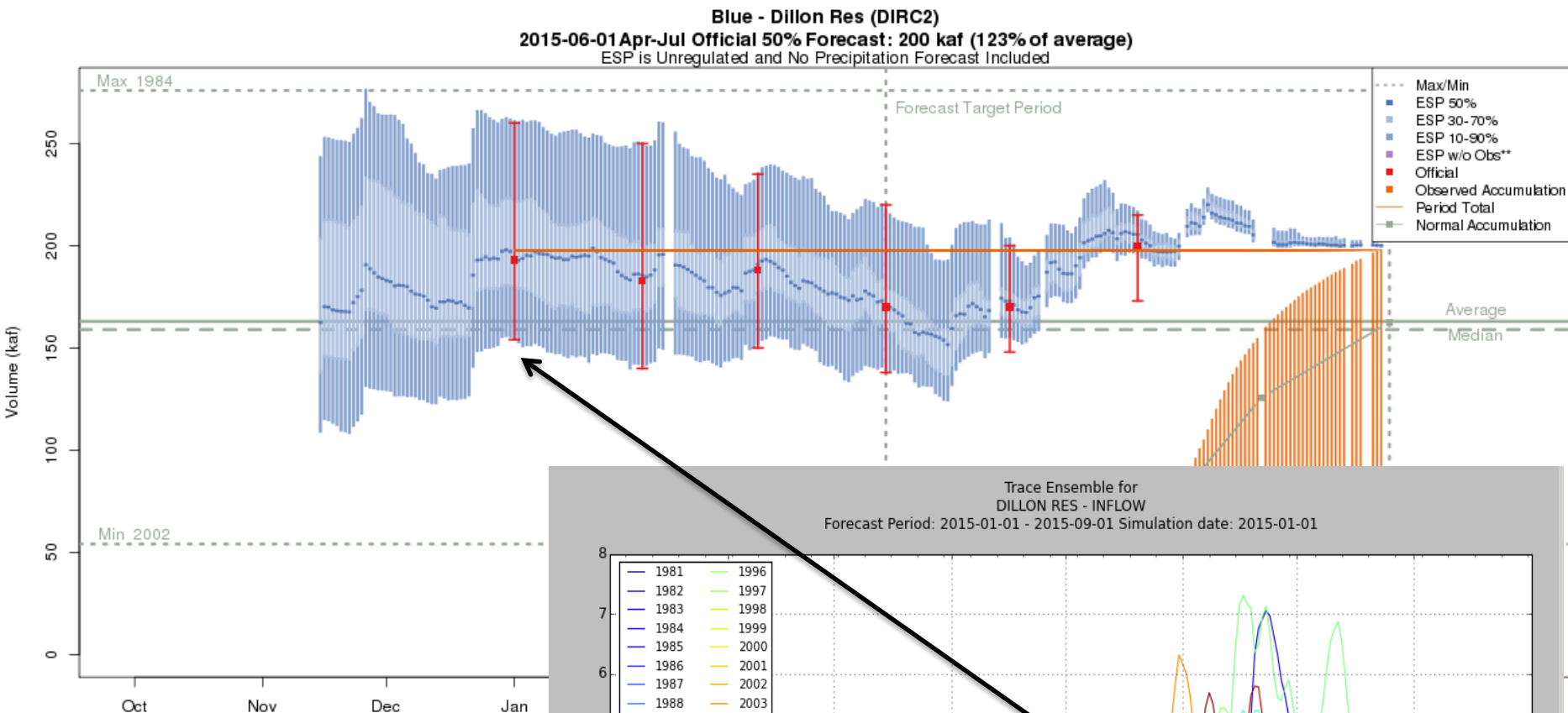
- Weather events not represented in the calibration period

# Ensemble Prediction Model – Starting on January 1<sup>st</sup> 2015 – April through July Forecast

Trace Ensemble for  
DILLON RES - INFLOW  
Forecast Period: 2015-01-01 - 2015-09-01 Simulation date: 2015-01-01

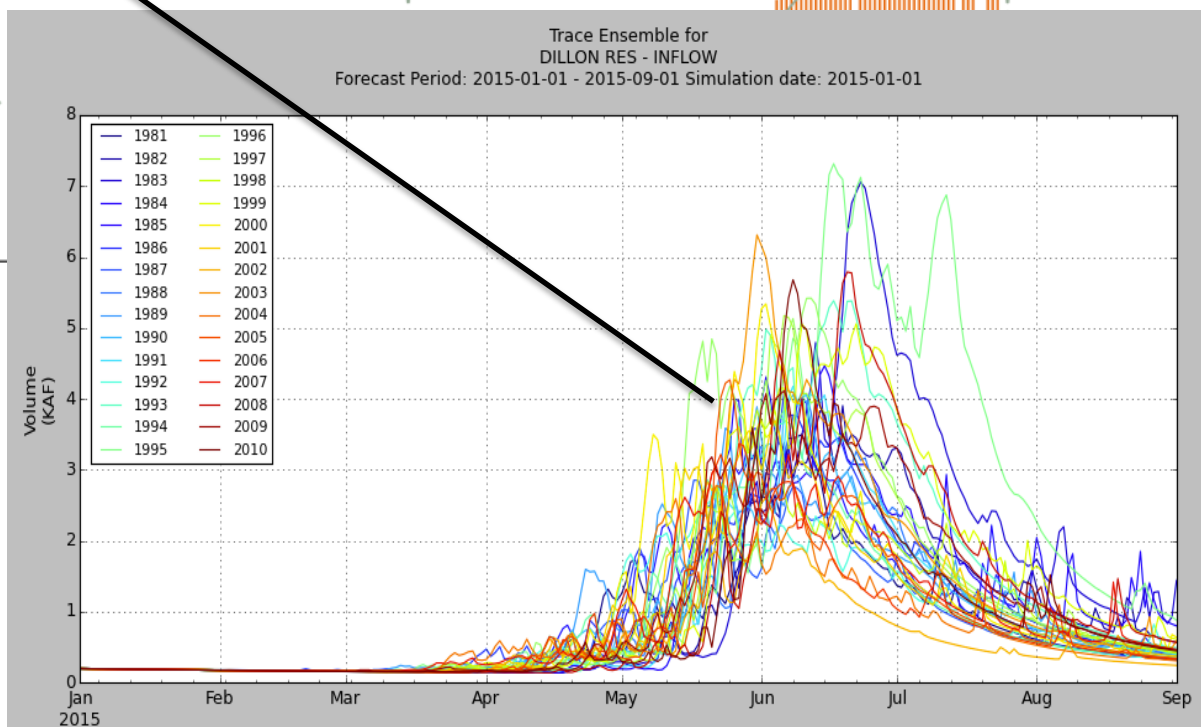


Range of possible outcomes are summarized in the forecast spread



January 1<sup>st</sup> 2015  
Forecast

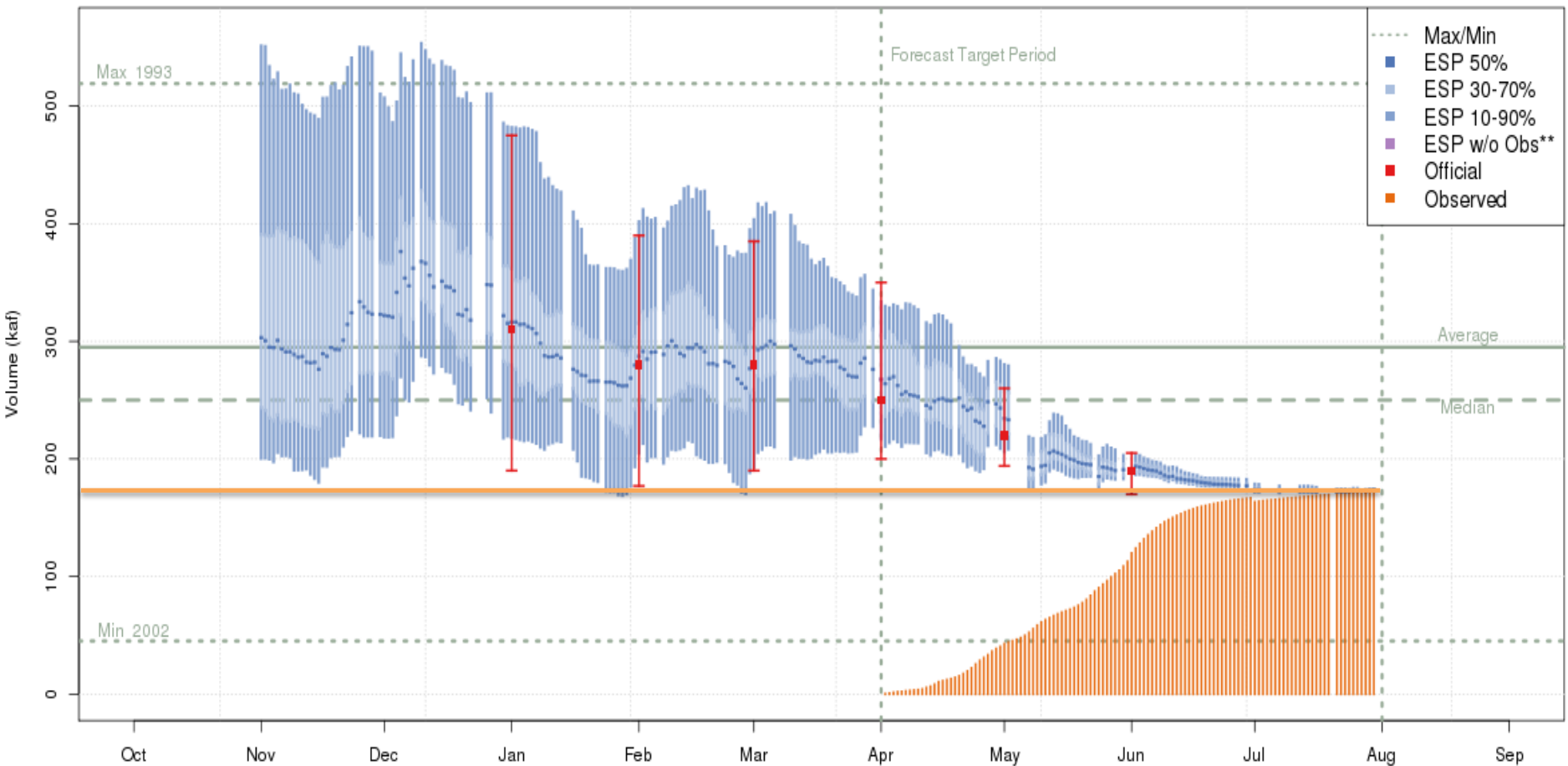
Jan 1 – A primary goal is to  
capture the resulting runoff  
in the forecast range



# Did The Model Get It Right (perform as expected) ?

## No

2014 Forecast for McPhee Reservoir Inflow



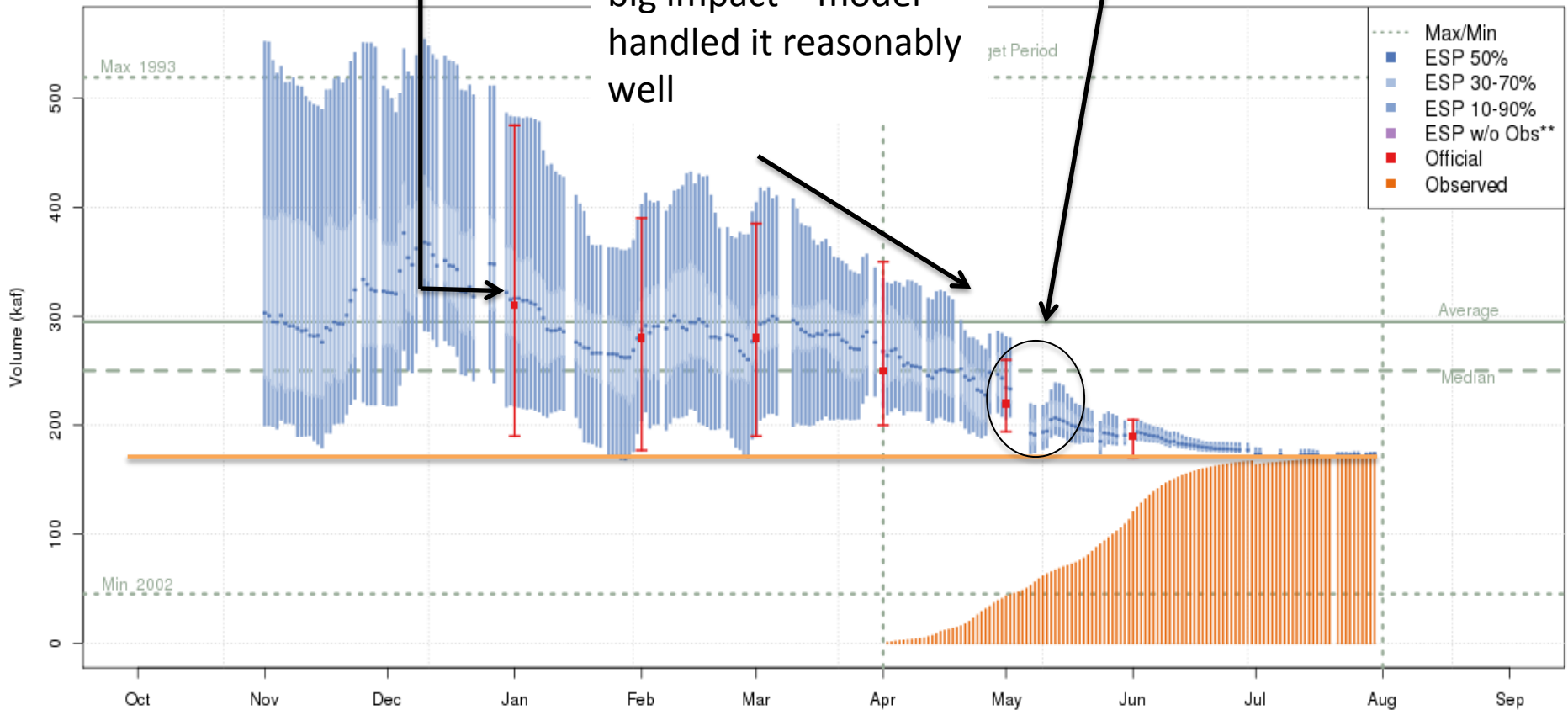


# McPhee Reservoir Inflow Forecasts 2014 : Initial States Issues

Probably started the season too “wet”

Dry spring also had a big impact – model handled it reasonably well

Snow state adjustments once we were in the runoff period



Most likely an issue with early season soil moisture and then snow representation  
Questionable Initial States

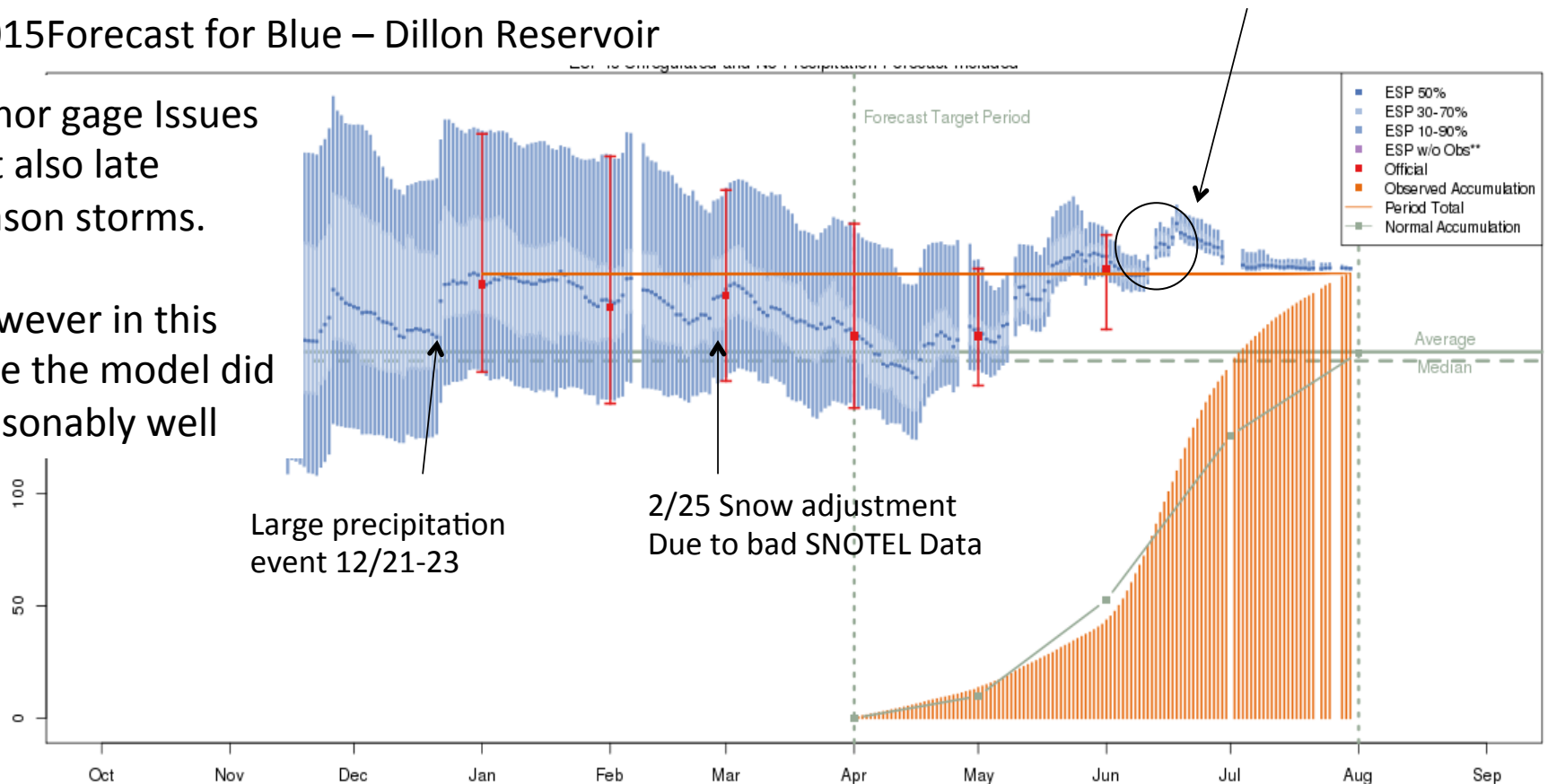
# Did The Model Get It Right (perform as expected) ?

## Yes, but data issues late season

### 2015 Forecast for Blue – Dillon Reservoir

Minor gage Issues  
but also late  
season storms.

However in this  
case the model did  
reasonably well

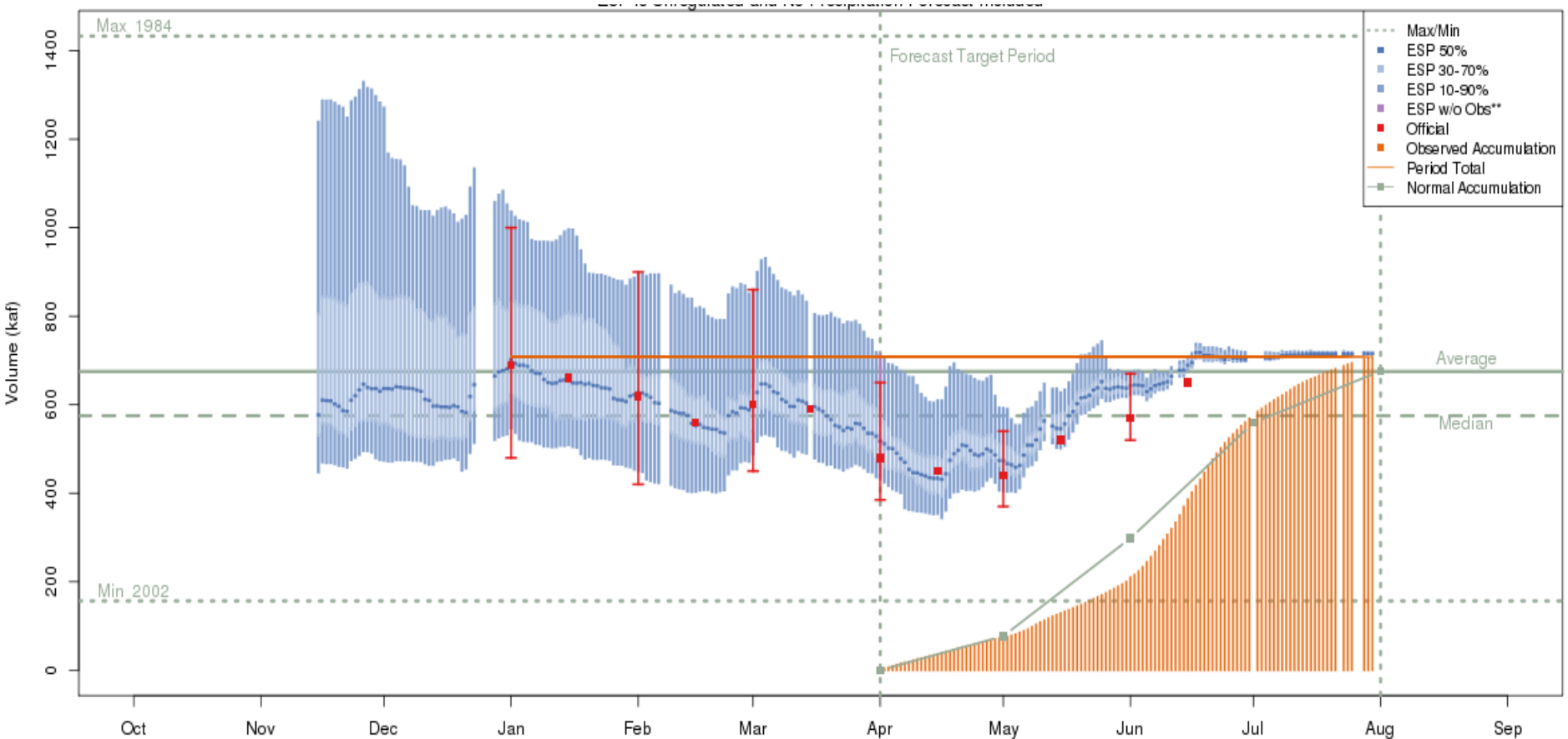


The latest (2015-07-30) 50% ESP forecast is 200 kaf.  
Plot Created 2015-09-10 15:01:16, NOAA / NWS / CBRFC  
Forecasts in the forecast target period include observed values.

# Did The Model Get It Right (perform as expected) ?

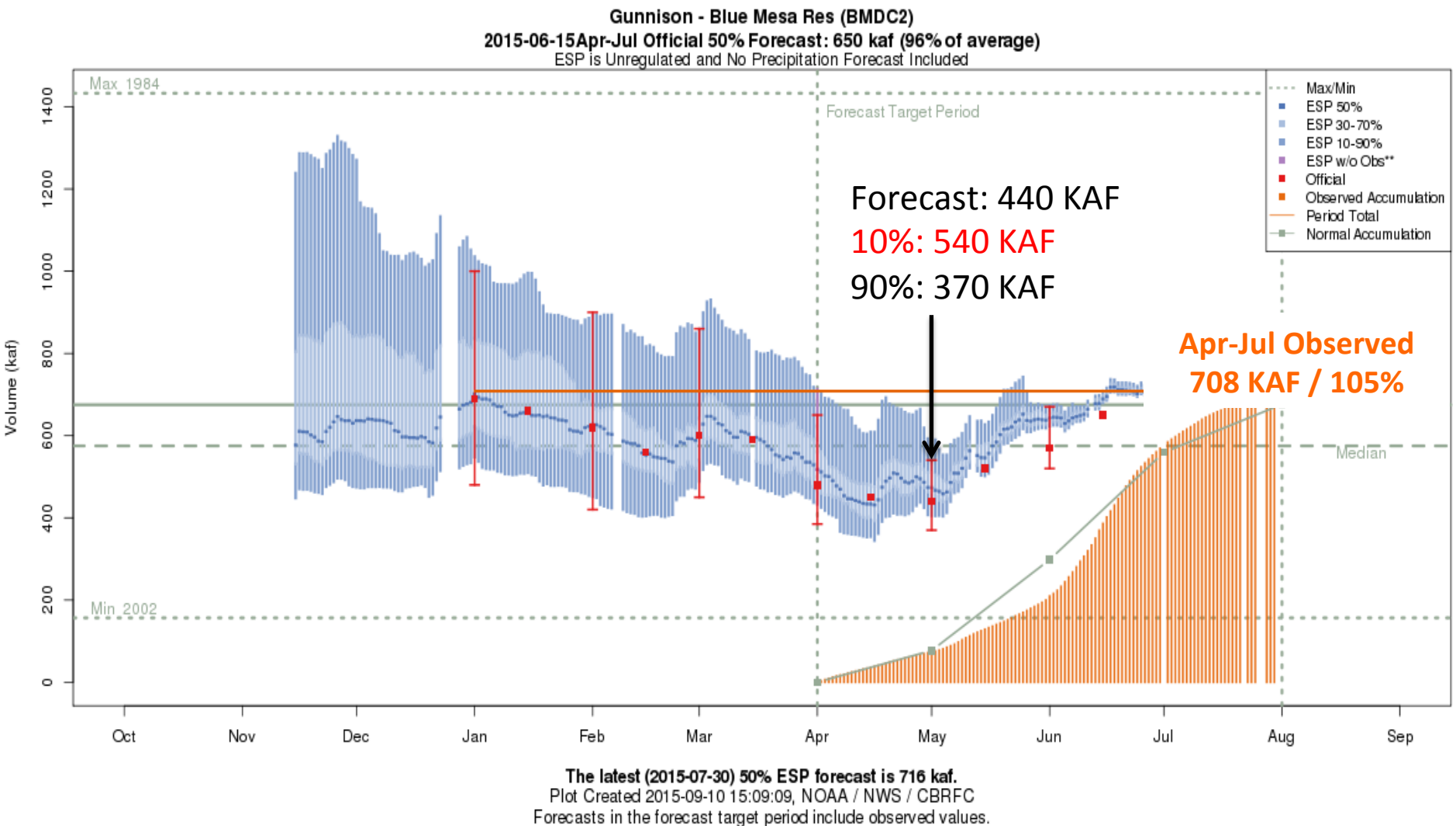
## Yes

### 2015 Forecast for Blue Mesa Reservoir Inflow



The latest (2015-07-30) 50% ESP forecast is 716 kaf.  
Plot Created 2015-09-10 15:09:09, NOAA / NWS / CBRFC  
Forecasts in the forecast target period include observed values.

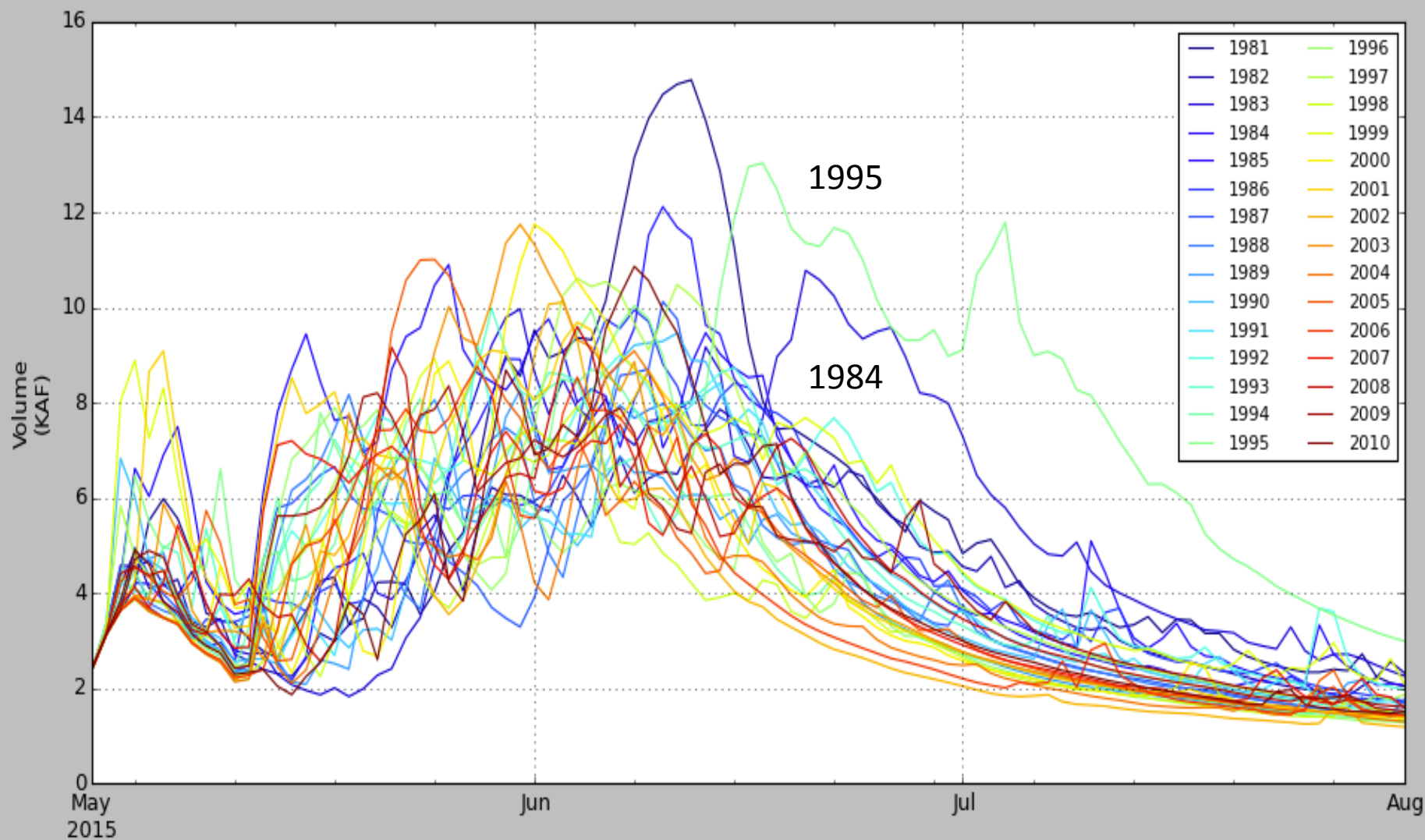
# Gunnison – Blue Mesa 2015: Extreme Weather



Largest Error was during the period where historical performance is best

# Ensemble Prediction Model – Starting on May 1<sup>st</sup> 2015 – May through July Forecast

Trace Ensemble for  
BLUE MESA RES INFLOW  
Forecast Period: 2015-05-01 - 2015-08-01 Simulation date: 2015-05-01



# Model / Forecast Performance & Uncertainty

## Blue Mesa Reservoir Inflow Forecast Progression 2015

### 1<sup>st</sup> of month Forecasts

Jan: 690 KAF (102%)  
Feb: 620 KAF (92%)  
Mar: 600 KAF (89%)  
Apr: 480 KAF (71%)  
May: **440 KAF (65%)**  
June: 570 KAF (84%)  
July: 700 KAF (104%)

**April-July Observed  
708 KAF (105%)**

10 % Chance of  
Exceeding : 540 KAF

50% Chance of  
Exceeding: 440 KAF

90 % Chance of  
Exceeding: 370 KAF

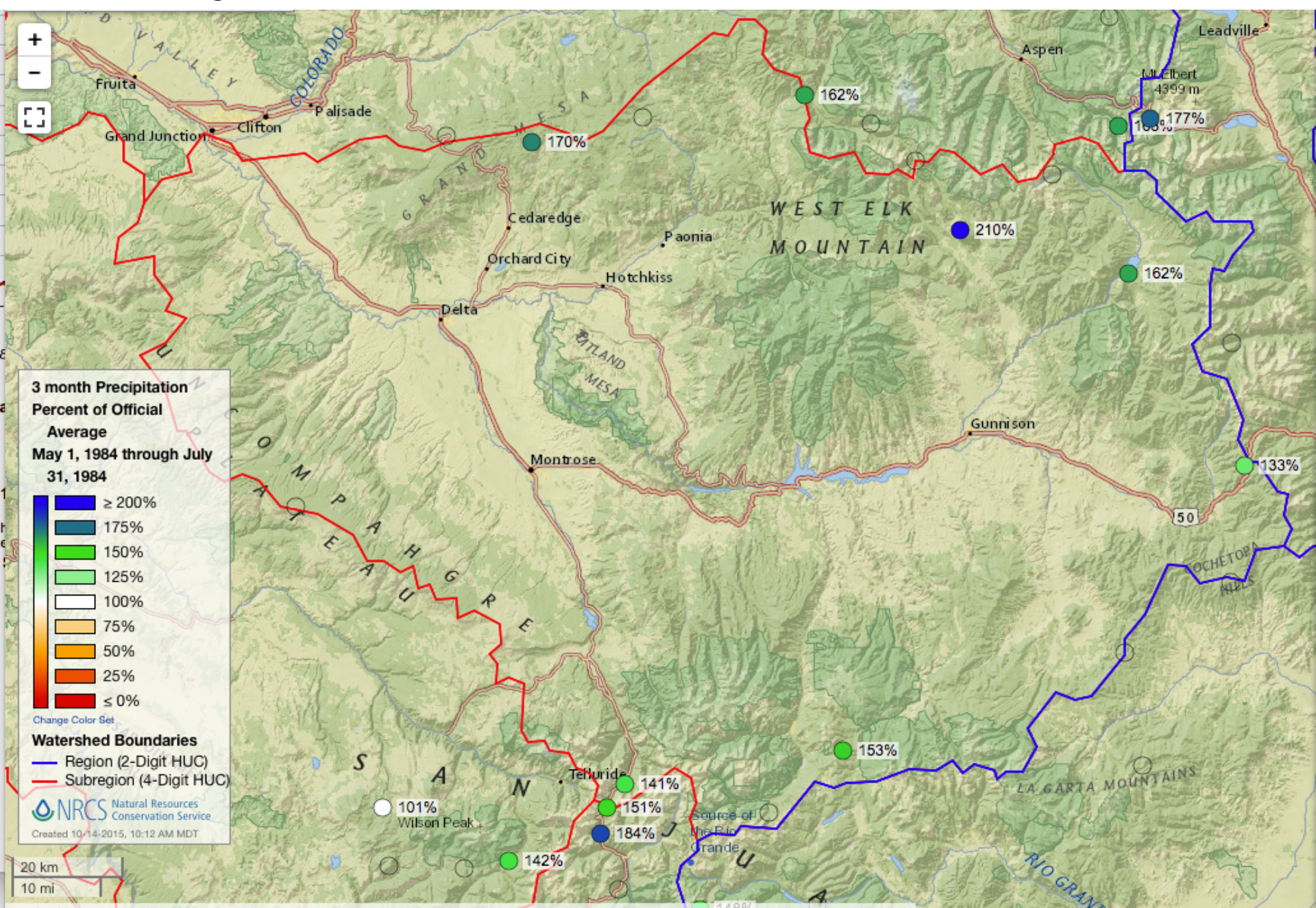
**Highest Forecast Trace (volume) on May 1 was 741 KAF: (3% exceedance probability) - 1995**

**Second Highest Trace (volume) on May 1 was 604 KAF: (7% exceedance probability) - 1984**



# Gunnison River Basin May-July 1984 SNOTEL Precipitation

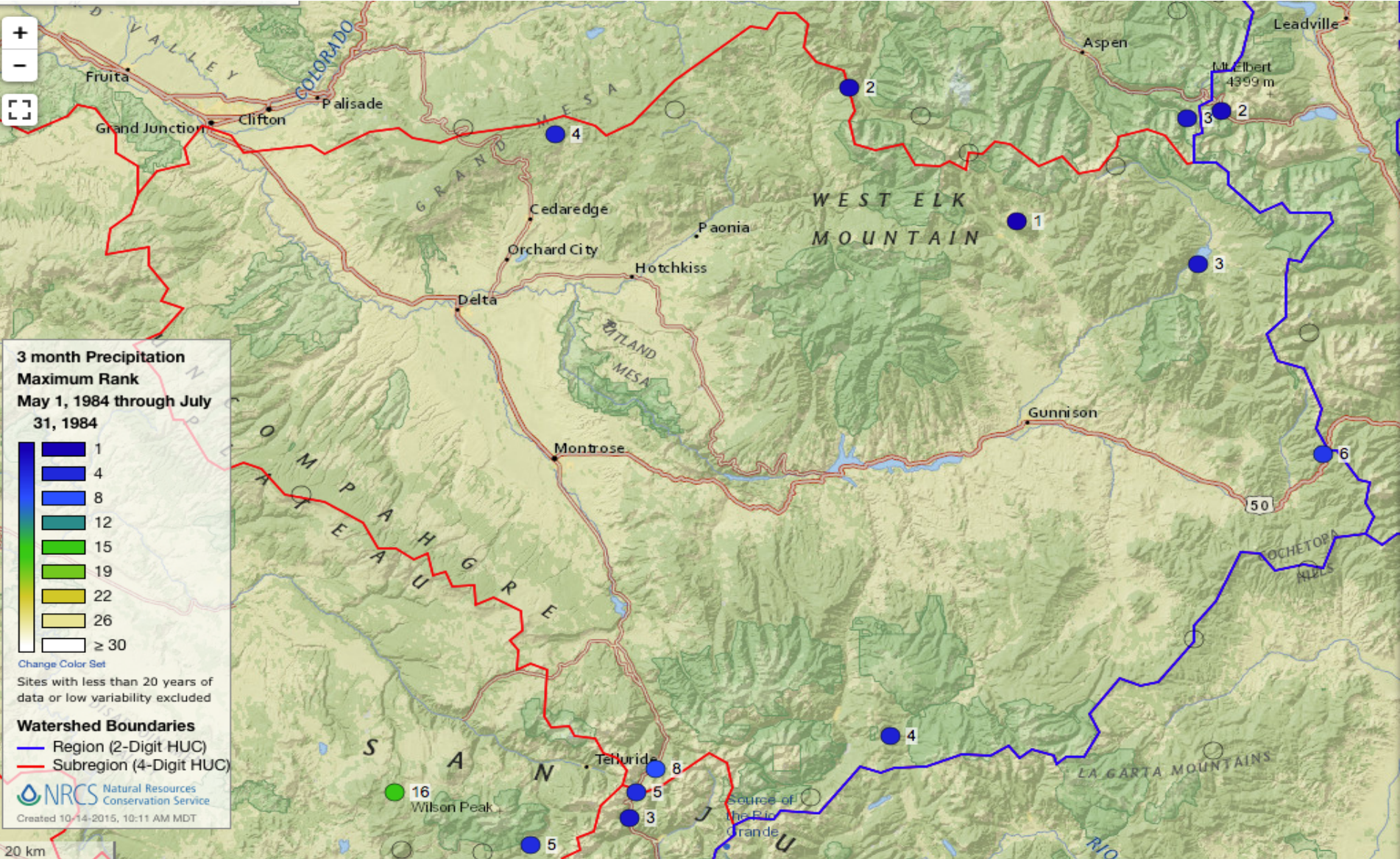
## Percent of Average





# Gunnison River Basin May-July 1984 SNOTEL Precipitation

## Historical Ranking

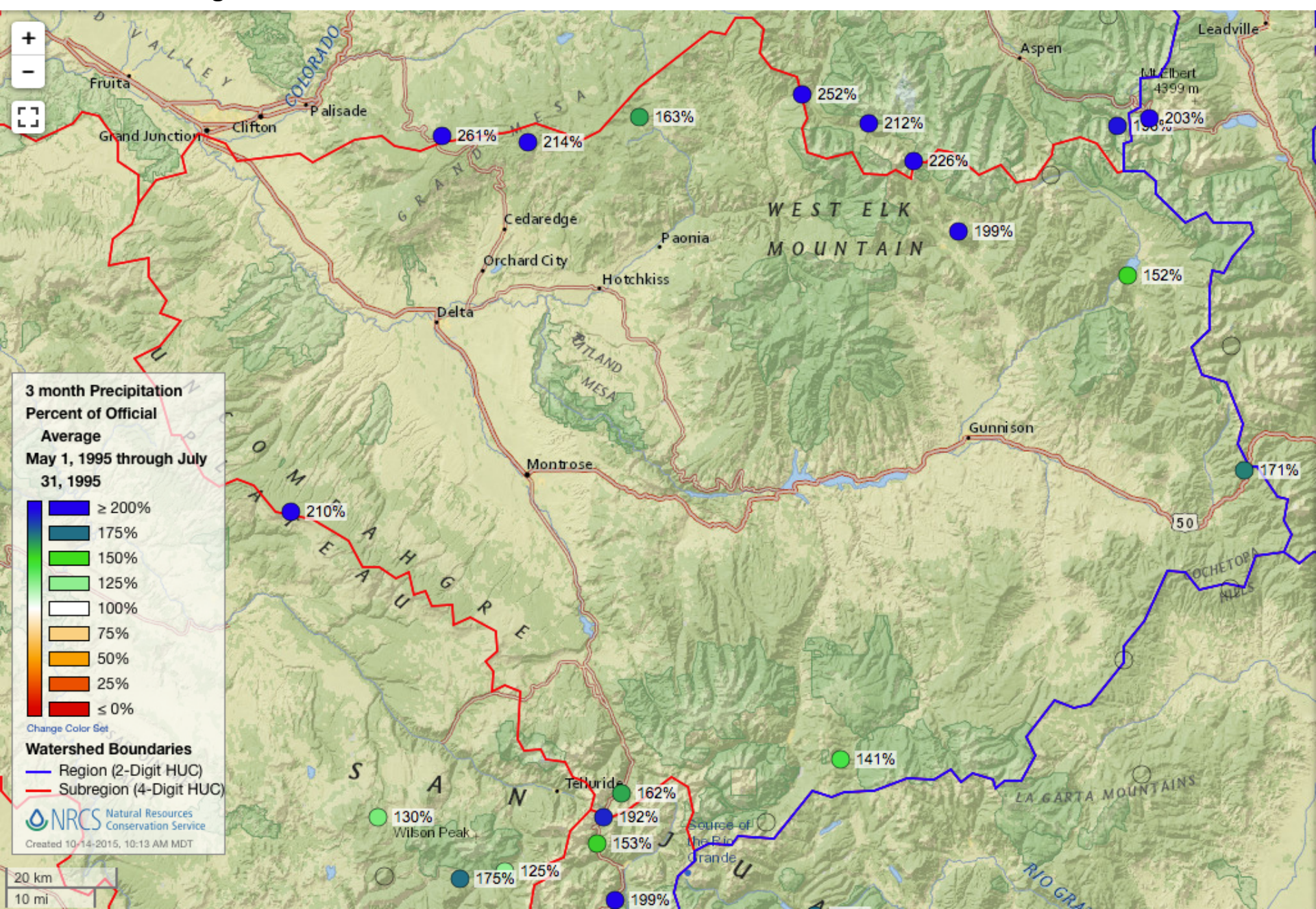


Several sites in the top 1-4 of their historical record  
Precipitation fell in the 3-10% historical exceedance probability for several sites



# Gunnison River Basin May-July 1995 SNOTEL Precipitation

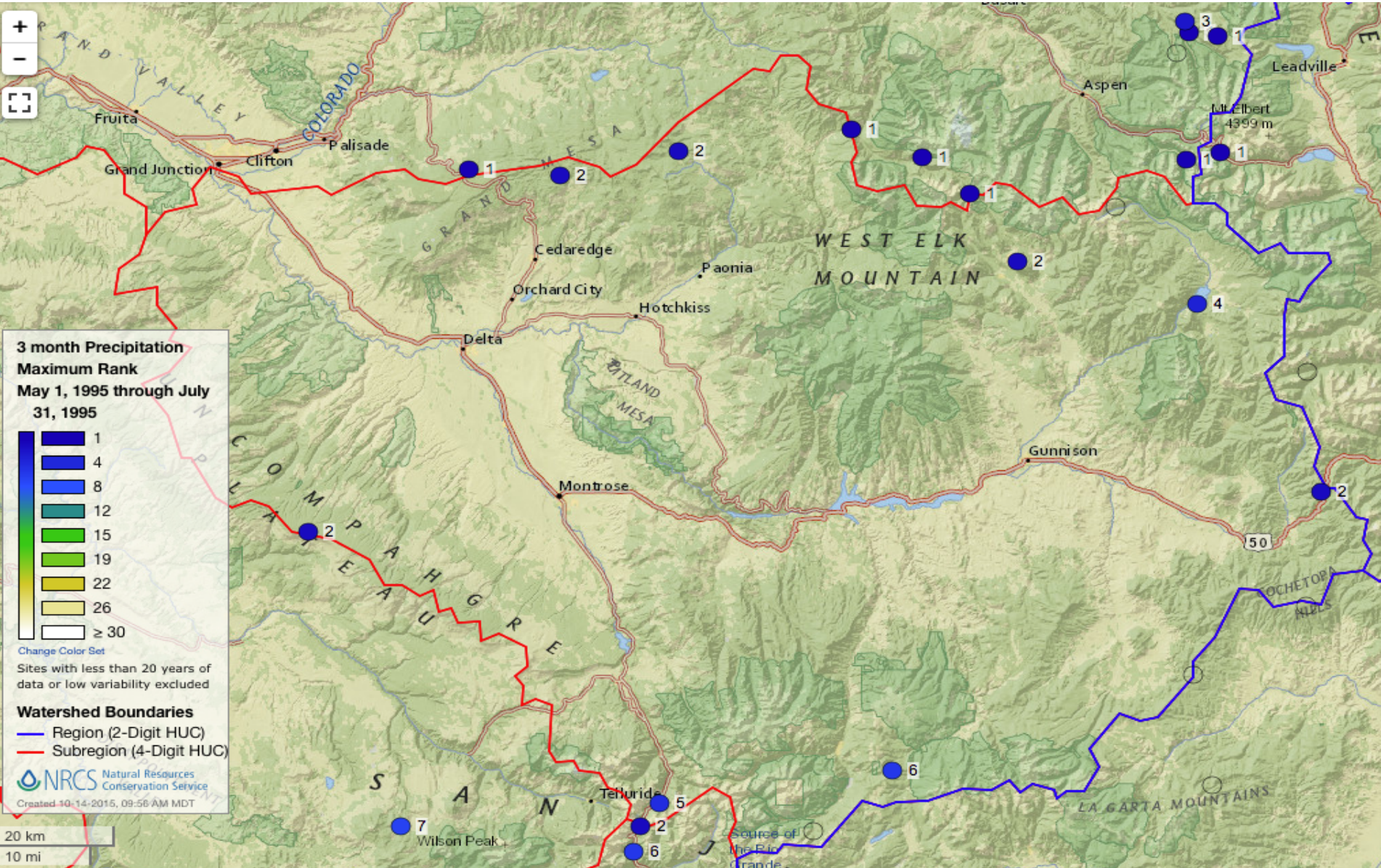
## Percent of Average





# Gunnison River Basin May-July 1995 SNOTEL Precipitation

## Historical Ranking

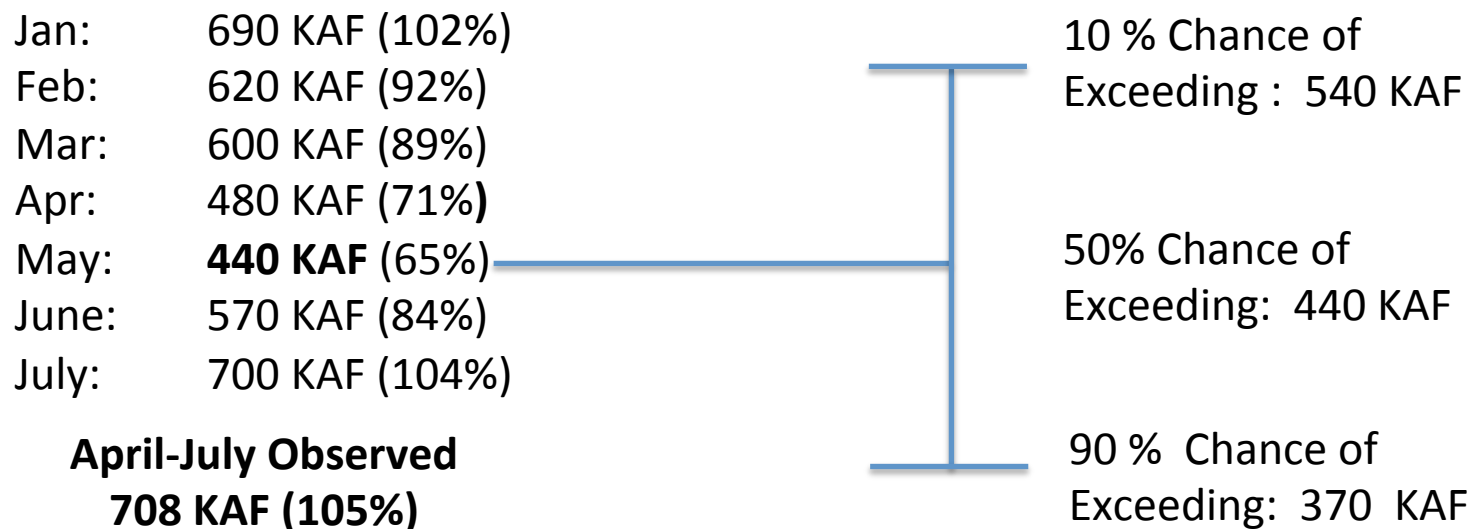


Several sites in the top 1-2 of their historical record)  
Precipitation fell in the 3-7% historical exceedance probability for several sites

# Model / Forecast Performance & Uncertainty

## Blue Mesa Reservoir Inflow Forecast Progression 2015

### 1<sup>st</sup> of month Forecasts



**Highest Forecast Trace on May 1 was 741 KAF: (3% exceedance probability) - 1995**

**Second Highest Forecast Trace on May 1 was 604 KAF: (7% exceedance probability) - 1984**

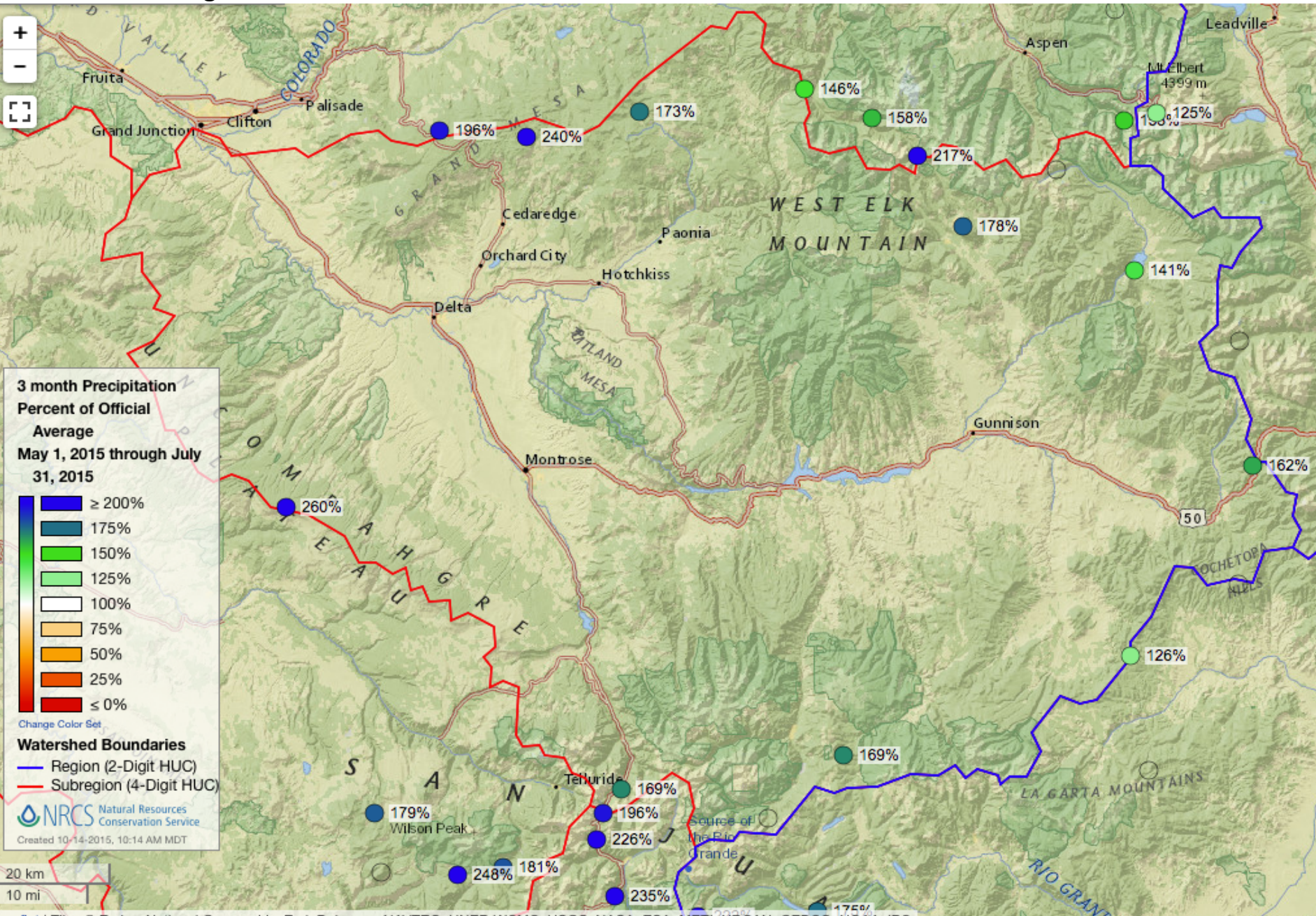
We would expect May-July precipitation to be in that top percentile of historical record to reach the observed volume of 708 KAF.

So was it ?



# Gunnison River Basin May-July 2015 SNOTEL Precipitation

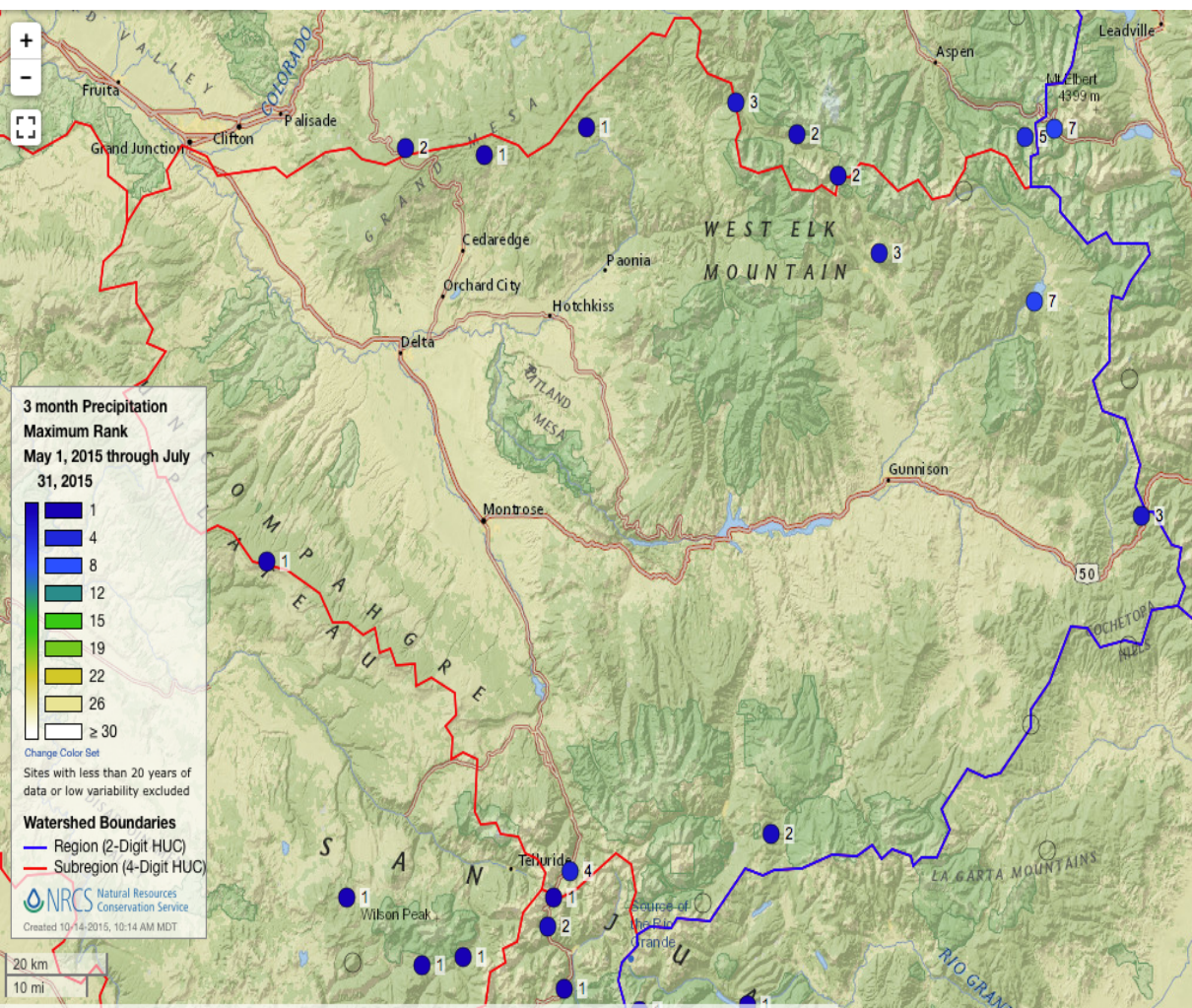
## Percent of Average





# Gunnison River Basin May-July 2015 SNOTEL Precipitation

## Historical Ranking



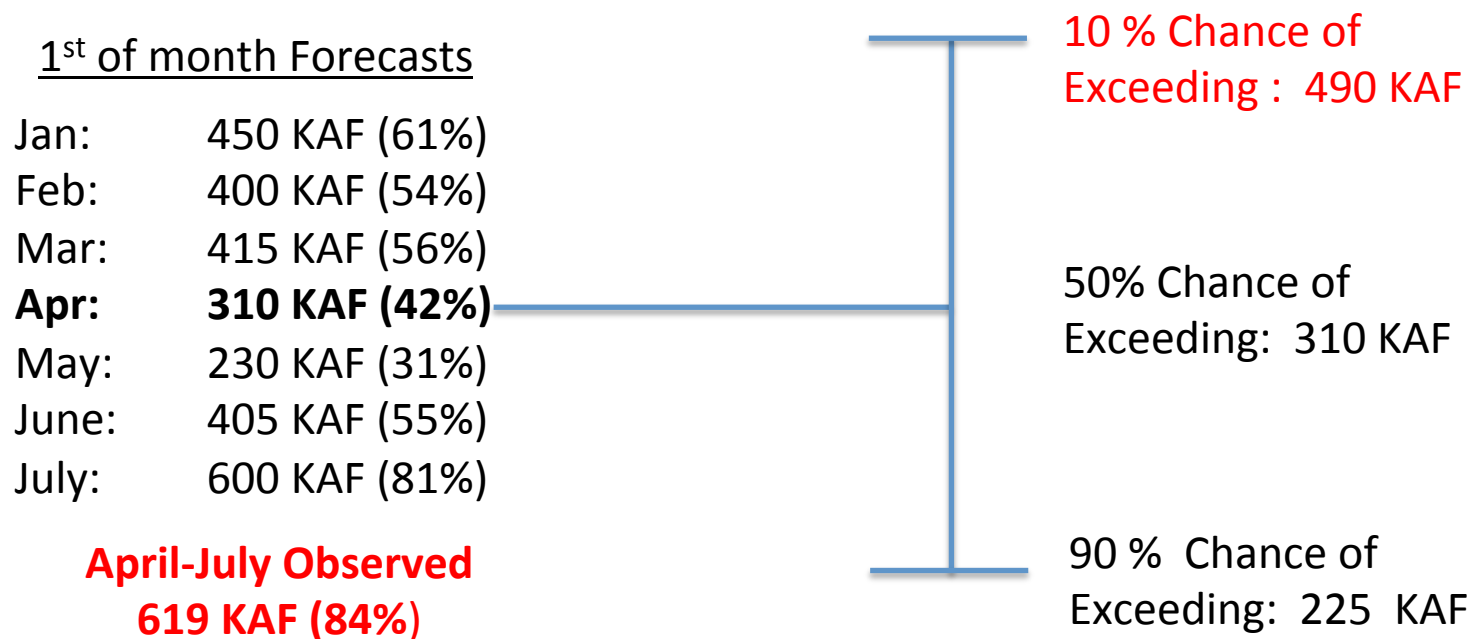
SNOTEL	Anomaly (in)	% of Avg
Park Reservoir	+8.9	240%
Overland Reservoir	+4.8	173%
Schofield Pass	+8.0	216%
Butte	+4.1	178%
Porphyry Creek	+3.5	162%
Slumgullion	+3.6	169%
Columbine Pass	+6.7	260%

May-July precipitation at SNOTEL sites were in the top 1-3 of the historical record (30-36 yrs)

Precipitation fell in the 3-9% historical exceedance probability range for several sites

# Model / Forecast Performance & Uncertainty

## Navajo Reservoir Inflow Forecast Progression 2015



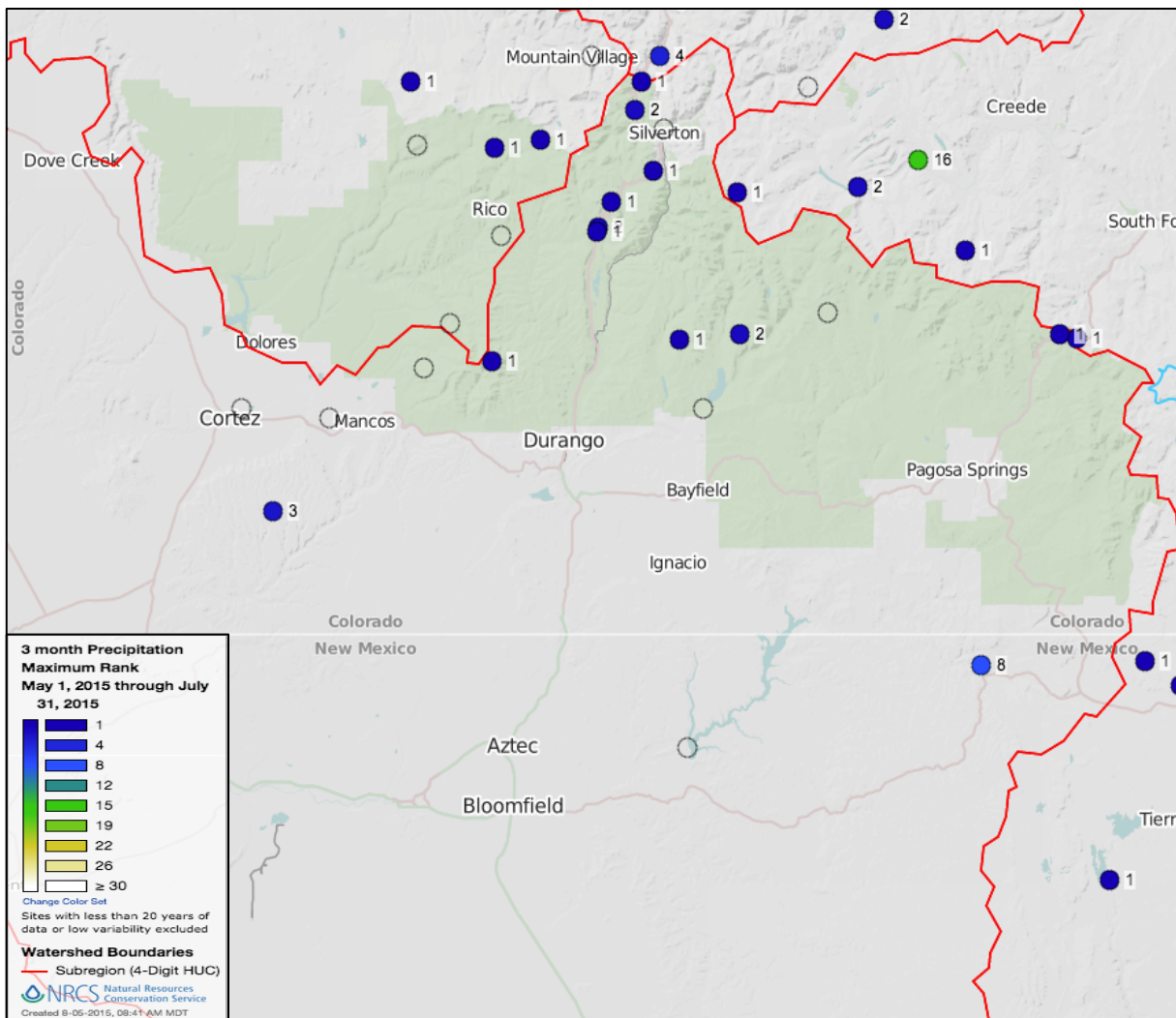
Highest Forecast Trace on April 1 was 698 KAF: (3% exceedance probability)

Second Highest Forecast Trace on April 1 was 584 KAF: (7% exceedance probability)

We would expect spring precipitation to be among the top percentile of record to reach the observed volume of 600 KAF.

So was it ?

# San Juan May-July SNOTEL Precipitation Historical Ranking

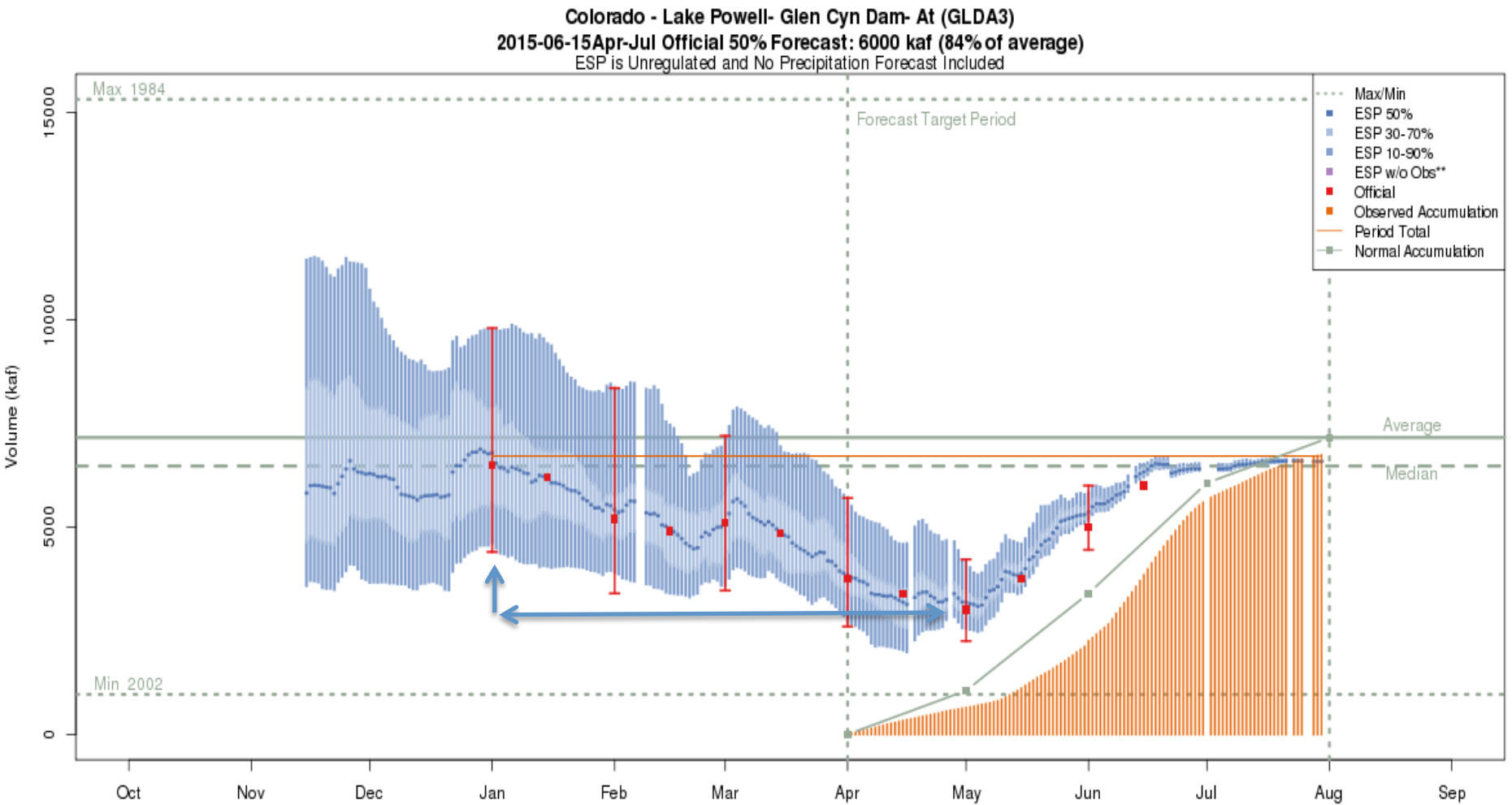


SNOTEL	Anomaly (in)	% of Avg
Red Mountain	+6.9	196%
Molas Lake	+7.0	235%
Spud Mt	+11.6	301%
Cascade	+7.8	227%
Columbus	+11.5	254%
Stump Lakes	+6.3	201%
Upper San Juan	+9.6	242%
Wolf Creek	+11.7	281%

Many sites registered the wettest May-July period in their historical record (30-35 years)

Precipitation fell in the 3-7% historical exceedance probability range

# 2015 Forecast Progression: Lake Powell

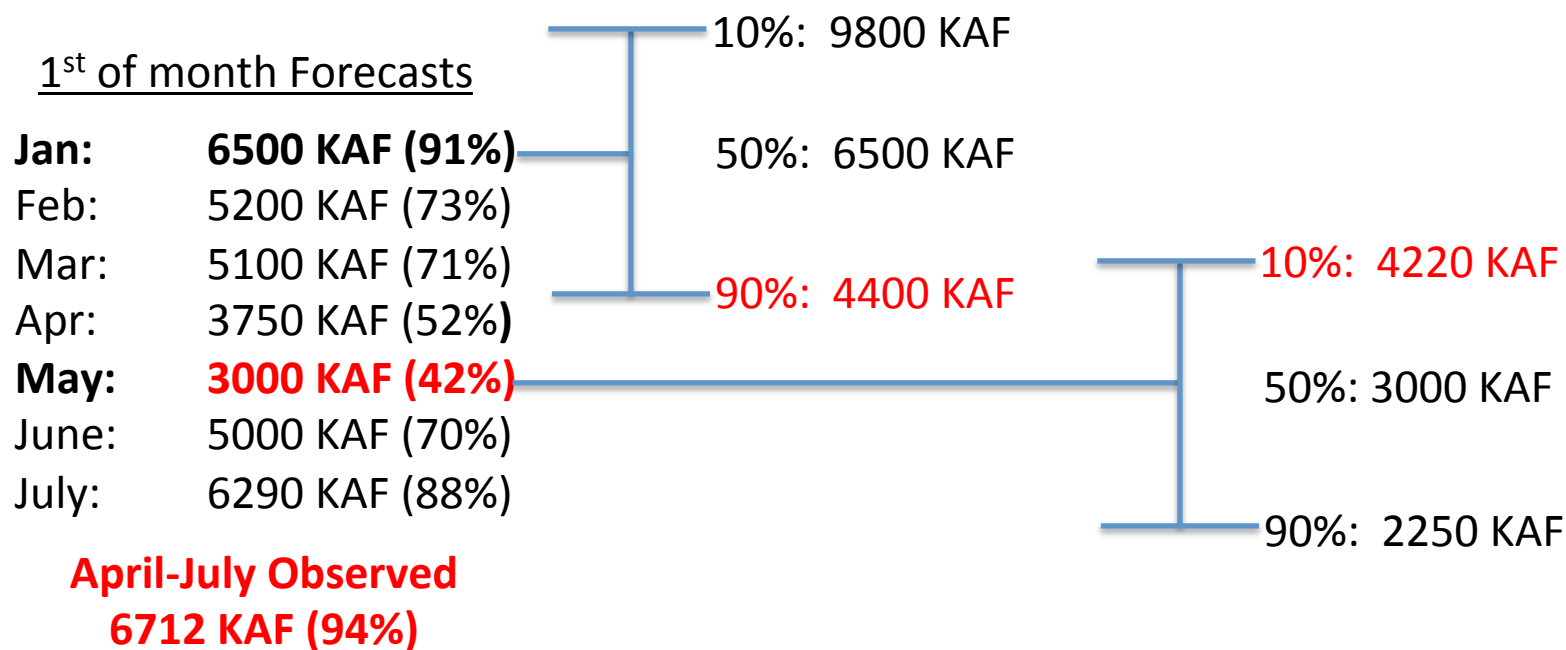


The latest (2015-07-30) 50% ESP forecast is 6583 kaf.  
Plot Created 2015-09-10 15:21:45, NOAA / NWS / CBRFC  
Forecasts in the forecast target period include observed values.



# Model / Forecast Performance & Uncertainty

## Lake Powell Inflow Forecast Progression 2015



Lowest Forecast Trace on Jan 1 was 2374 KAF: (97% exceedance probability)

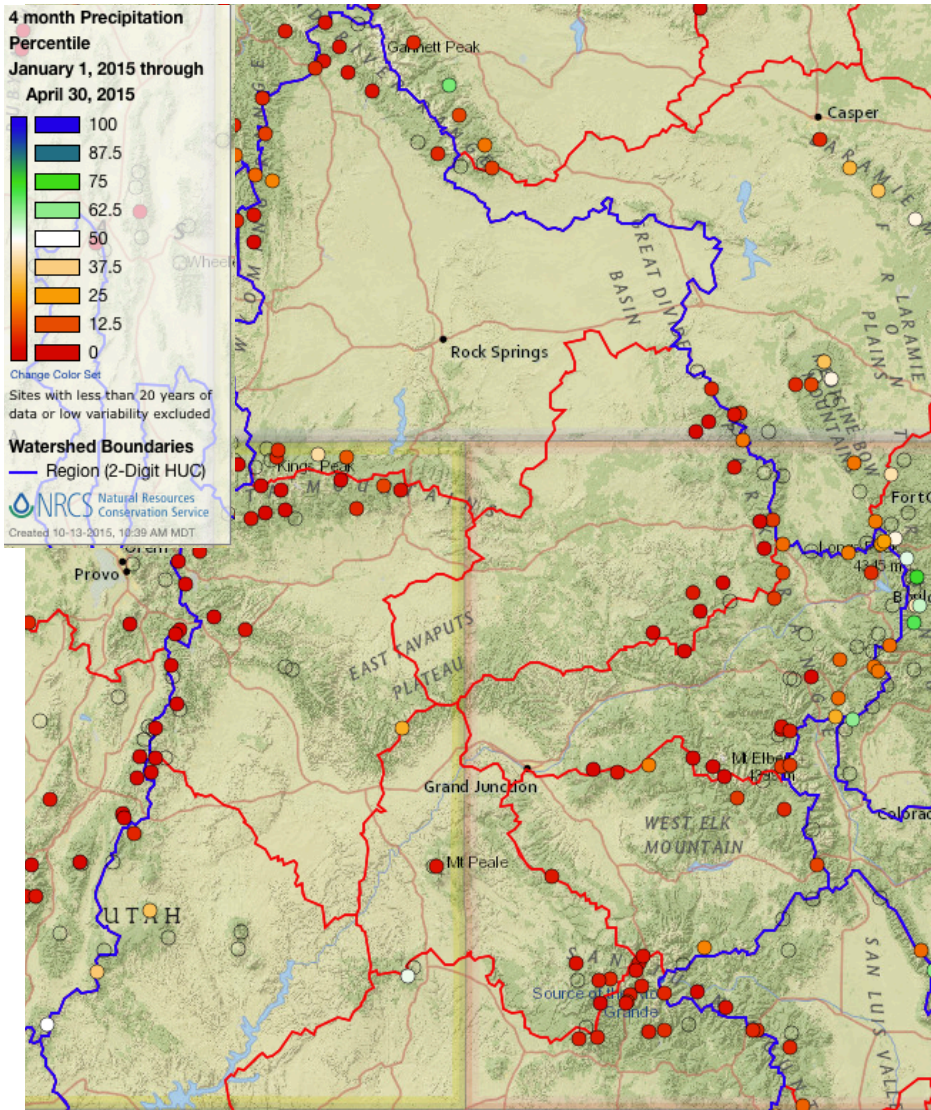
Second Lowest Forecast Trace on Jan 1 was 4371 KAF: (93% exceedance probability)

Highest Forecast Trace on May 1 was 5836 KAF: (3% exceedance probability)

Second Highest Forecast Trace on May 1 was 4390 KAF: (7% exceedance probability)

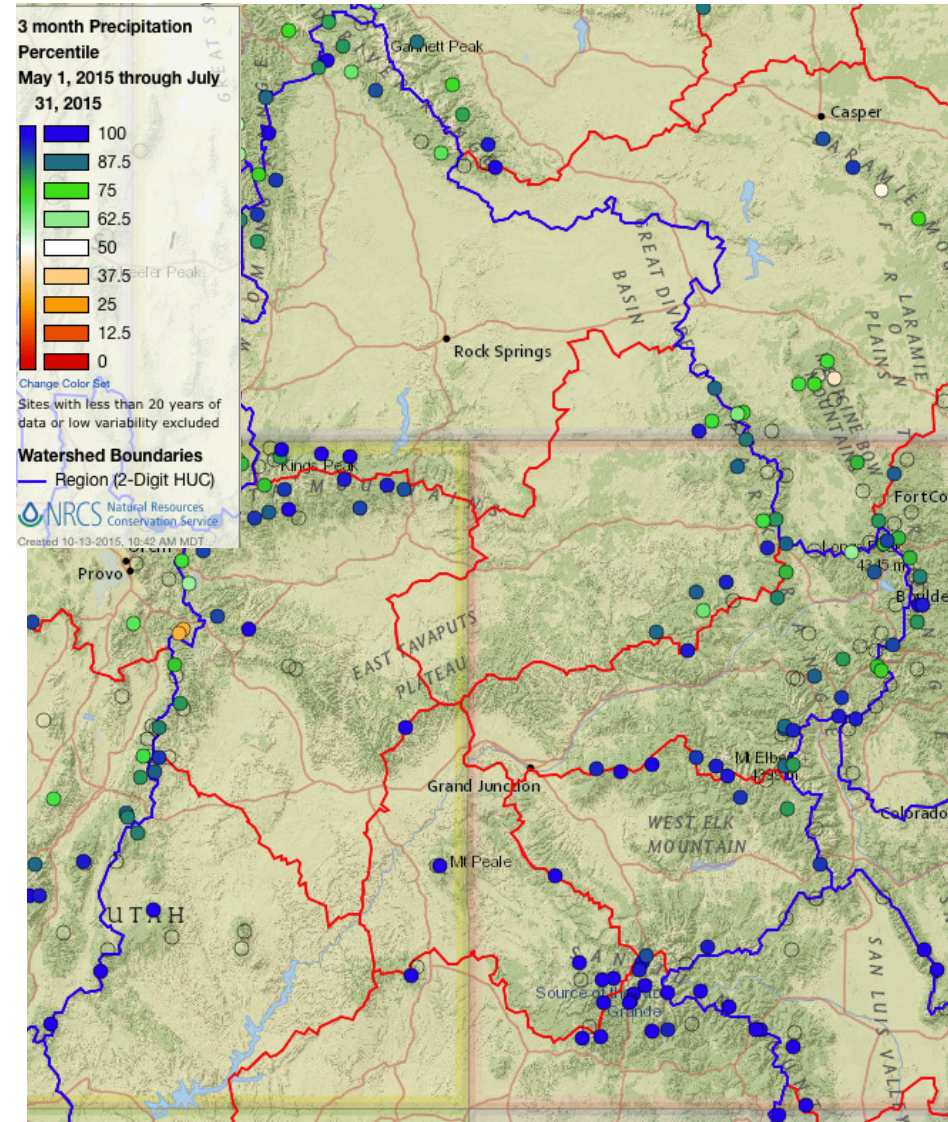
# Colorado River above Lake Powell : SNOTEL Precipitation Rankings – Two Extreme Periods

January through April 2015



Many sites driest 1-2 on record

May through July 2015



Many sites wettest 1-3 on record



What can we take-away from this?

Model error exists, in a large part due to poor data inputs, but extreme weather can result in large forecast errors.

Model in general **performed as expected in 2015**..but we were not focusing on the extreme end of the runoff scenarios we were provided with that were closer to the actual observed runoff volumes.

The ability to catch such future weather extremes in water supply forecasts is very limited (& depends upon events in the calibration period used).

Early season forecasts (50% exceedance) are likely to miss the mark if future conditions end up extremely wet or dry.

The forecast distribution is important to consider depending on your level of risk. The ability to catch extreme events in the forecast distribution is dependent upon the variety of scenarios in the calibration period data.

Simply comparing the observed runoff with the 50% exceedance forecast isn't always a solid indicator of the model performance for a particular year.