Great Basin
March 2016
Water Supply Briefing

10 am March 7, 2016

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Colorado Basin River Forecast Center
National Weather Service
NOAA

Conference Phone #: 877-929-0660 Passcode #: 1706374

* Please mute your phone until you have a question-Thank You *

Water Supply Briefings:

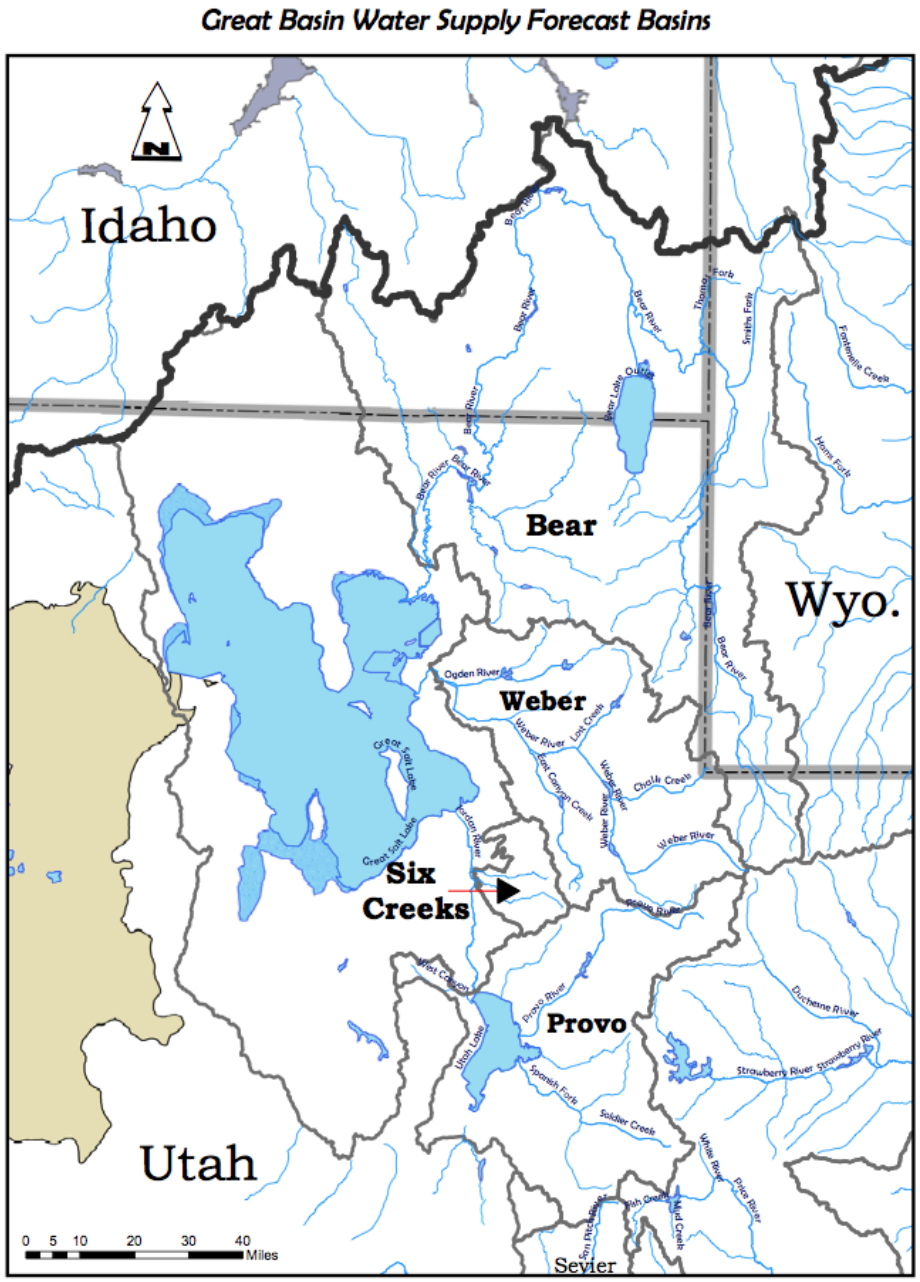
- Provide an understanding of:
  - Hydrologic conditions in the Great Basin
  - How these conditions impact and are represented in our hydrologic model
  - Model guidance and resulting water supply forecasts
  - Accuracy of the water supply forecasts
  - Other impacts / considerations affecting water supply forecasts

We are breaking out the Great Basin:

Allow us to better focus on the Bear, Weber, Six-Creeks, Provo/ UT Lake forecast areas.

We can add the Sevier River Basin if there is interest.

We will still have a separate Colorado River Basin water supply briefing.

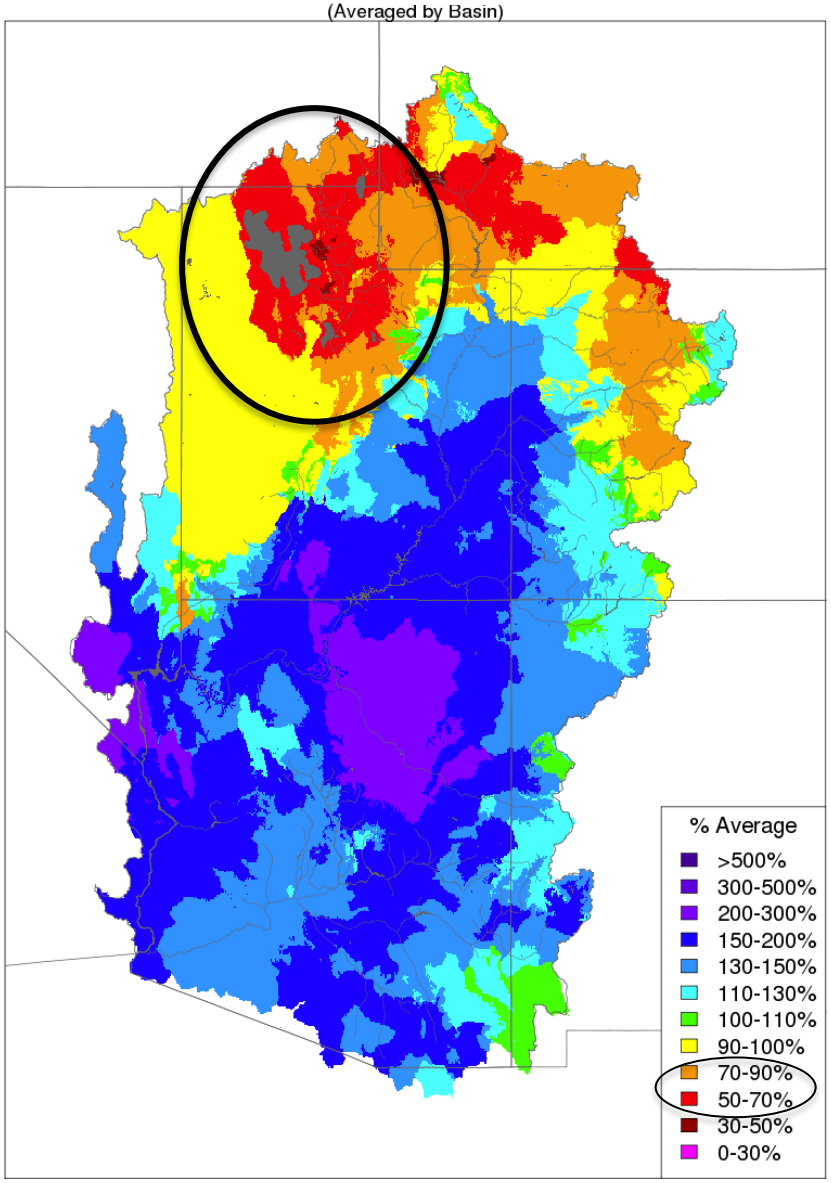


Today's Presentation – Questions to Answer

- **Several Great Basin SNOTEL sites indicate 75-90% of median ("normal"). Why are stream flow runoff volume forecasts so much lower ?**
  - Impacts of fall weather on high elevation snowpack and soil moisture.
- **Consequences of the dry / warm February.**
  - Snow melt is ahead of schedule and we're falling farther behind normal conditions.
- **The water supply outlook / forecasts**
  - Bear, Weber, Six-Creeks, Provo conditions and forecasts.
  - Can we recover ? What are the chances for average runoff conditions ?
  - How good are forecasts in early March?
- **El Niño**
  - What happened ? What's next ?
- **A weather pattern change is upon us! What can we expect?**
- **Long range outlook**

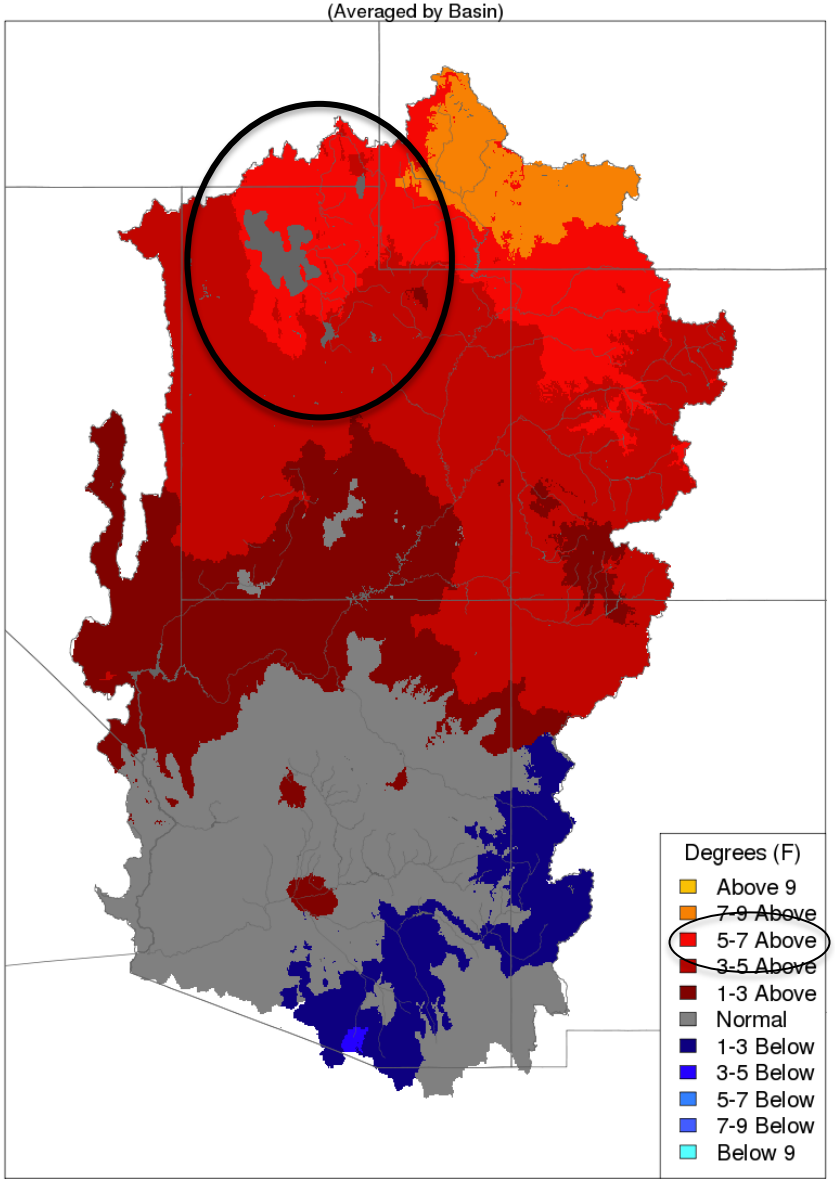
Fall Precipitation and Temperatures

Water Year Precipitation, October 2015 – November 2015
(Averaged by Basin)



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

Max Temp - Monthly Deviation - October 2015
(Averaged by Basin)



Prepared by NOAA, Colorado Basin River Forecast Center
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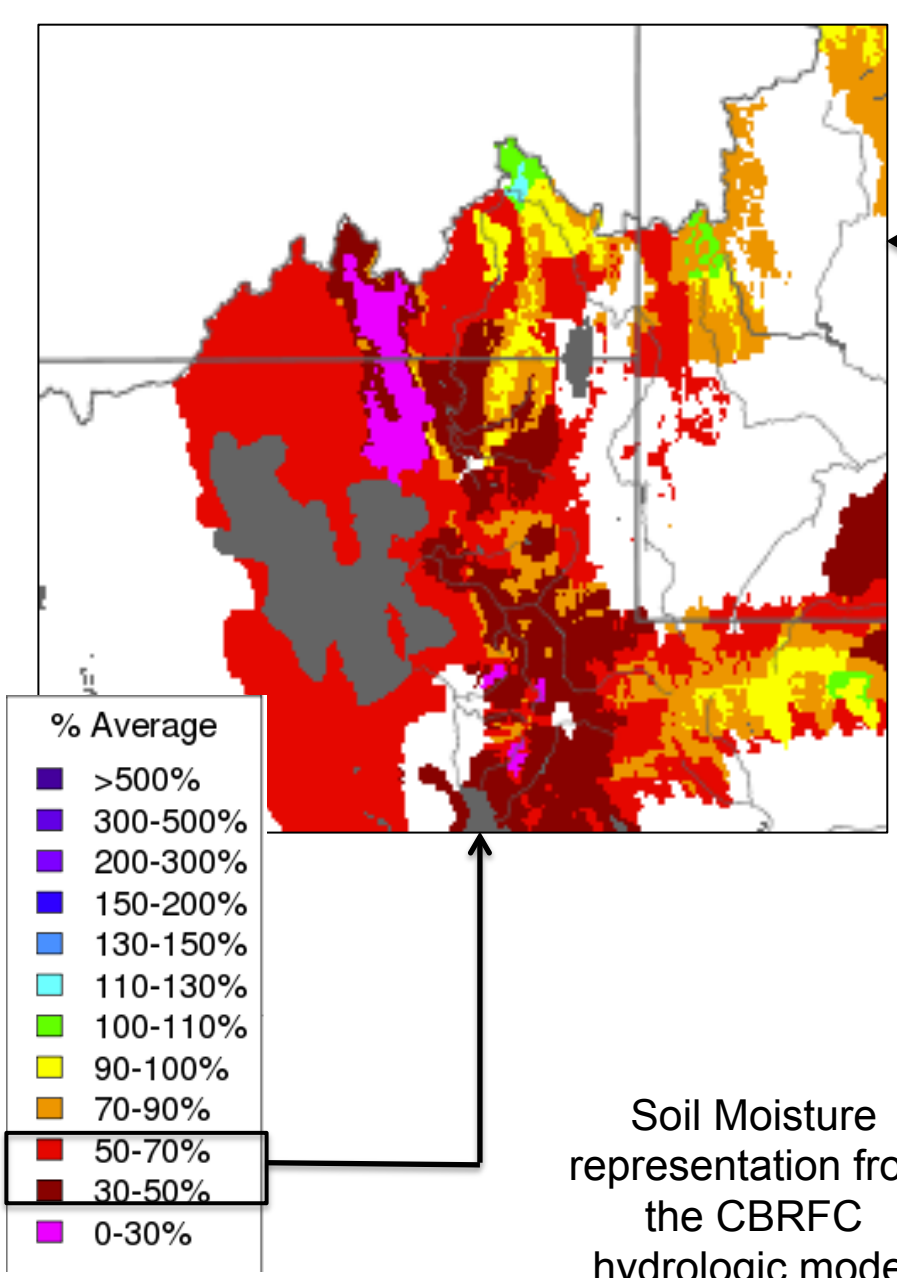
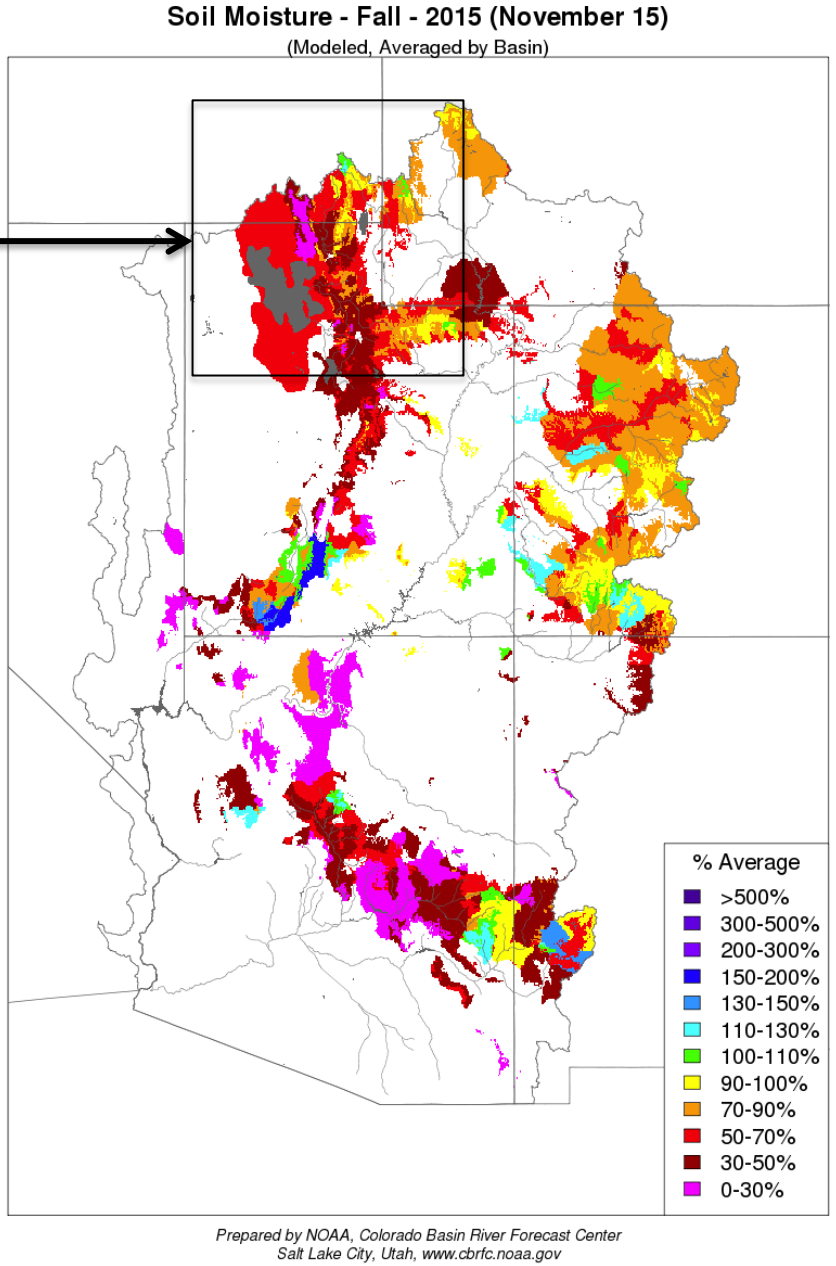
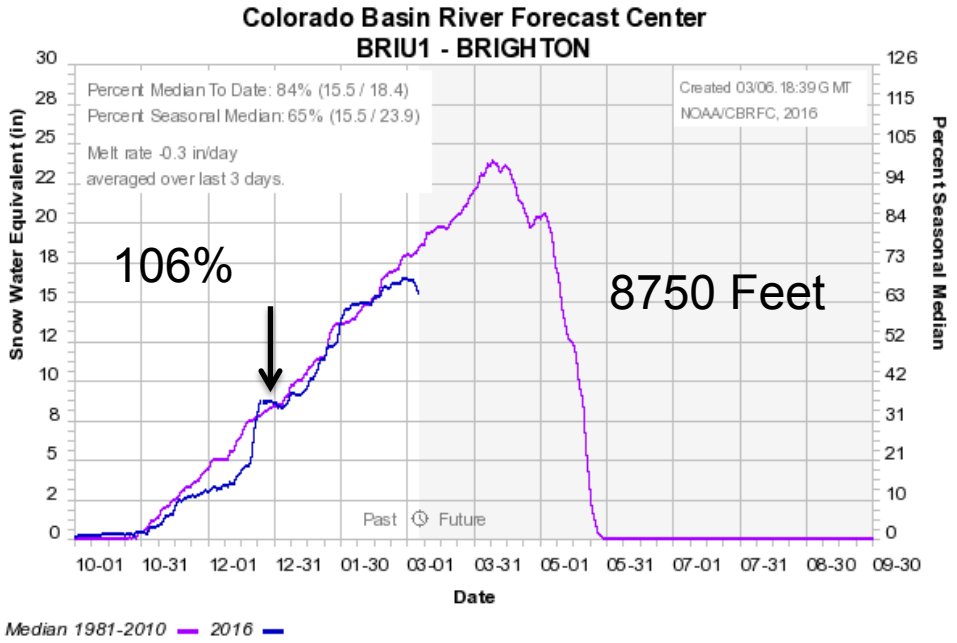
Model soil moisture conditions entering the winter

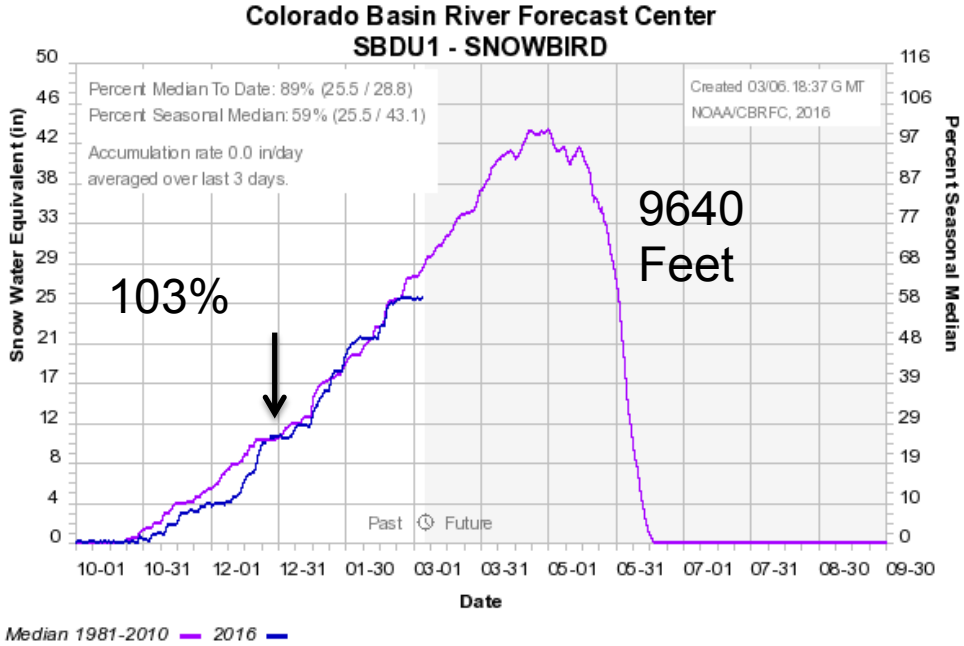


Soil Moisture representation from the CBRFC hydrologic model



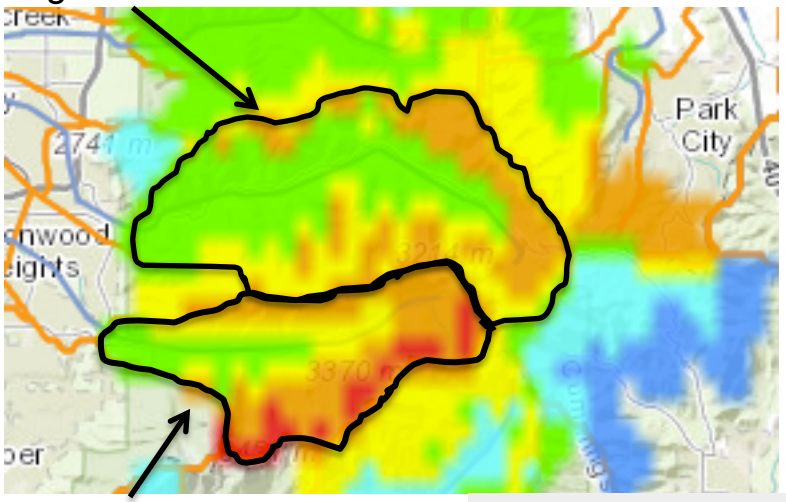
Highest elevation snow conditions – Late December 2015





Snow represented in the CBRFC hydrologic model

Big Cottonwood

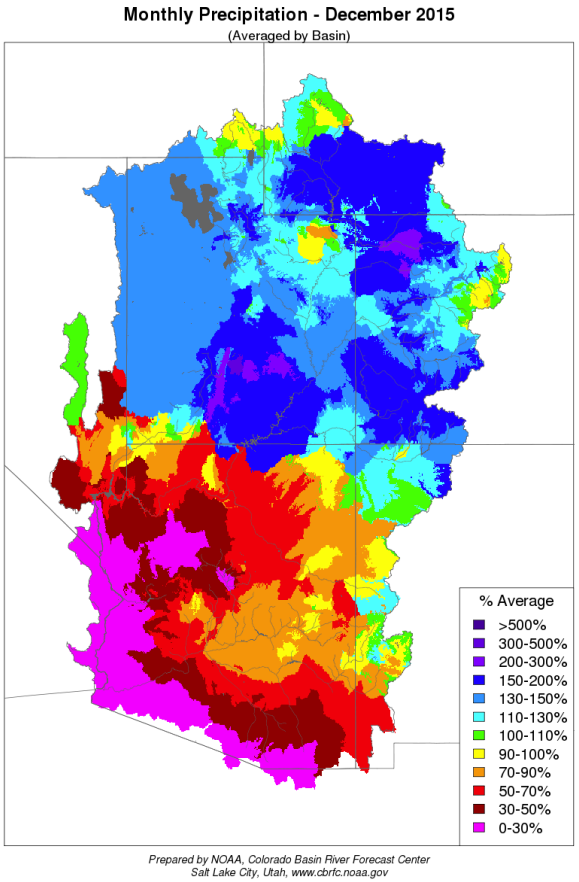


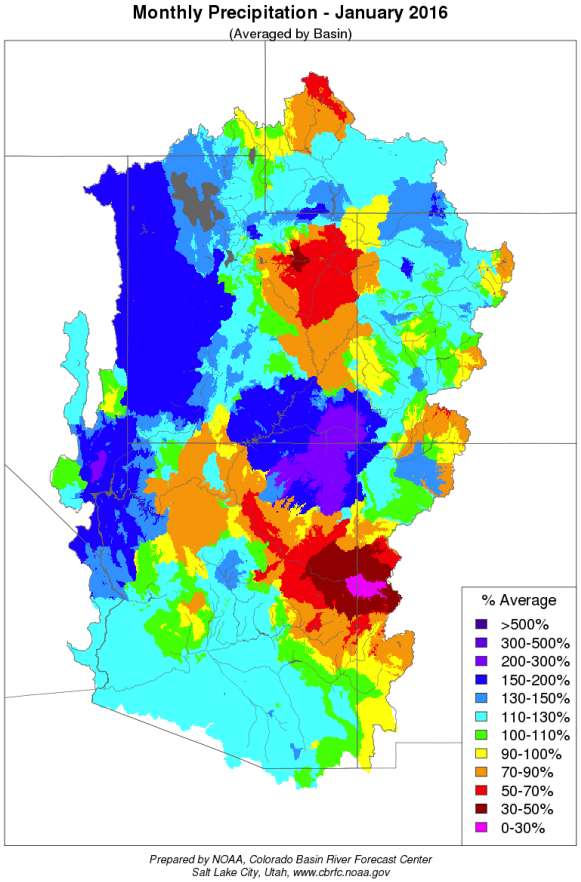
Little Cottonwood

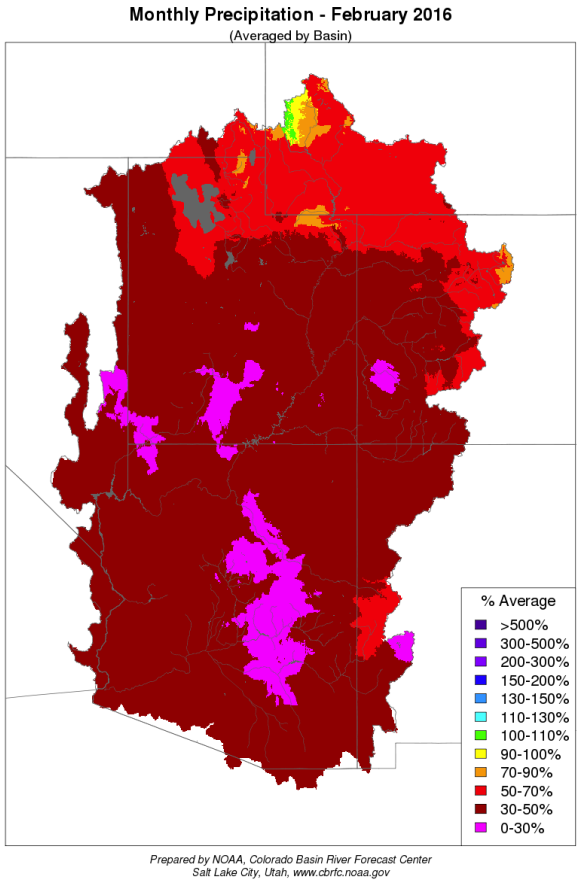
% Median SWE

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

Winter 2015 / 2016 Precipitation







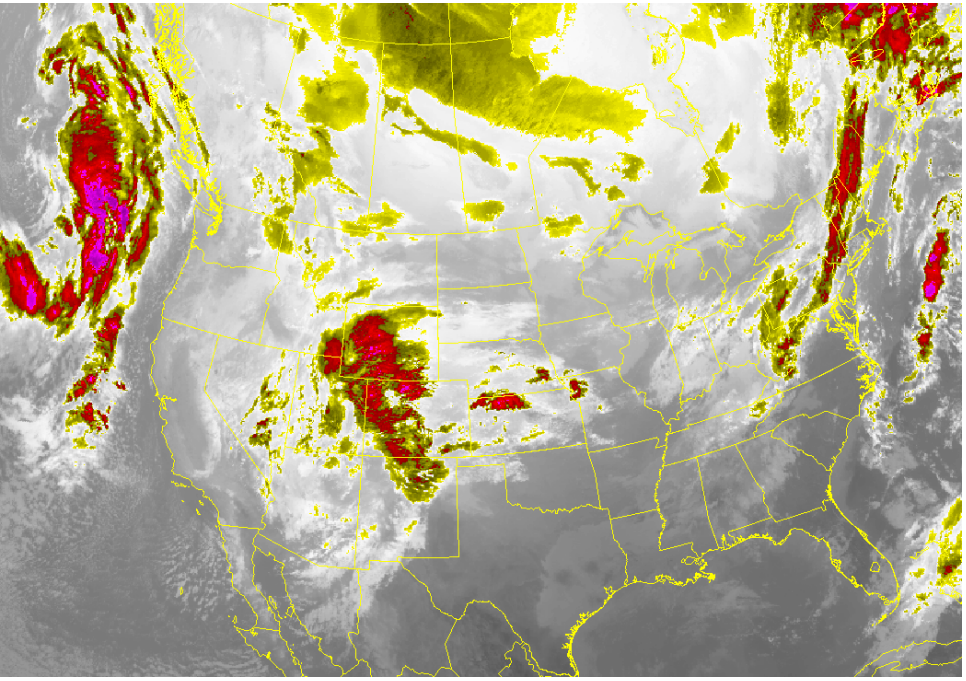
Bear :	115%
Weber:	135%
Six Creeks:	130%
Provo/UT Lake:	130%

Bear :	110%
Weber:	115%
Six Creeks:	110%
Provo/UT Lake:	105%

Bear :	70%
Weber:	60%
Six Creeks:	50%
Provo/UT Lake:	45%

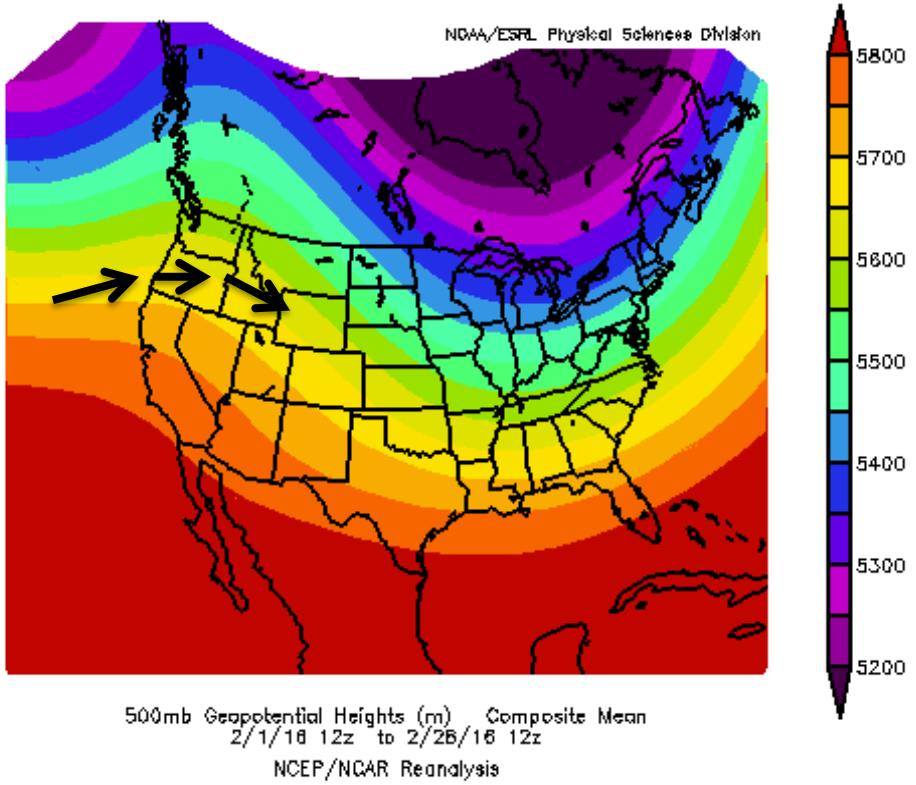
February 2016 Weather Pattern

February 1st satellite image



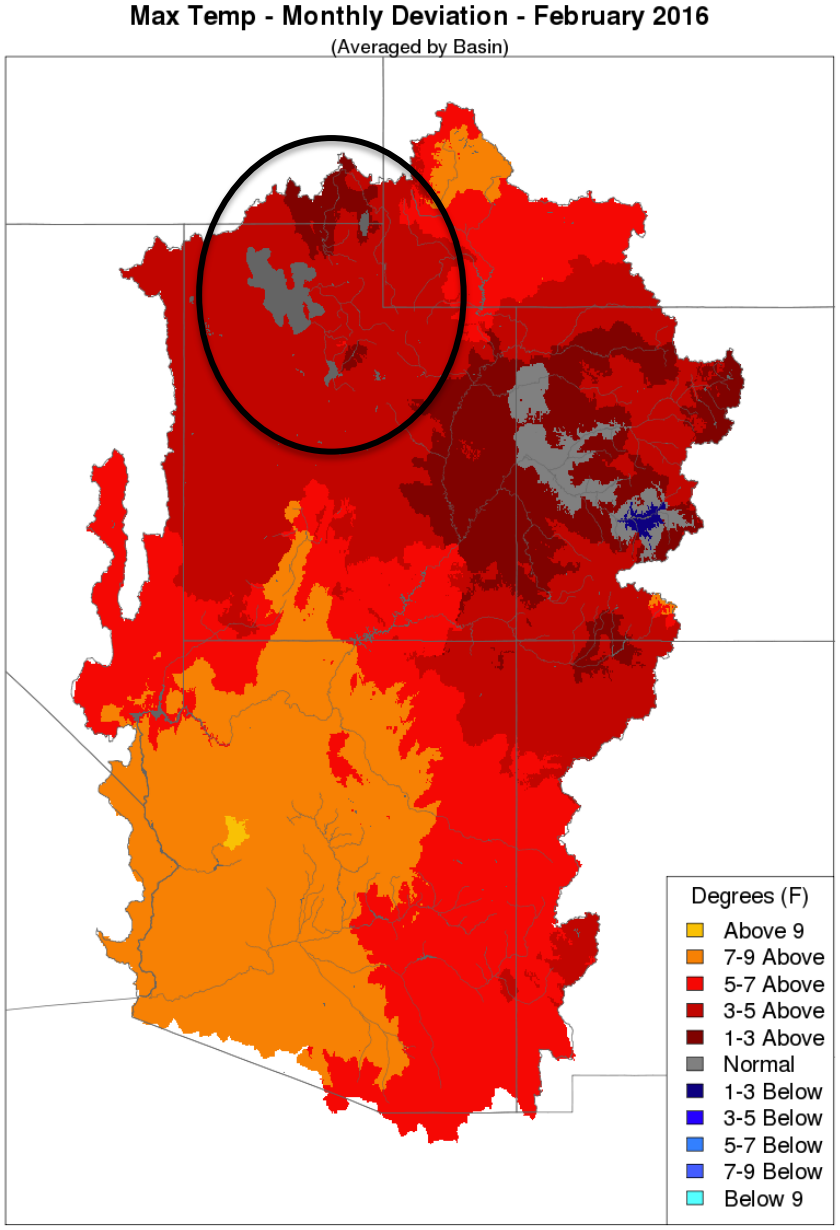
Most Feb precipitation came from just a couple of storm systems

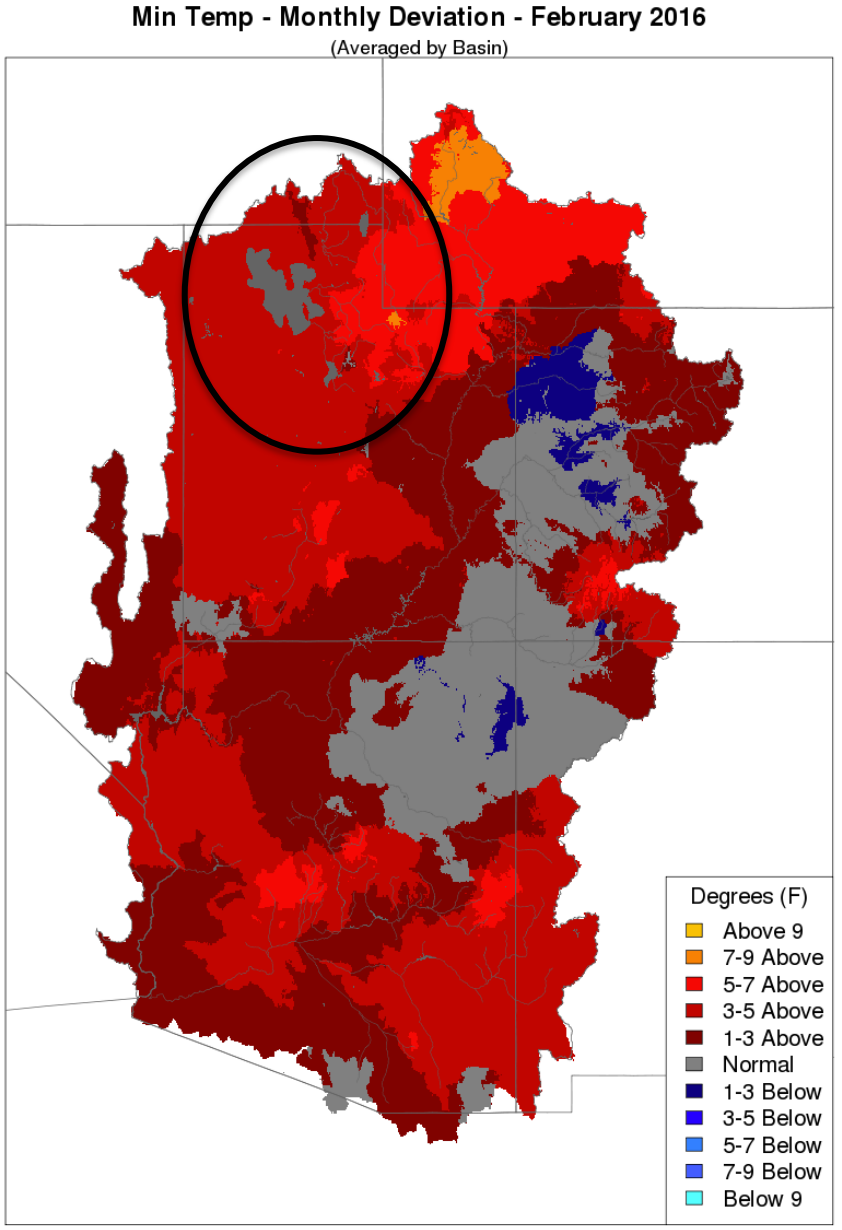
February upper atmosphere pattern



Storms encountered a ridge of high pressure; weakened, split, produced minimal precipitation.

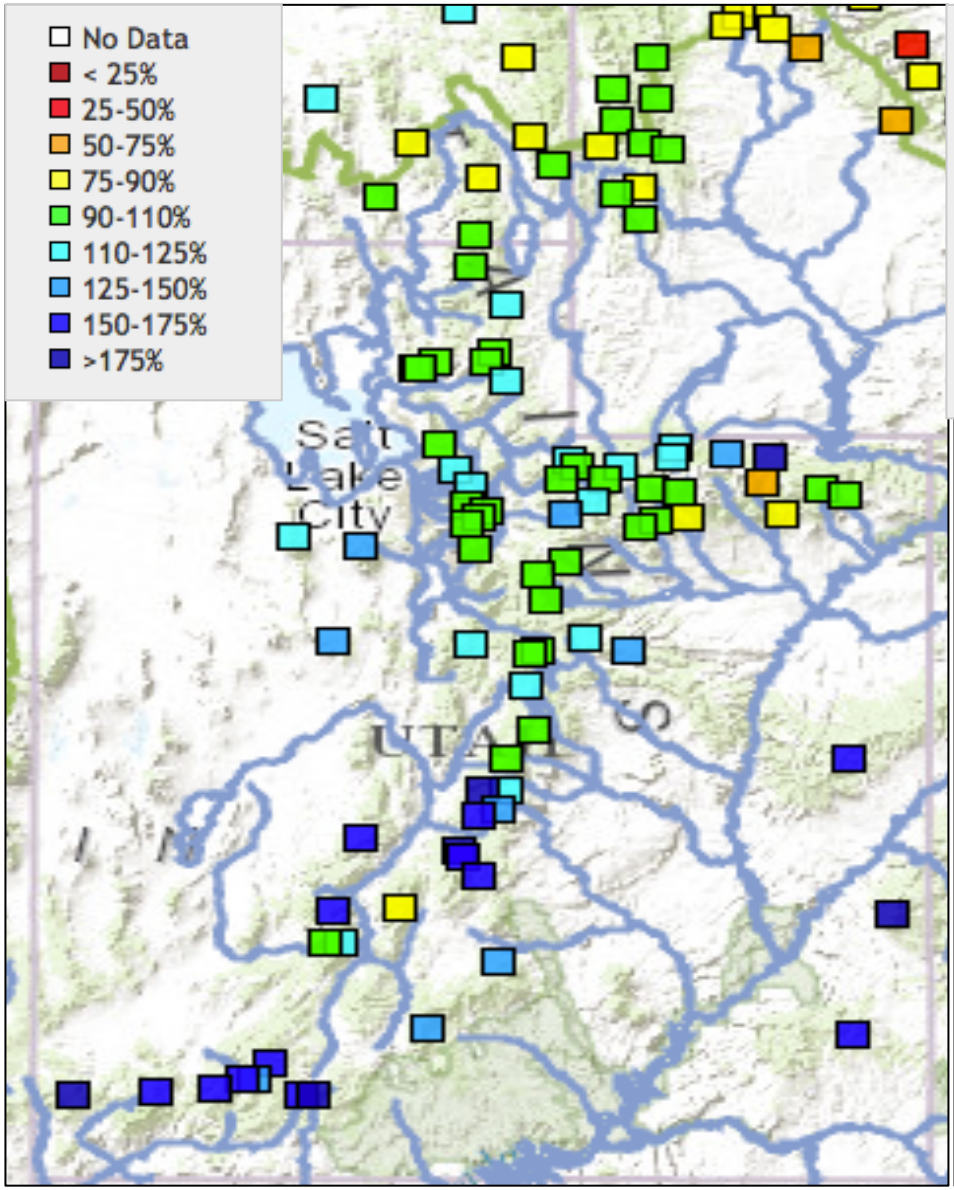
February 2016 Temperatures



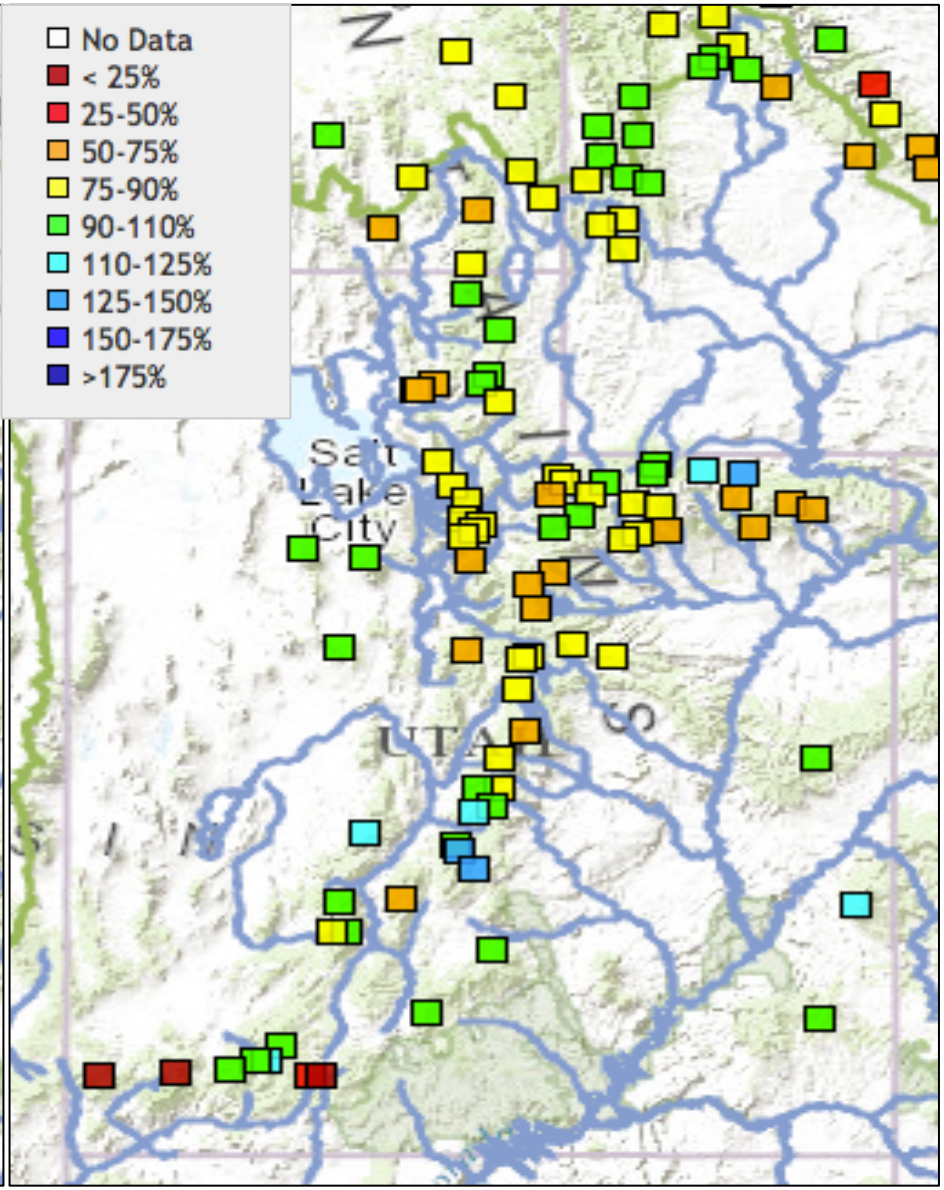


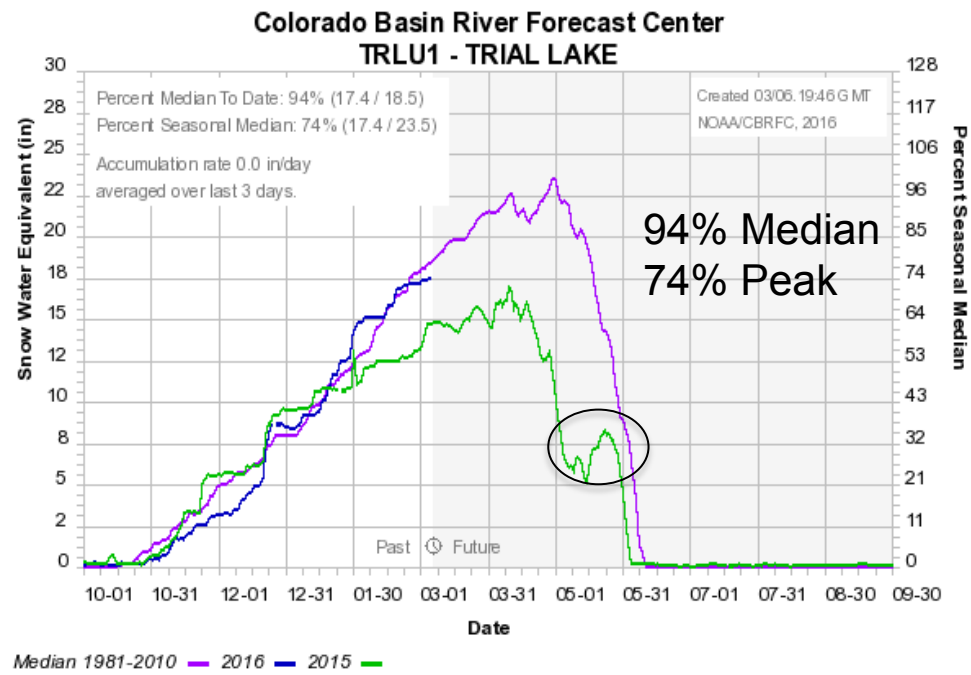
Snowpack Conditions (SNOTEL Sites)

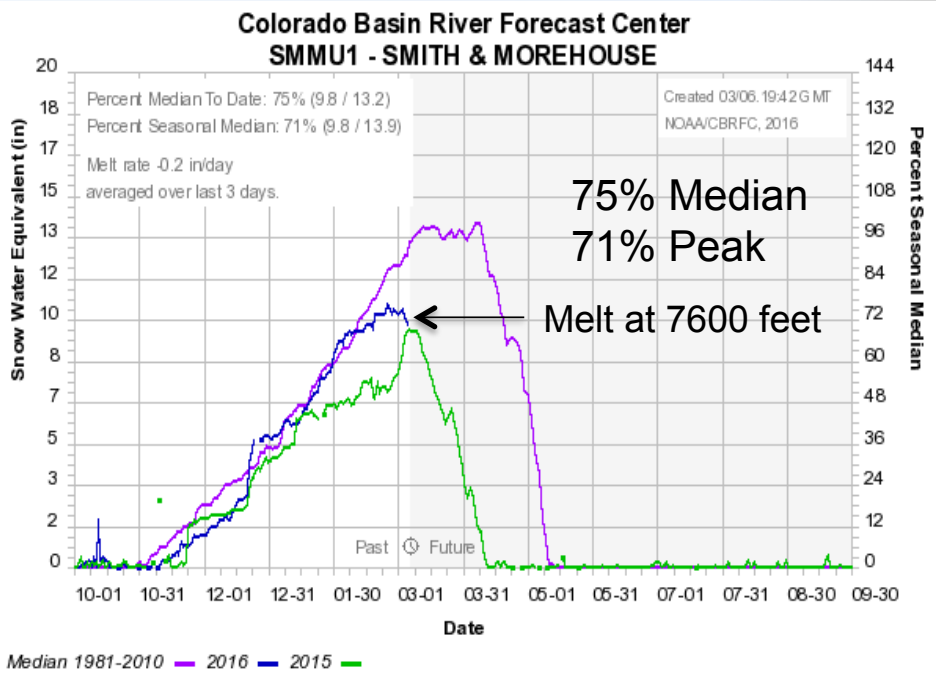
SNOW (% median): February 3 2016

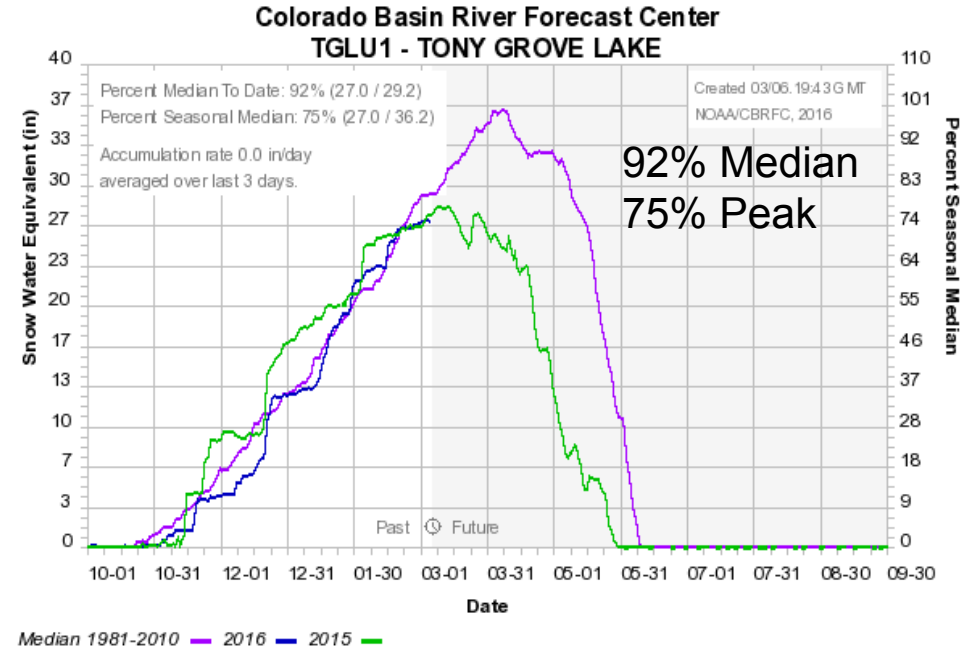


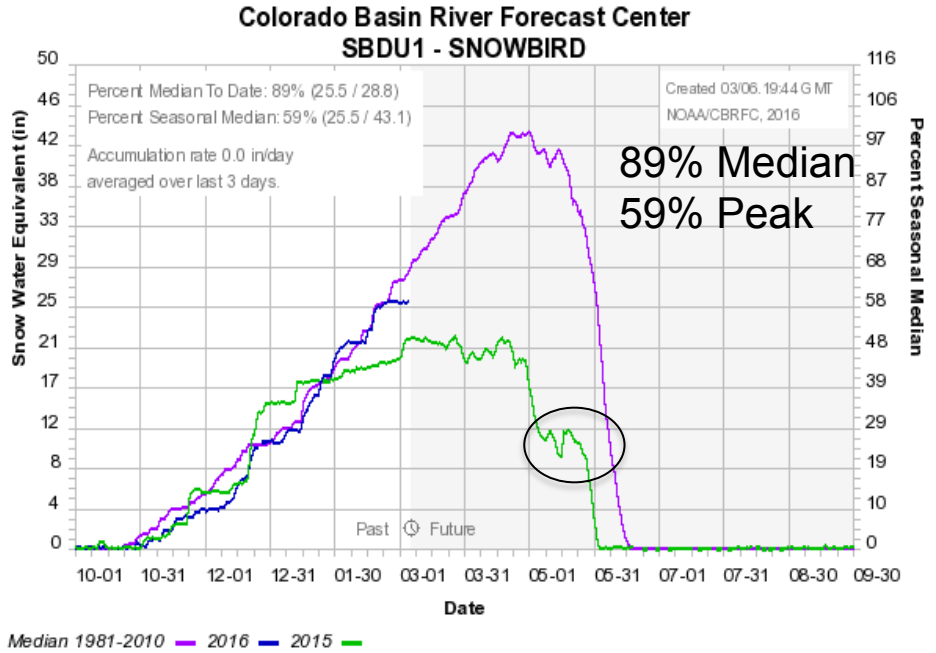
SNOW (% median): March 6 2016




Colorado Basin River Forecast Center
TRLU1 - TRIAL LAKE
Percent Median To Date: 94% (17.4 / 18.5)
Percent Seasonal Median: 74% (17.4 / 23.5)
Accumulation rate 0.0 in/day
averaged over last 3 days.
Created 03/06.19:46 G MT
NOAA/CBRFC, 2016
94% Median
74% Peak
Past
Future
Snow Water Equivalent (in)
Percent Seasonal Median
Date
Median 1981-2010
2016
2015


Colorado Basin River Forecast Center
SMMU1 - SMITH & MOREHOUSE
Percent Median To Date: 75% (9.8 / 13.2)
Percent Seasonal Median: 71% (9.8 / 13.9)
Melt rate -0.2 in/day
averaged over last 3 days.
Created 03/06.19:42 G MT
NOAA/CBRFC, 2016
75% Median
71% Peak
Melt at 7600 feet
Past
Future
Snow Water Equivalent (in)
Percent Seasonal Median
Date
Median 1981-2010
2016
2015

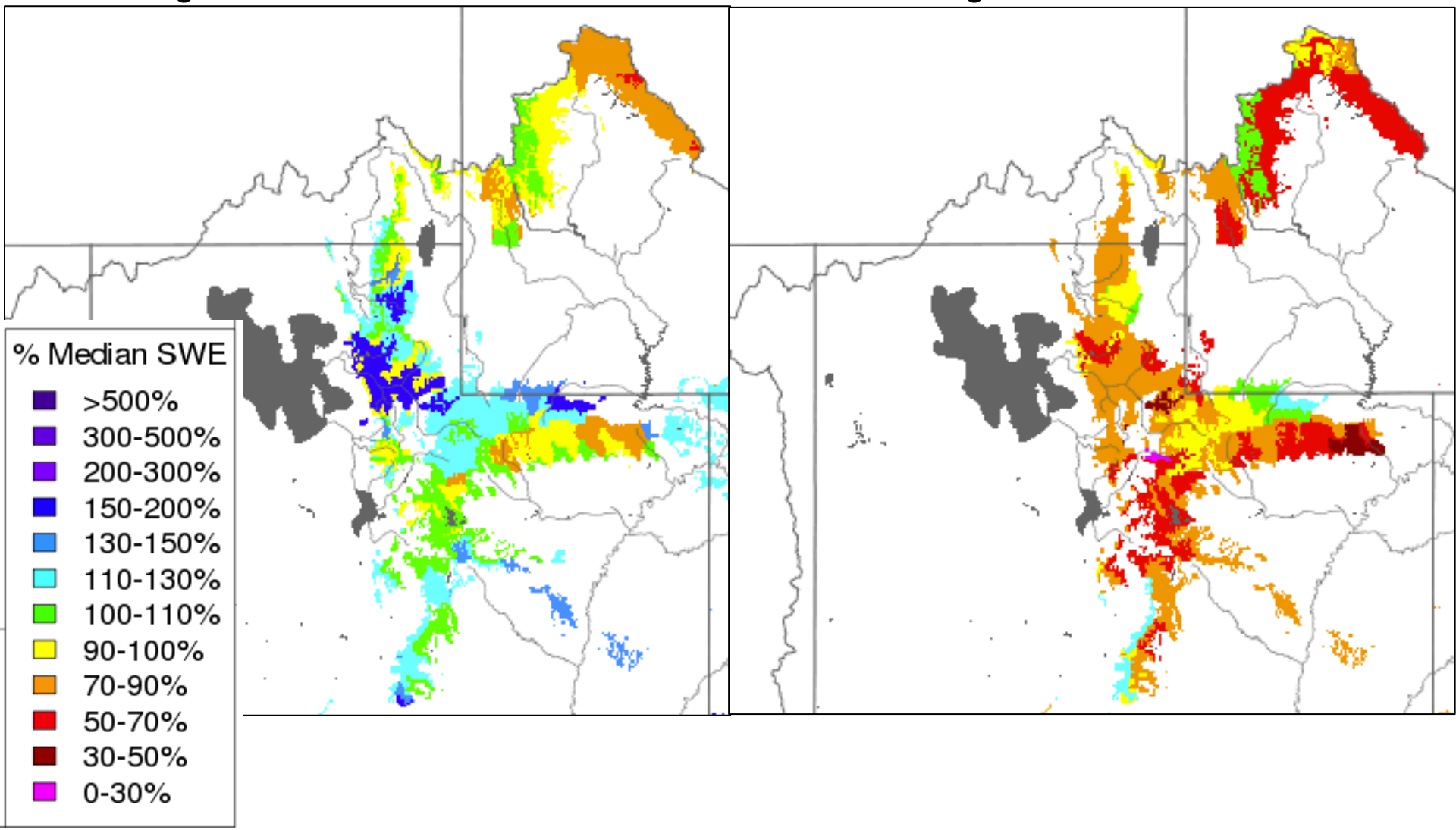

Colorado Basin River Forecast Center
TGLU1 - TONY GROVE LAKE
Percent Median To Date: 92% (27.0 / 29.2)
Percent Seasonal Median: 75% (27.0 / 36.2)
Accumulation rate 0.0 in/day
averaged over last 3 days.
Created 03/06.19:43 G MT
NOAA/CBRFC, 2016
92% Median
75% Peak
Past
Future
Snow Water Equivalent (in)
Percent Seasonal Median
Date
Median 1981-2010
2016
2015


Colorado Basin River Forecast Center
SBDU1 - SNOWBIRD
Percent Median To Date: 89% (25.5 / 28.8)
Percent Seasonal Median: 59% (25.5 / 43.1)
Accumulation rate 0.0 in/day
averaged over last 3 days.
Created 03/06.19:44 G MT
NOAA/CBRFC, 2016
89% Median
59% Peak
Past
Future
Snow Water Equivalent (in)
Percent Seasonal Median
Date
Median 1981-2010
2016
2015

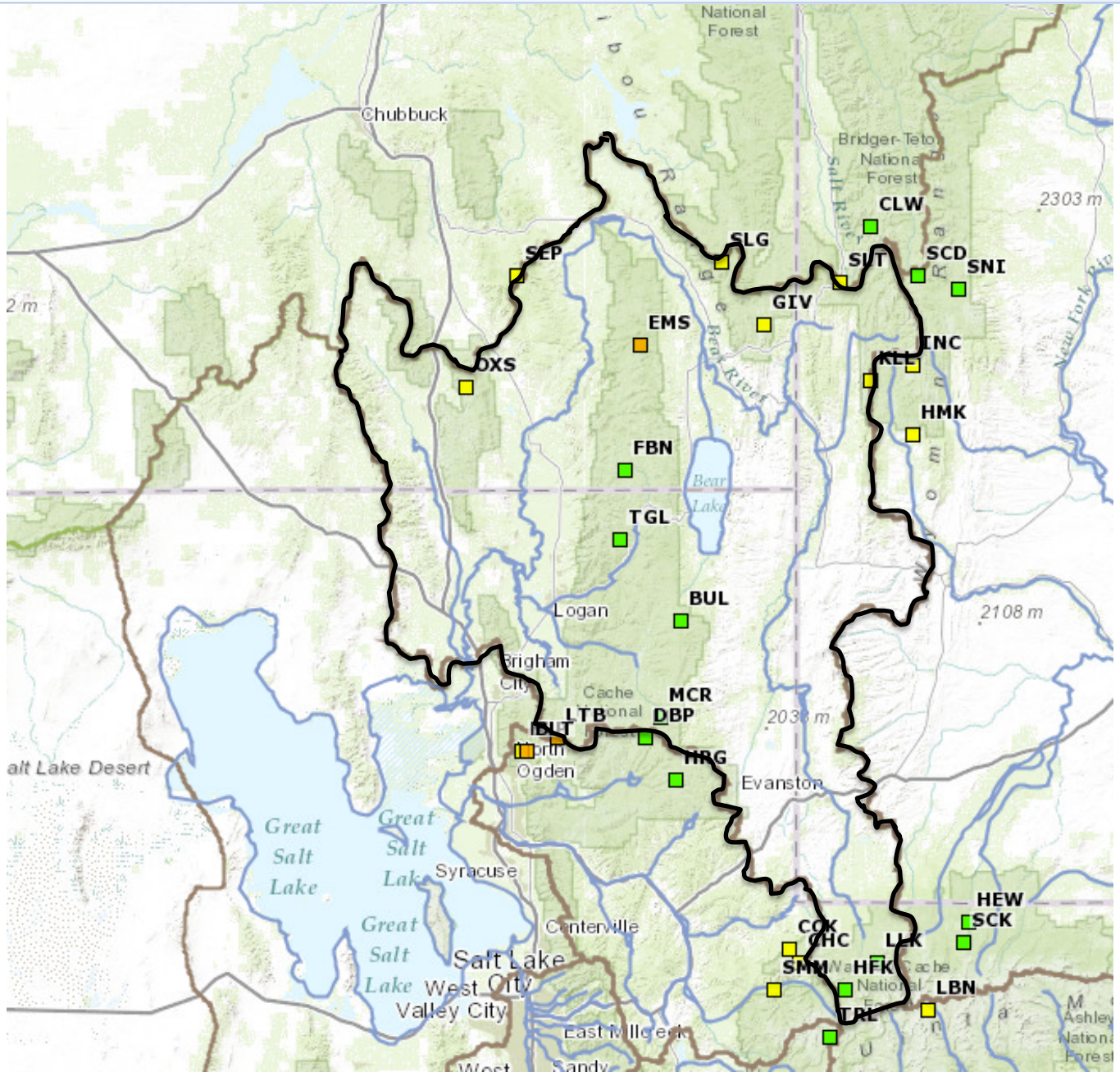
Snow - CBRFC Hydrologic Model

Feb 1st 2016
Significant Runoff Areas

Mar 6th 2016
Significant Runoff Areas



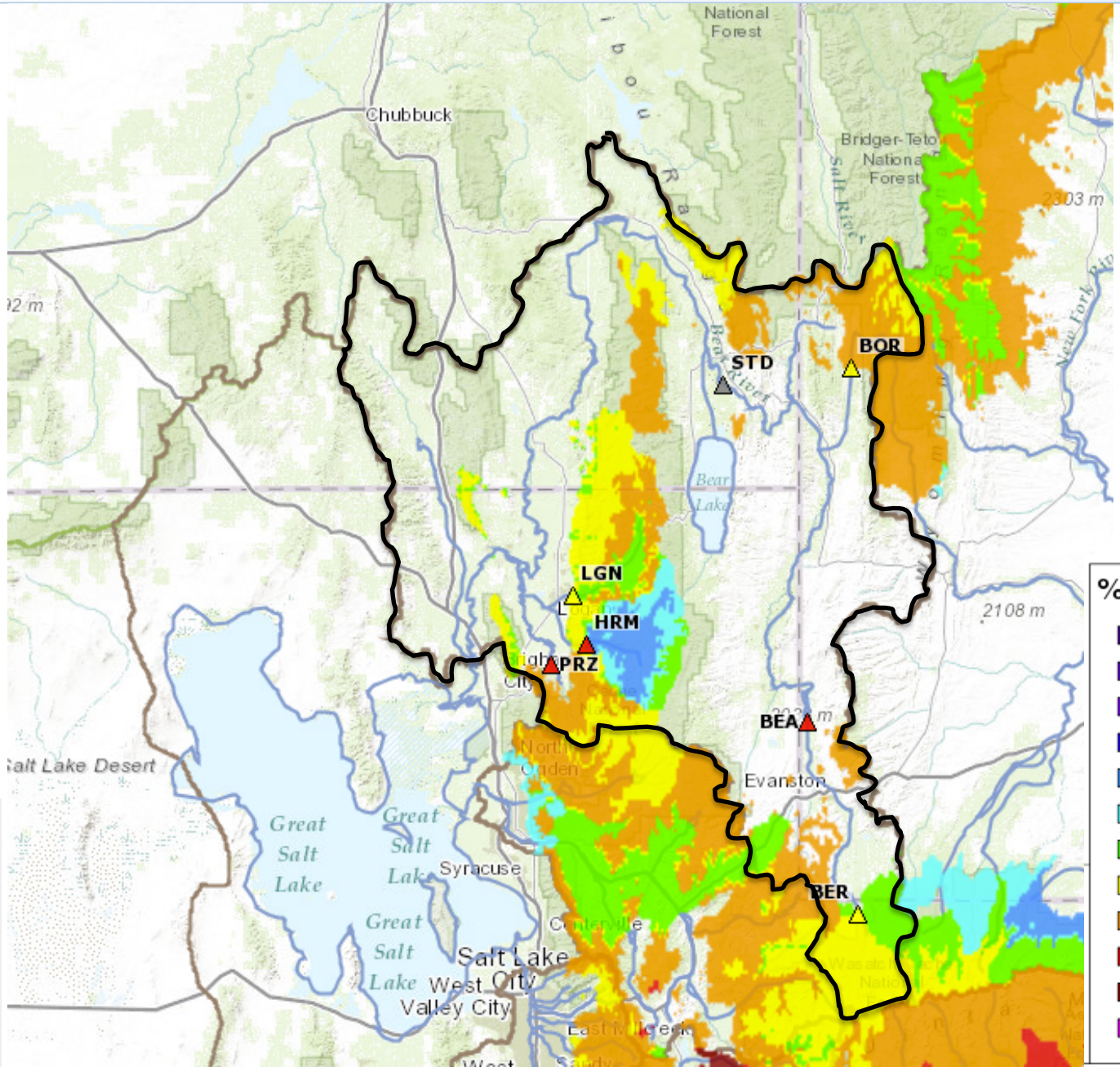
Bear River Basin: March 4th SNOTEL (percent of median)



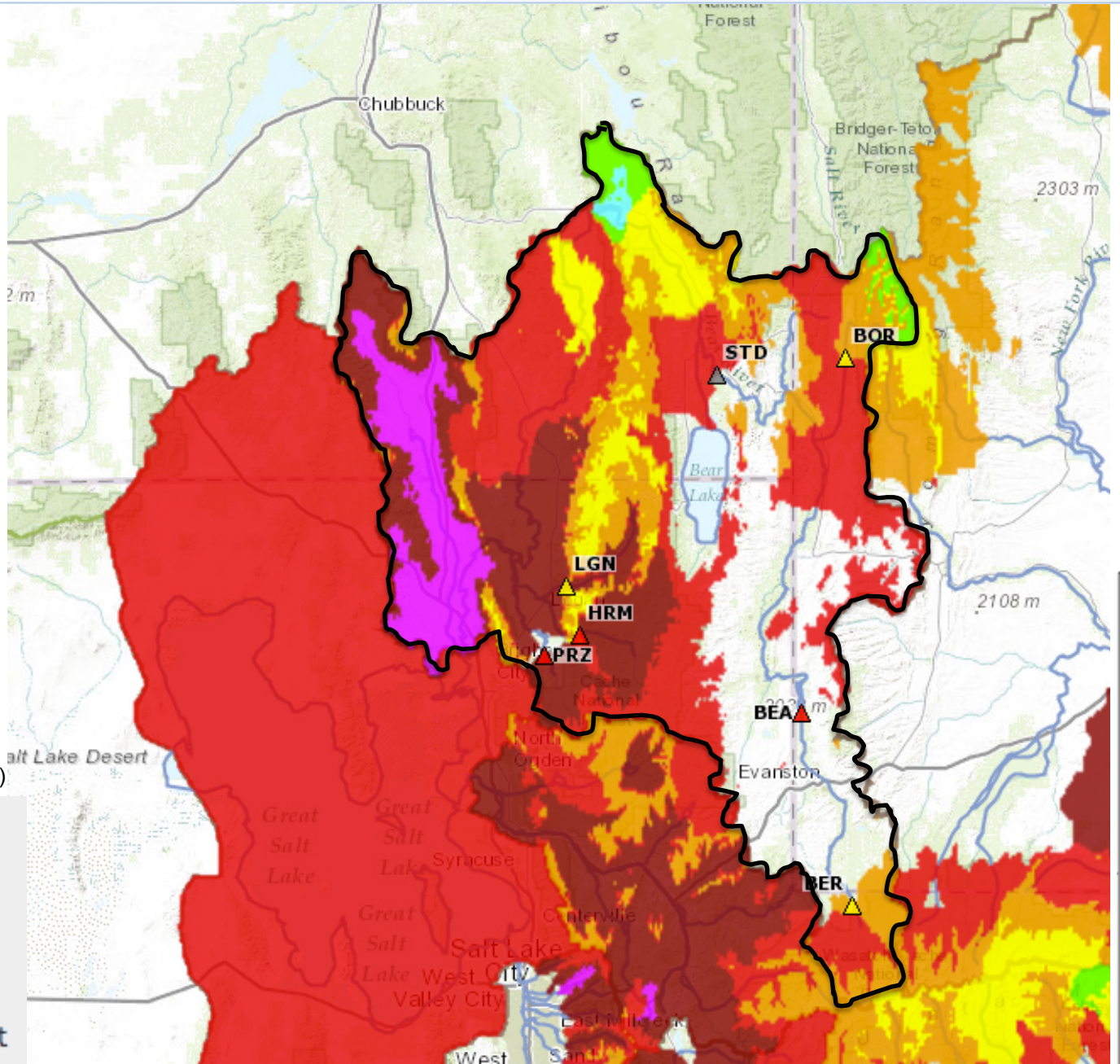
SNOTEL
Percent of Median

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

Bear River Basin: CBRFC Model Snow – March 4th



Bear River Basin: CBRFC Model soil moisture entering winter



Water supply forecast point

(% average Forecast)

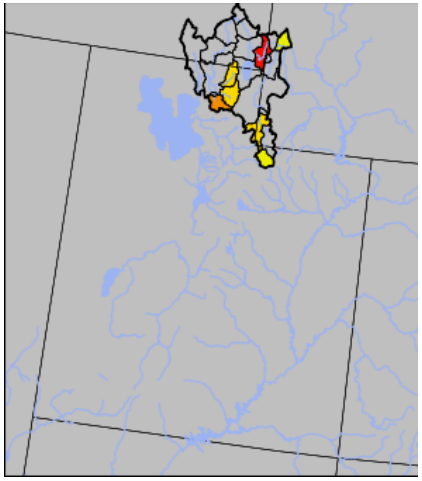
- < 70%
- 70-90%
- 90-110%
- 110-130%
- >130%
- Regulated
- No Forecast

CBRFC Model Soil Moisture

% Normal

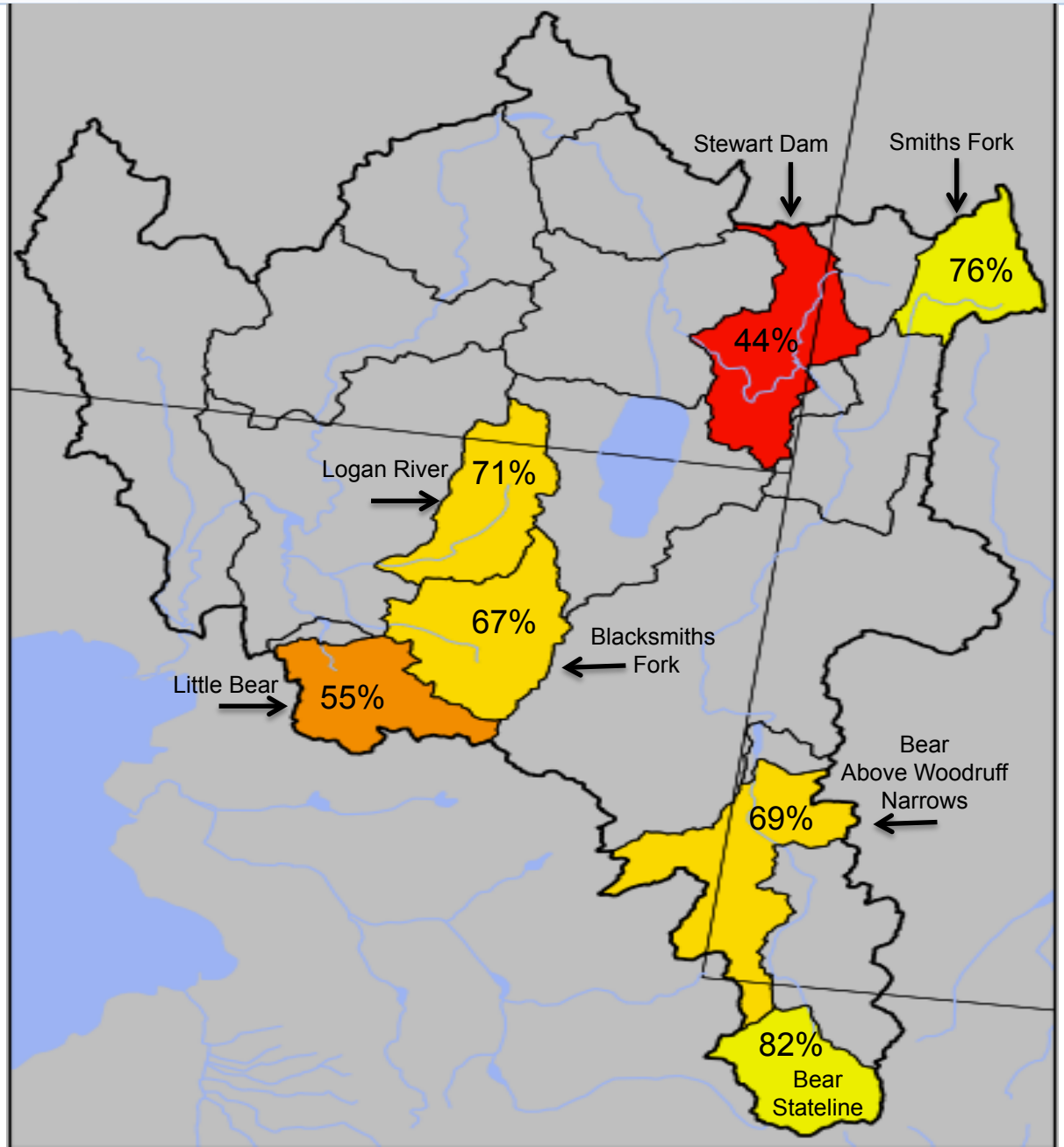
- >500%
- 300-500%
- 200-300%
- 150-200%
- 130-150%
- 110-130%
- 100-110%
- 90-100%
- 70-90%
- 50-70%
- 30-50%
- 0-30%

March 1st Water Supply Forecasts – Bear River Basin

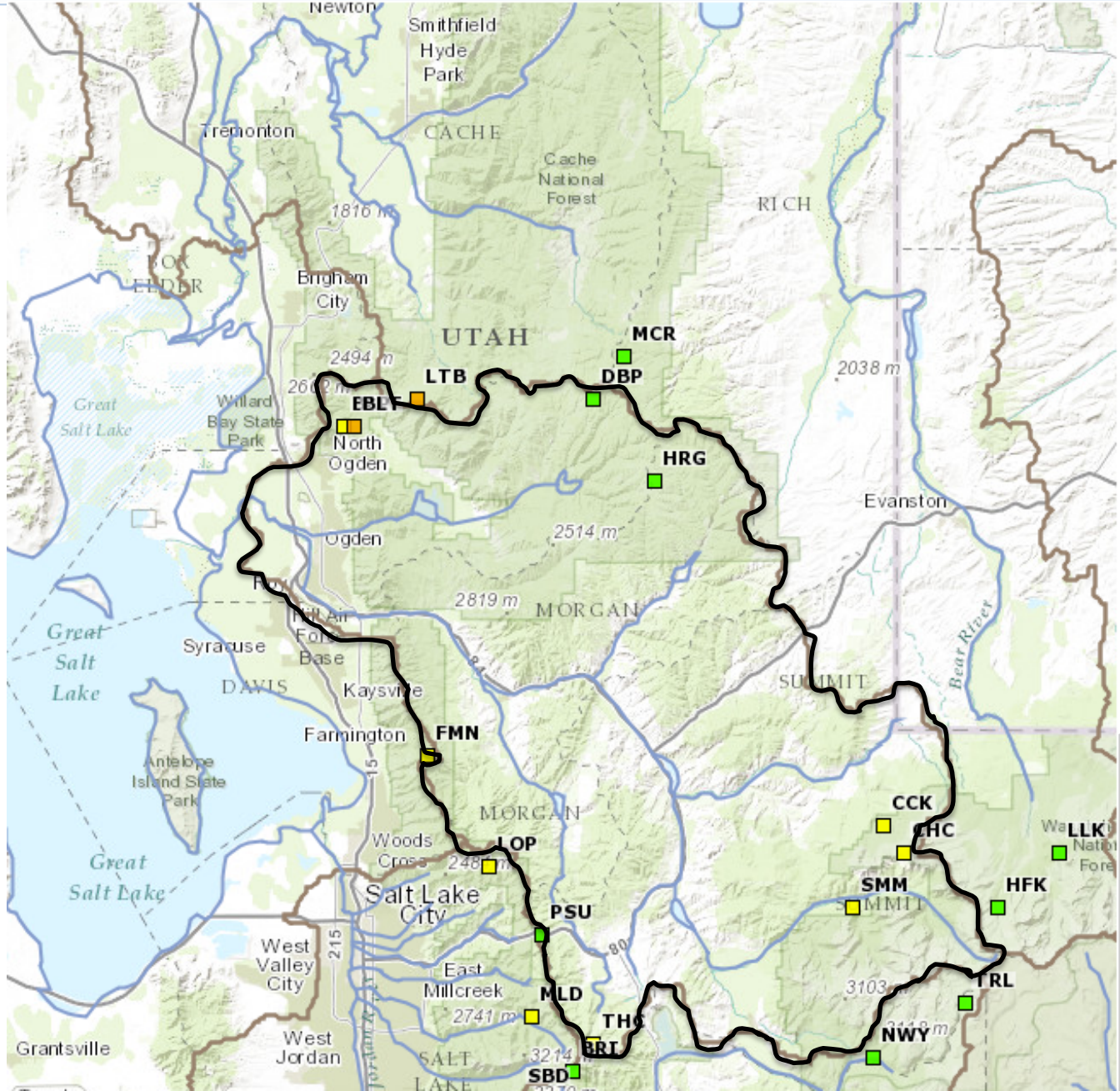


April-July
Forecast
Streamflow Volumes
(% of 1981-2010 average)

- Below 25%
- 25% - 35%
- 35% - 45%
- 45% - 55%
- 55% - 65%
- 65% - 75%
- 75% - 85%
- 85% - 95%
- 95% - 105%
- 105% - 115%
- 115% - 125%
- 125% - 135%
- 135% - 145%
- 145% - 155%
- 155% - 165%
- 165% - 175%
- Above 175%
- NA



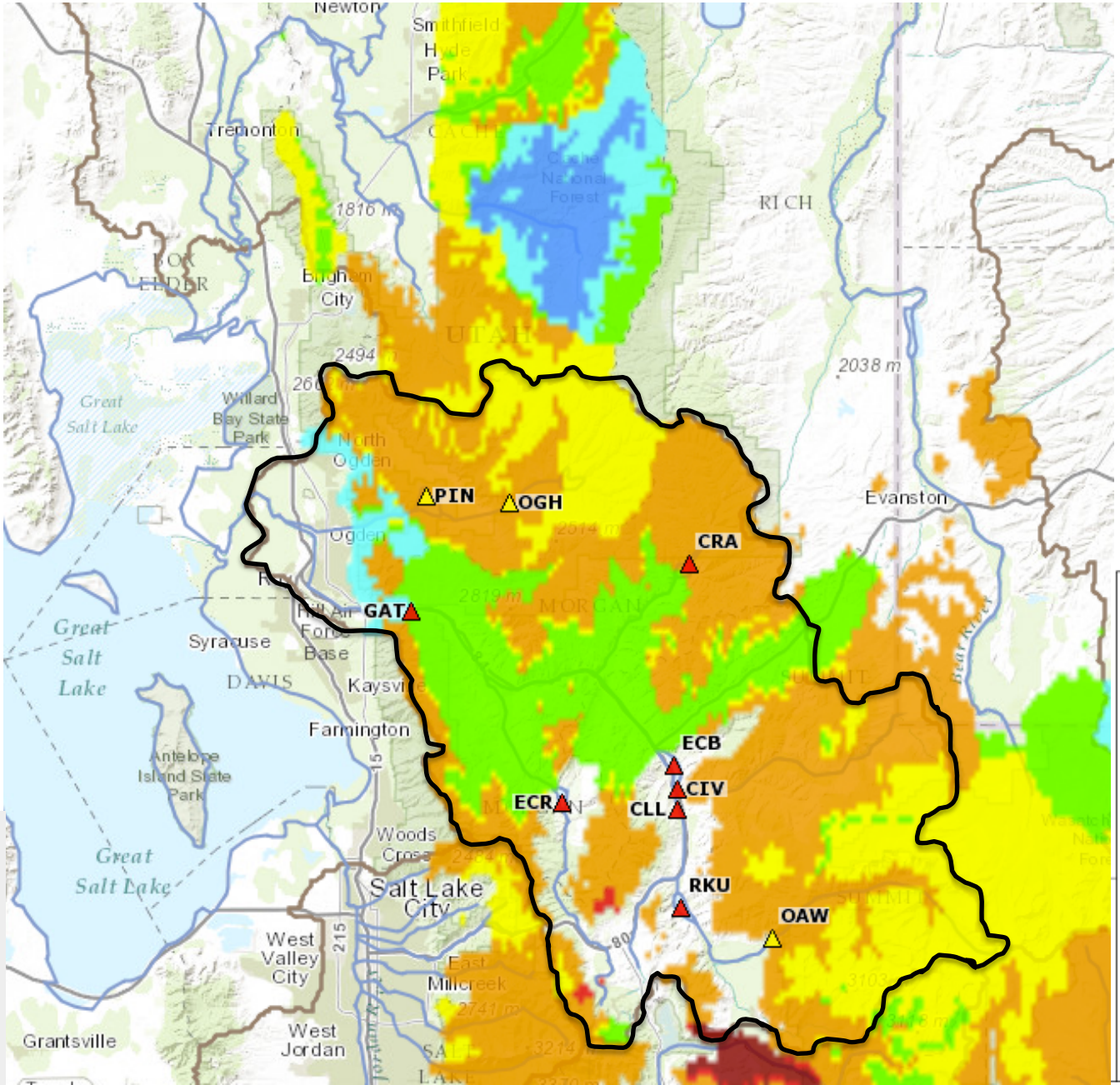
Weber River Basin: March 4th SNOTEL (percent of median)



SNOTEL
Percent of Median

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

Weber River Basin: CBRFC Model Snow – March 4th



Water supply forecast point

(% average Forecast)

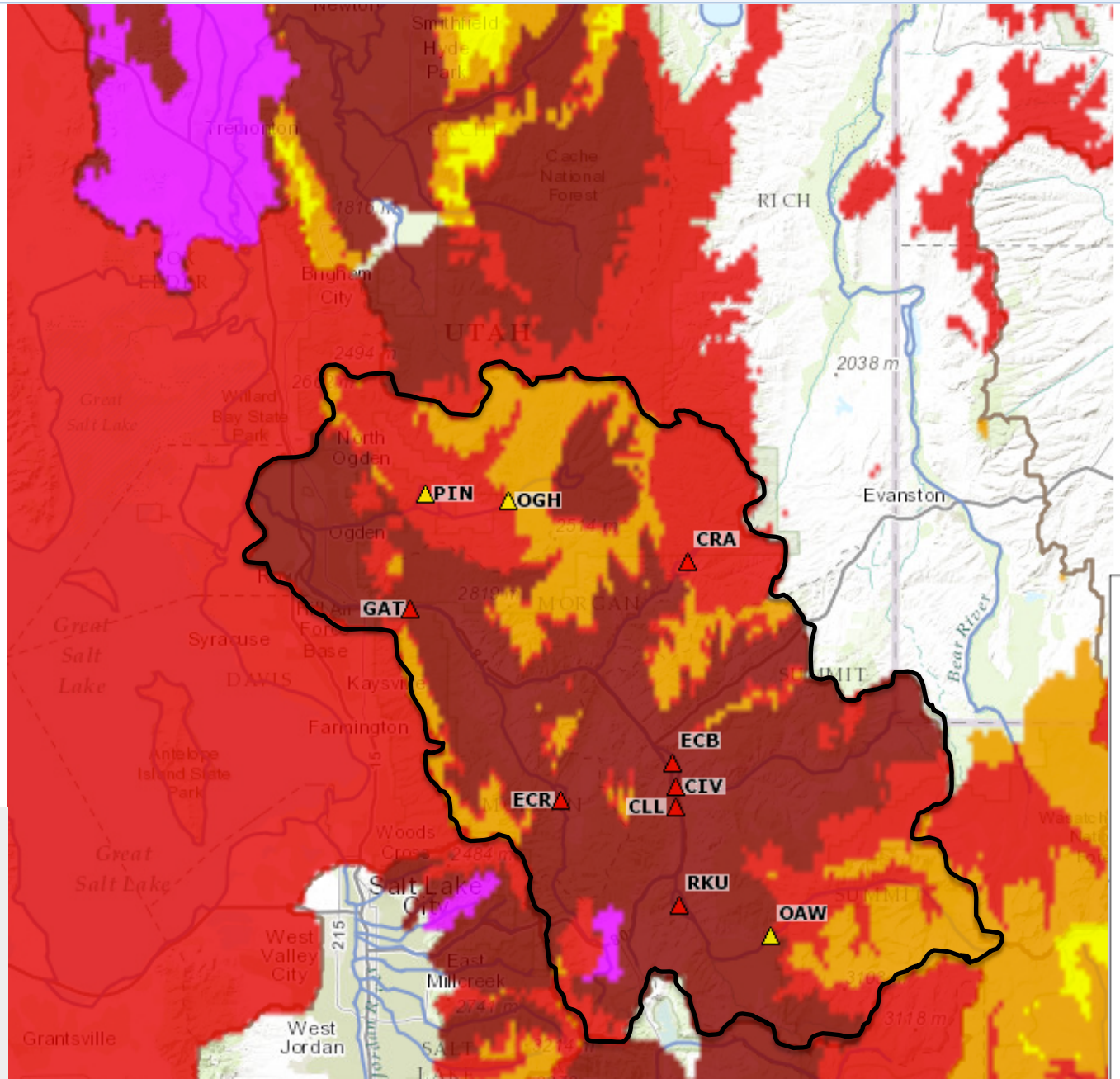
- < 70%
- 70-90%
- 90-110%
- 110-130%
- >130%
- Regulated
- No Forecast

CBRFC Model Snow

% Median SWE

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

Weber River Basin: CBRFC Model soil moisture entering winter



Water supply forecast point

(% average Forecast)

- < 70%
- 70-90%
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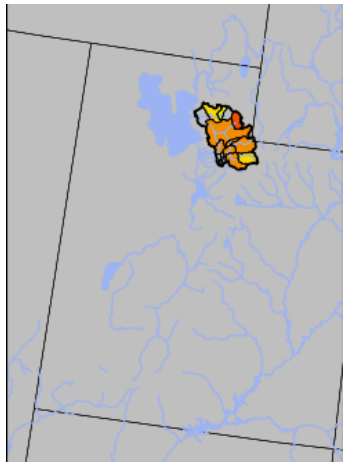
- 110-130%
- >130%
- Regulated
- No Forecast

CBRFC Model Soil Moisture

% Normal

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

March 1st Water Supply Forecasts – Weber River Basin



April-July Forecast Streamflow Volumes (% of 1981-2010 average)

- Below 25%
- 25% - 35%
- 35% - 45%
- 45% - 55%
- 55% - 65%
- 65% - 75%
- 75% - 85%
- 85% - 95%
- 95% - 105%
- 105% - 115%
- 115% - 125%
- 125% - 135%
- 135% - 145%
- 145% - 155%
- 155% - 165%
- 165% - 175%
- Above 175%
- NA

South Fork Ogden

72% Pineview Inflow

82%

53% Lost Creek Inflow

58% Weber-Gateway

Echo

63%

60% East Canyon Inflow

Weber Coalville

63%

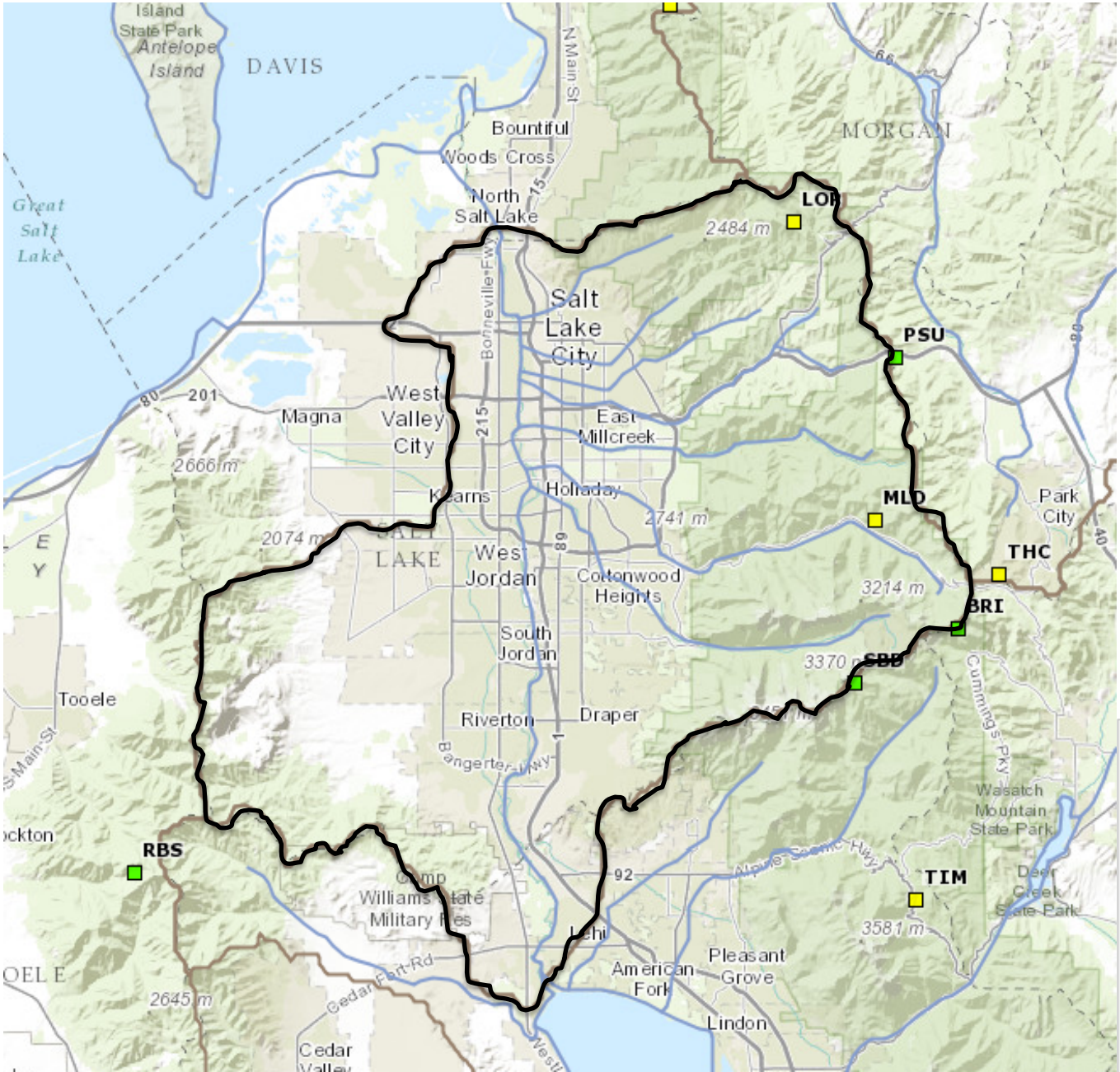
56% Chalk Creek

64%

88% Weber-Oakley

Rockport Inflow

Six Creeks: March 4th SNOTEL (percent of median)



SNOTEL
Percent of Median

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- < 25%
- 25-50%
- 50-75%
- 75-90%
- 90-110%
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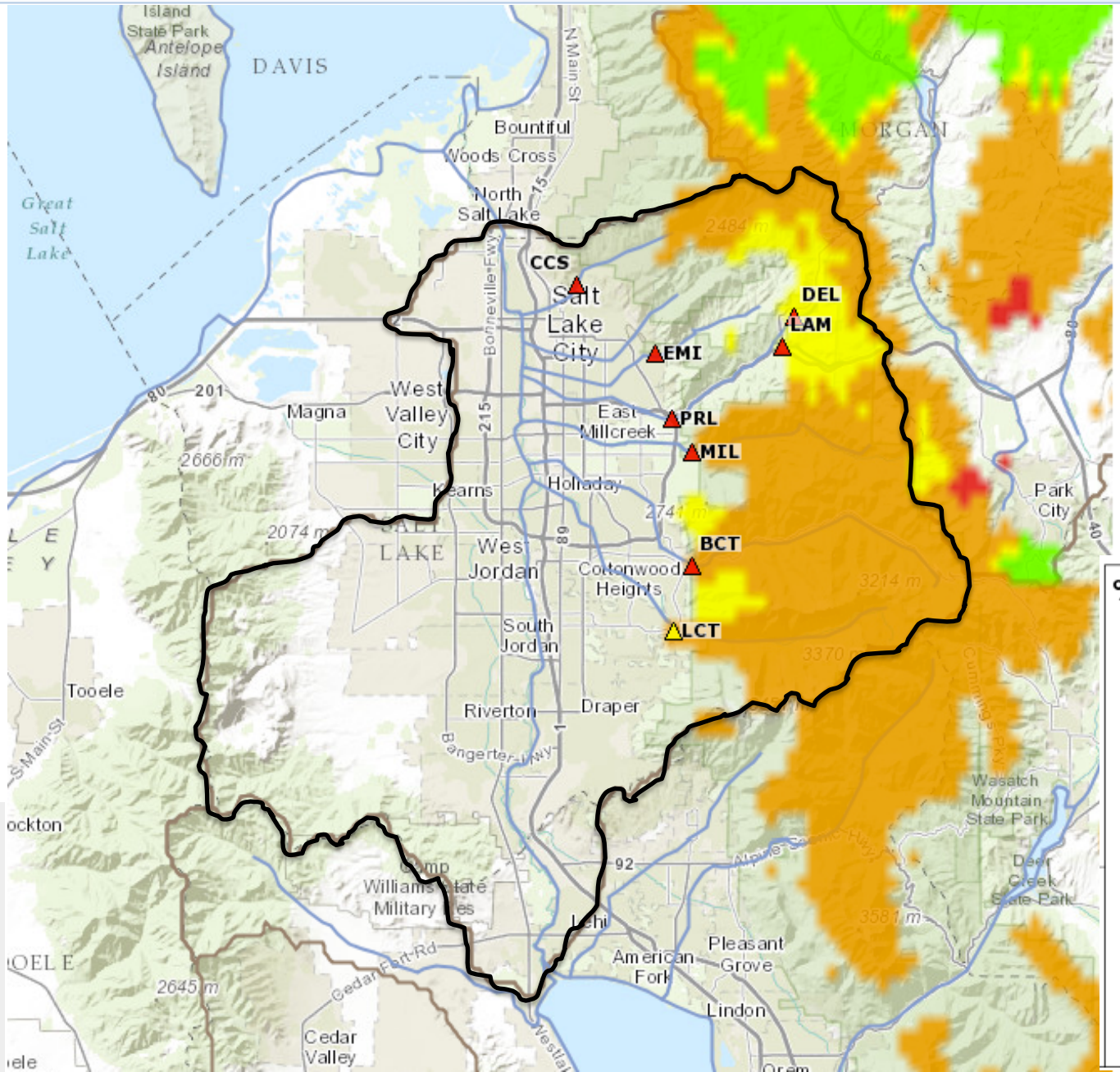
- 125-150%
- 150-175%
- >175%

Six Creeks: CBRFC Model Snow – March 4th



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CBRFC Model Snow

% Median SWE

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- 130-150%
- 110-130%
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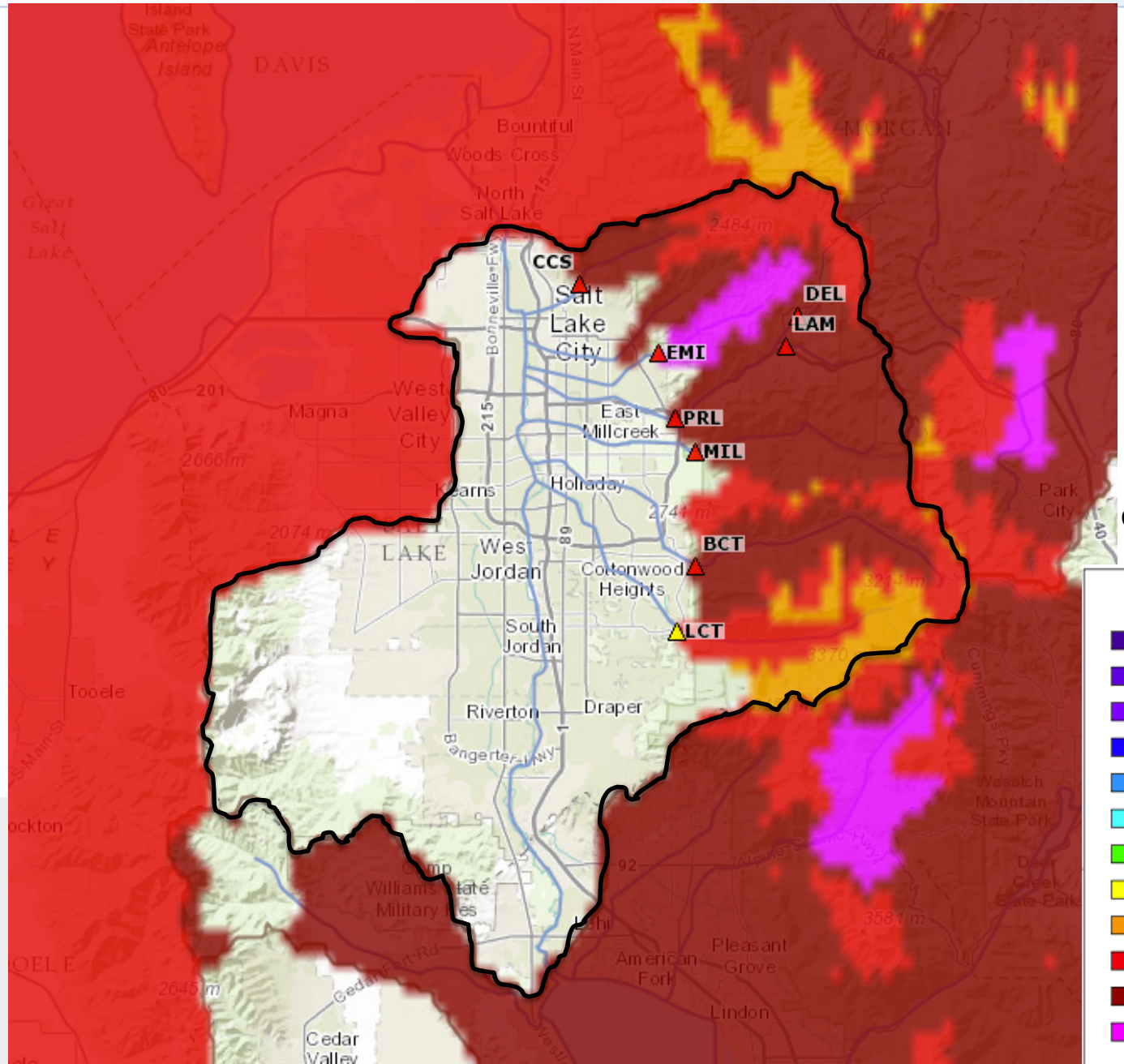
- 50-70%
- 30-50%
- 0-30%

Six Creeks: CBRFC Model soil moisture entering winter



Water supply forecast point

(% average Forecast)

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CBRFC Model Soil Moisture

% Normal

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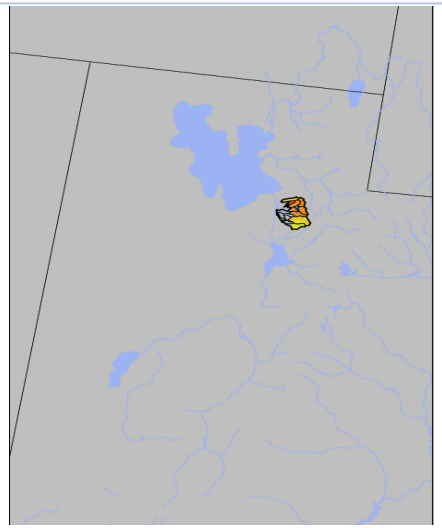
- 100-110%
- 90-100%
- 70-90%
- 50-70%
- 30-50%
- 0-30%

March 1st Water Supply Forecasts – Six Creeks



April-July
Forecast
Streamflow Volumes
(% of 1981-2010 average)

- Below 25%
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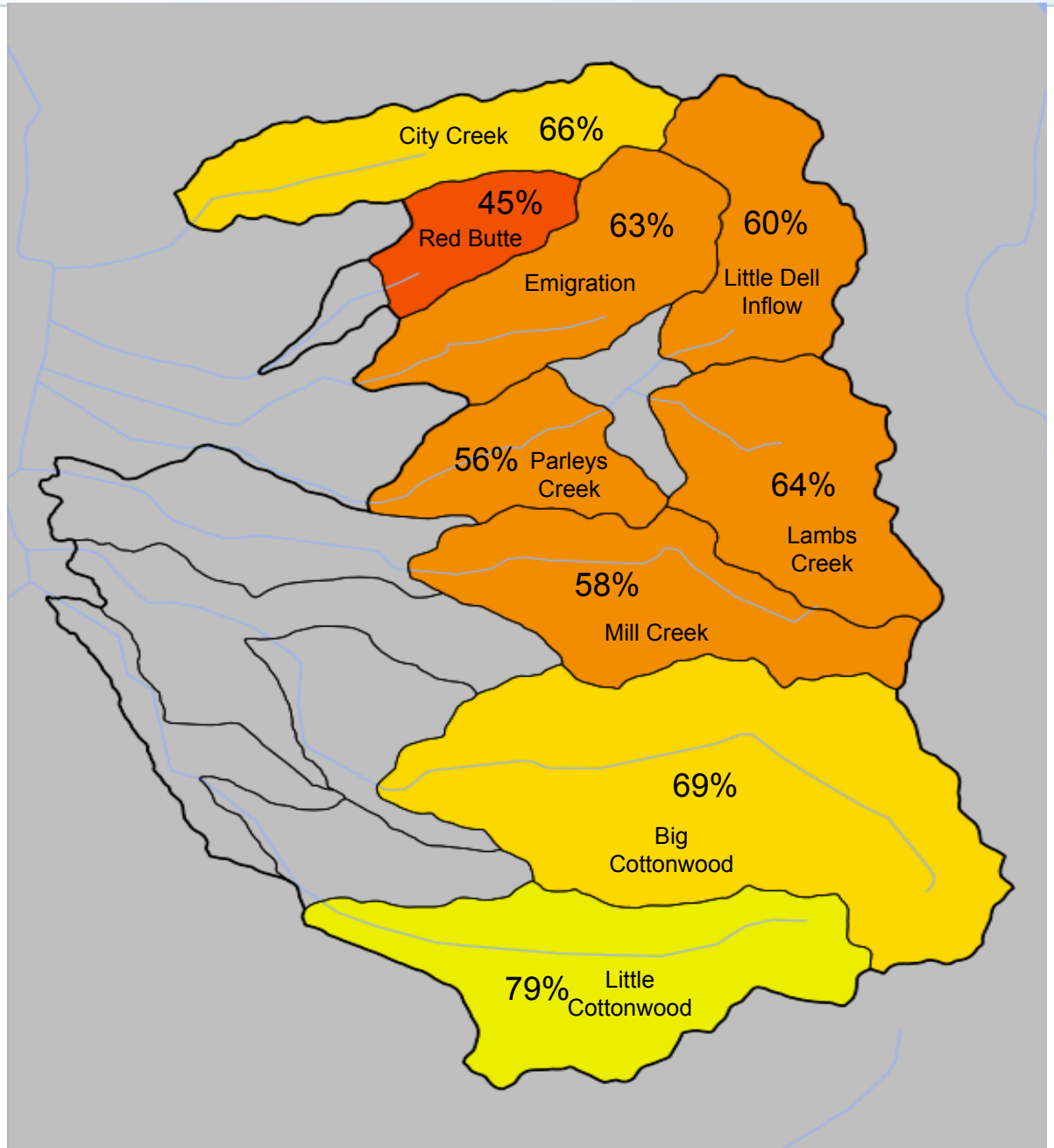
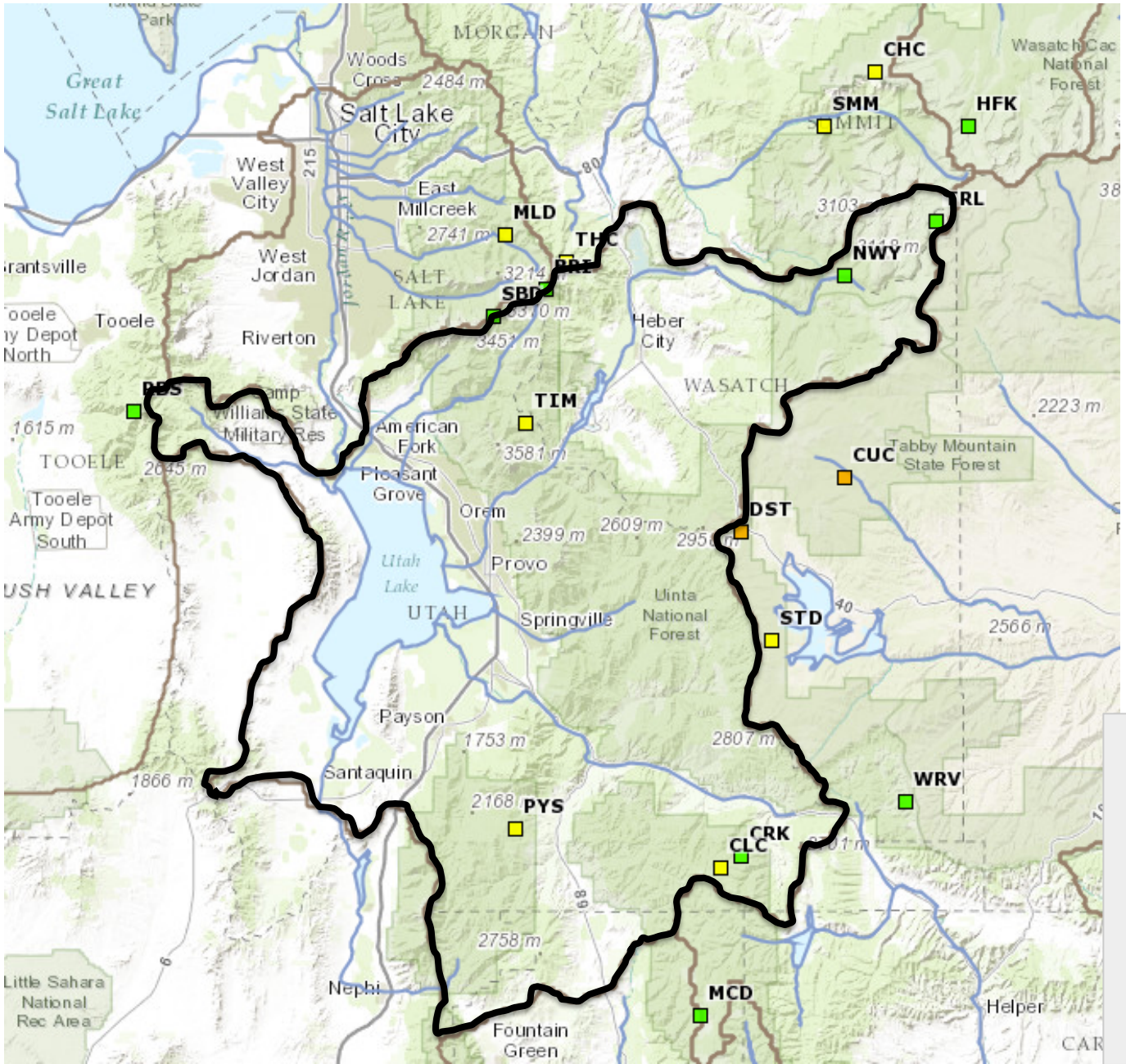
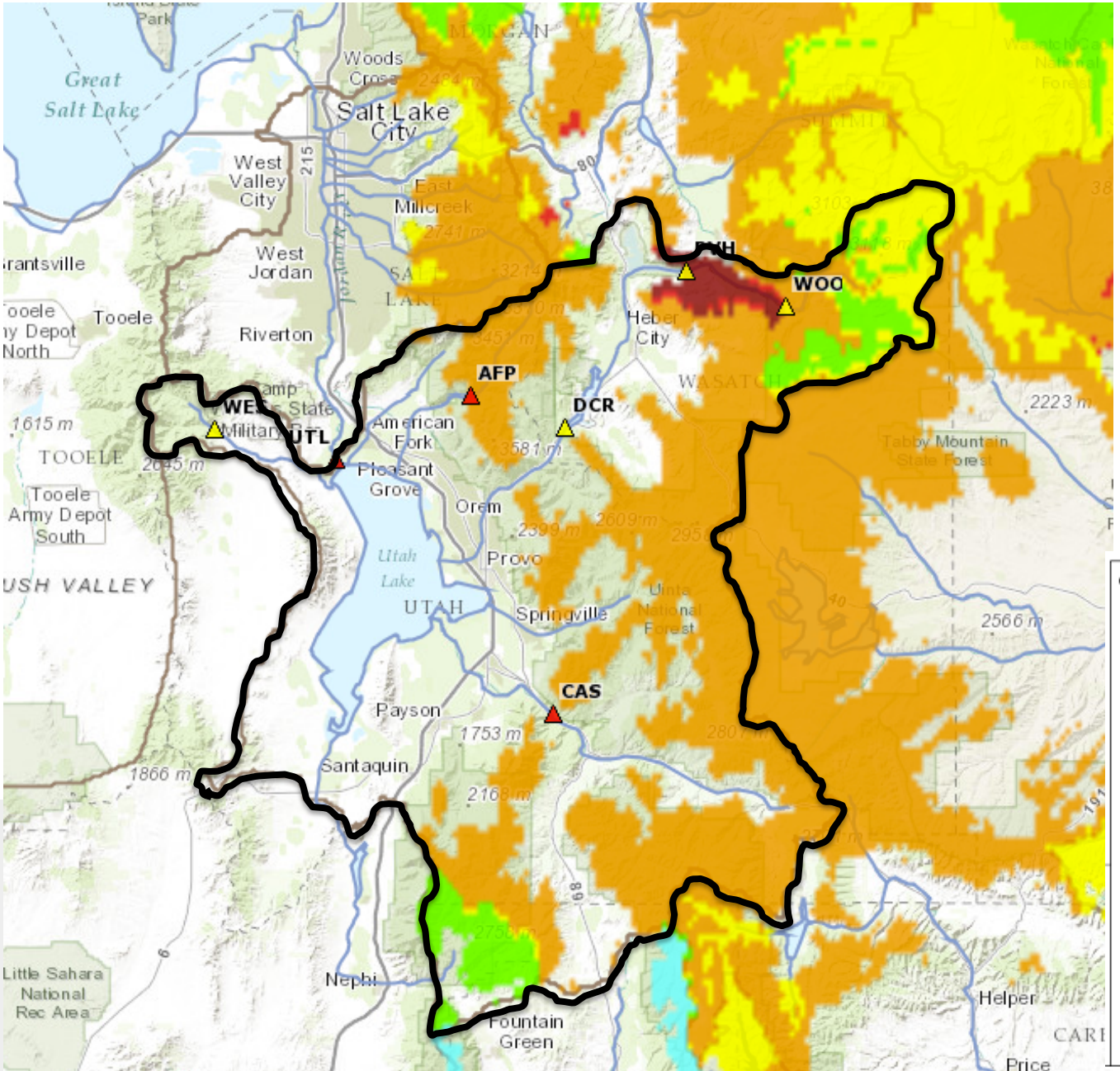
- 45% - 55%
- 55% - 65%
- 65% - 75%
- 75% - 85%
- 85% - 95%
- 95% - 105%
- 105% - 115%
- 115% - 125%
- 125% - 135%
- 135% - 145%
- 145% - 155%
- 155% - 165%
- 165% - 175%
- Above 175%
- NA



Provo River / UT Lake: March 4th SNOTEL (percent of median)



Provo River / UT Lake: CBRFC Model Snow – March 4th



Water supply forecast point

(% average Forecast)

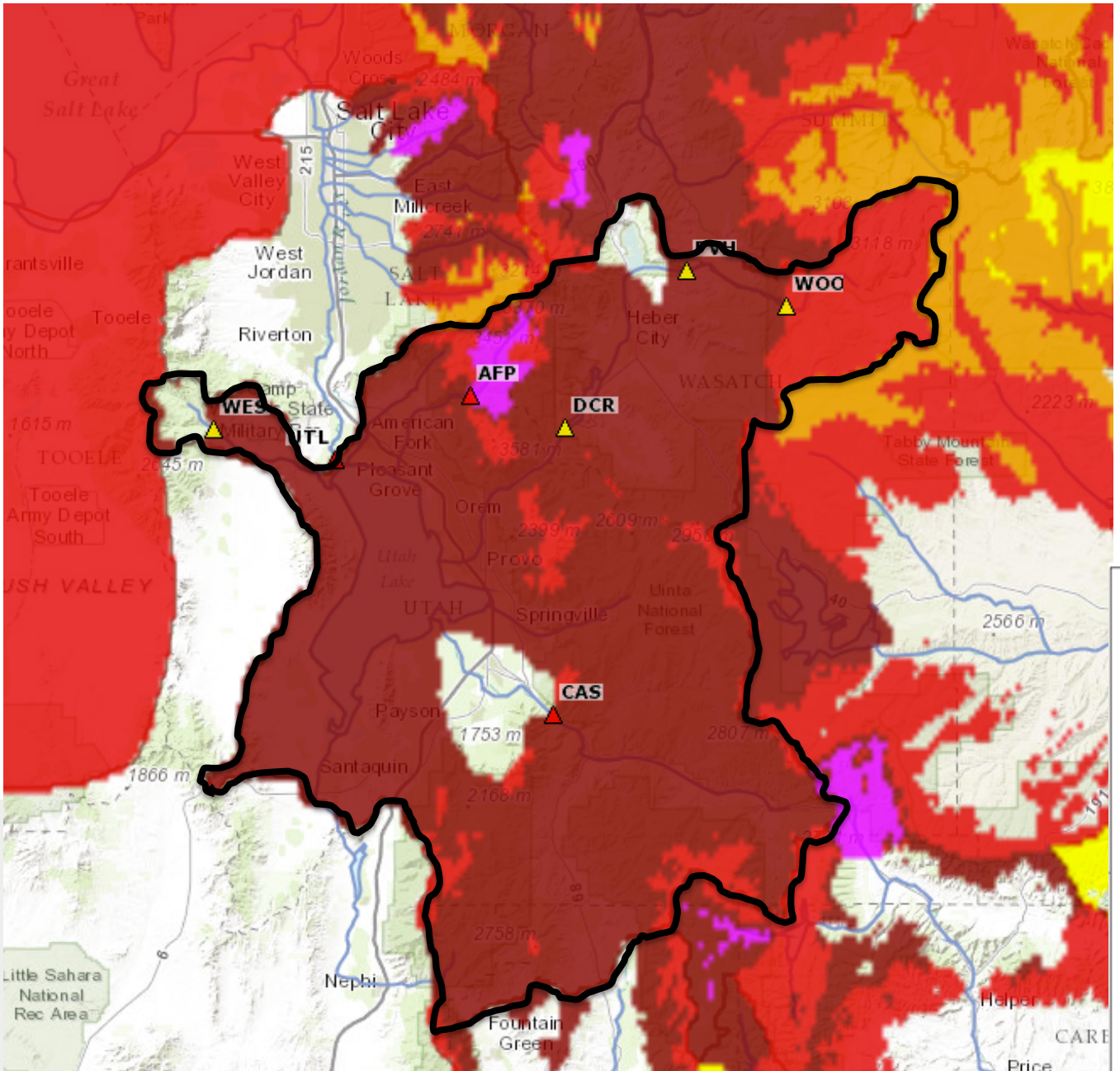
- < 70%
- 70-90%
- 90-110%
- 110-130%
- >130%
- Regulated
- No Forecast

CBRFC Model Snow

% Median SWE

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

Provo River / UT Lake: CBRFC Model soil moisture entering winter



Water supply forecast point

(% average Forecast)

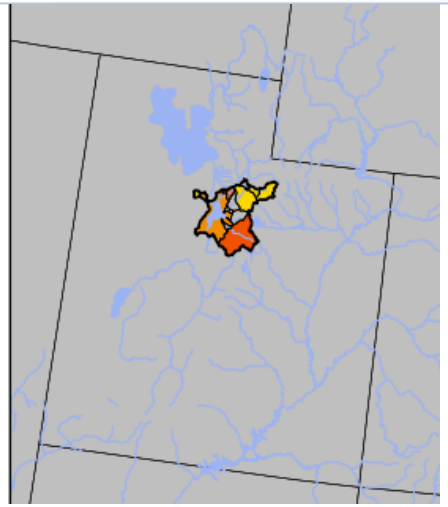
- < 70%
- 70-90%
- 90-110%
- 110-130%
- >130%
- Regulated
- No Forecast

CBRFC Model Soil Moisture

% Normal

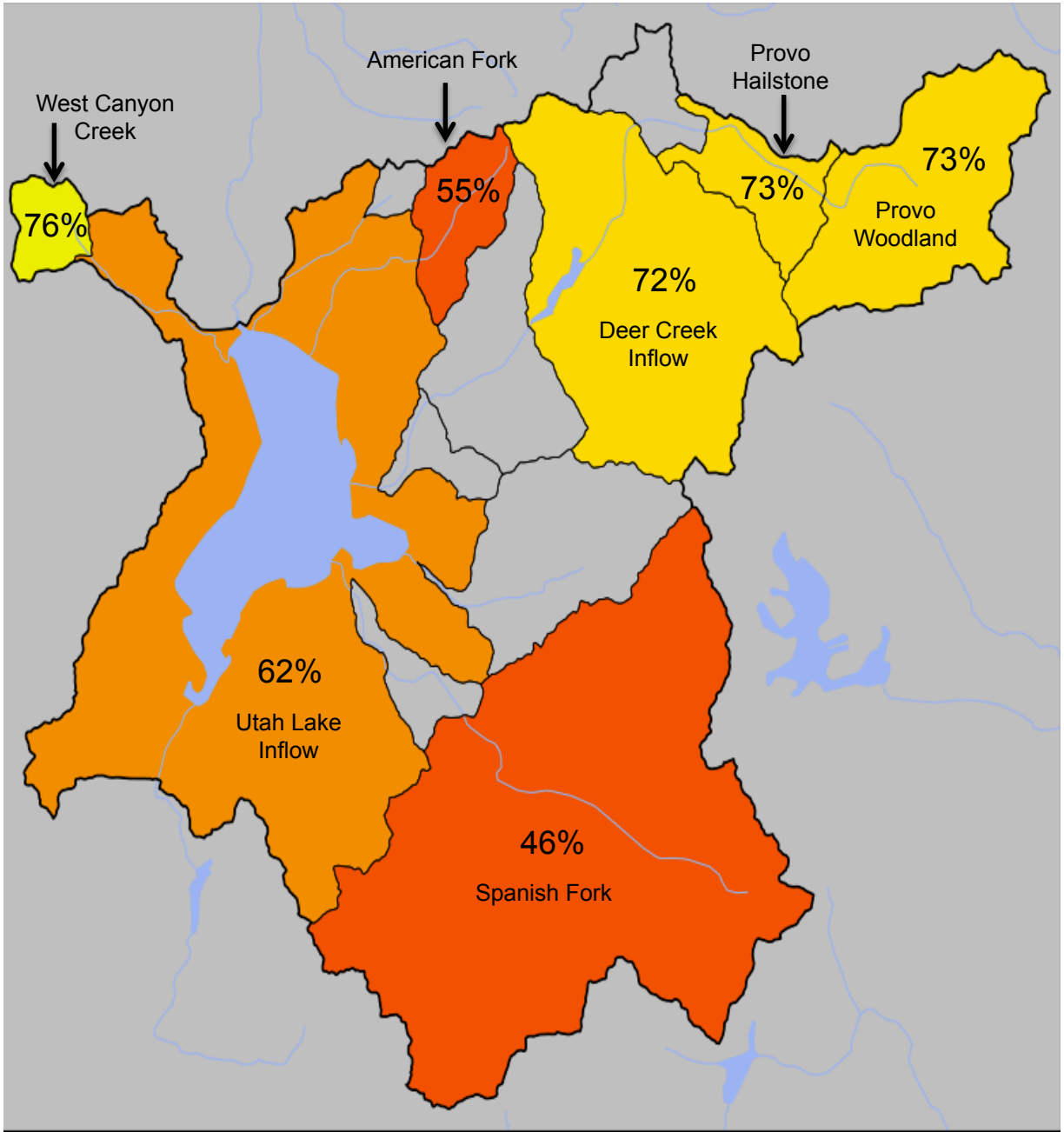
- >500%
- 300-500%
- 200-300%
- 150-200%
- 130-150%
- 110-130%
- 100-110%
- 90-100%
- 70-90%
- 50-70%
- 30-50%
- 0-30%

March 1st Water Supply Forecasts – Provo River / Utah Lake

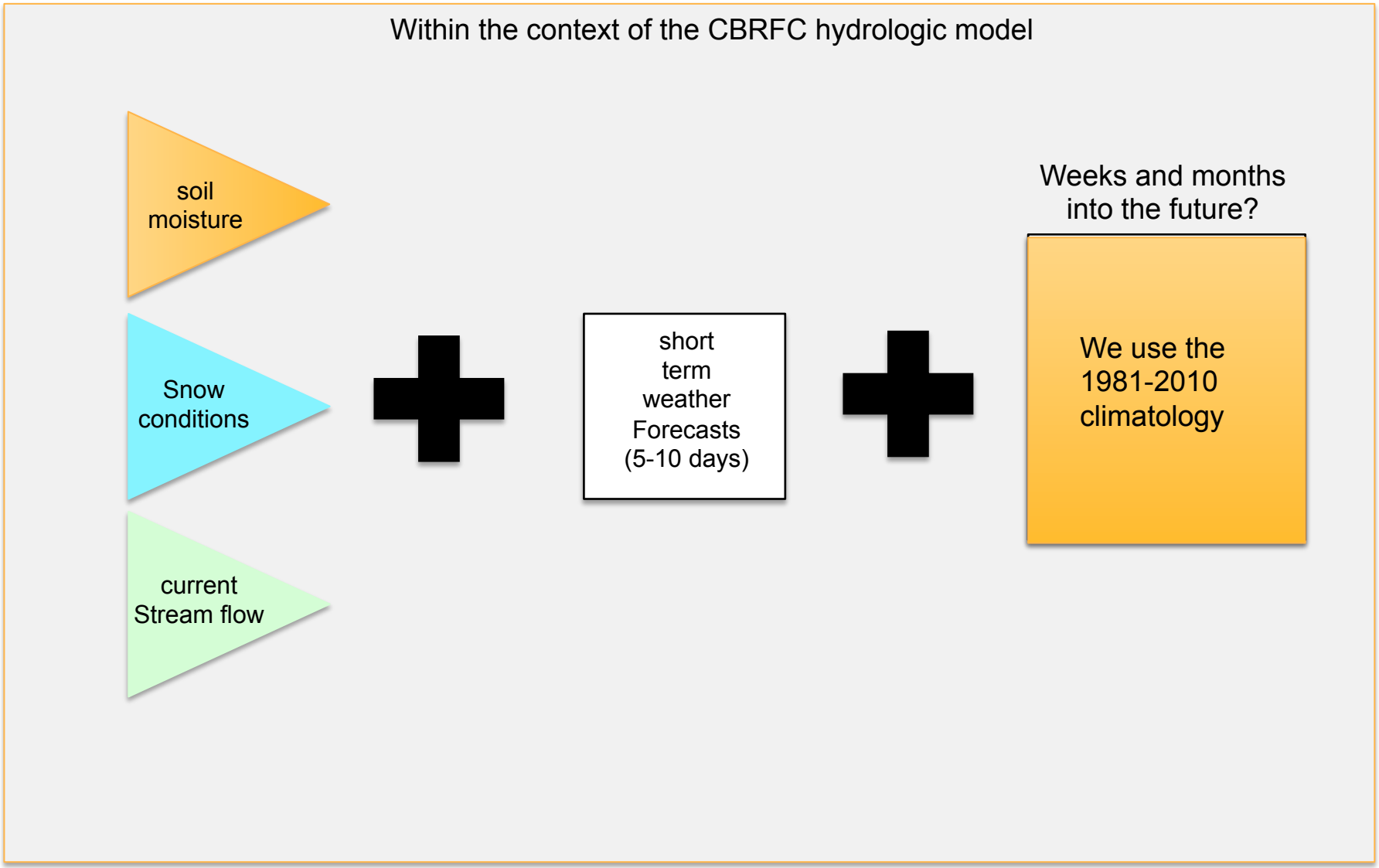


April-July
Forecast
Streamflow Volumes
(% of 1981-2010 average)

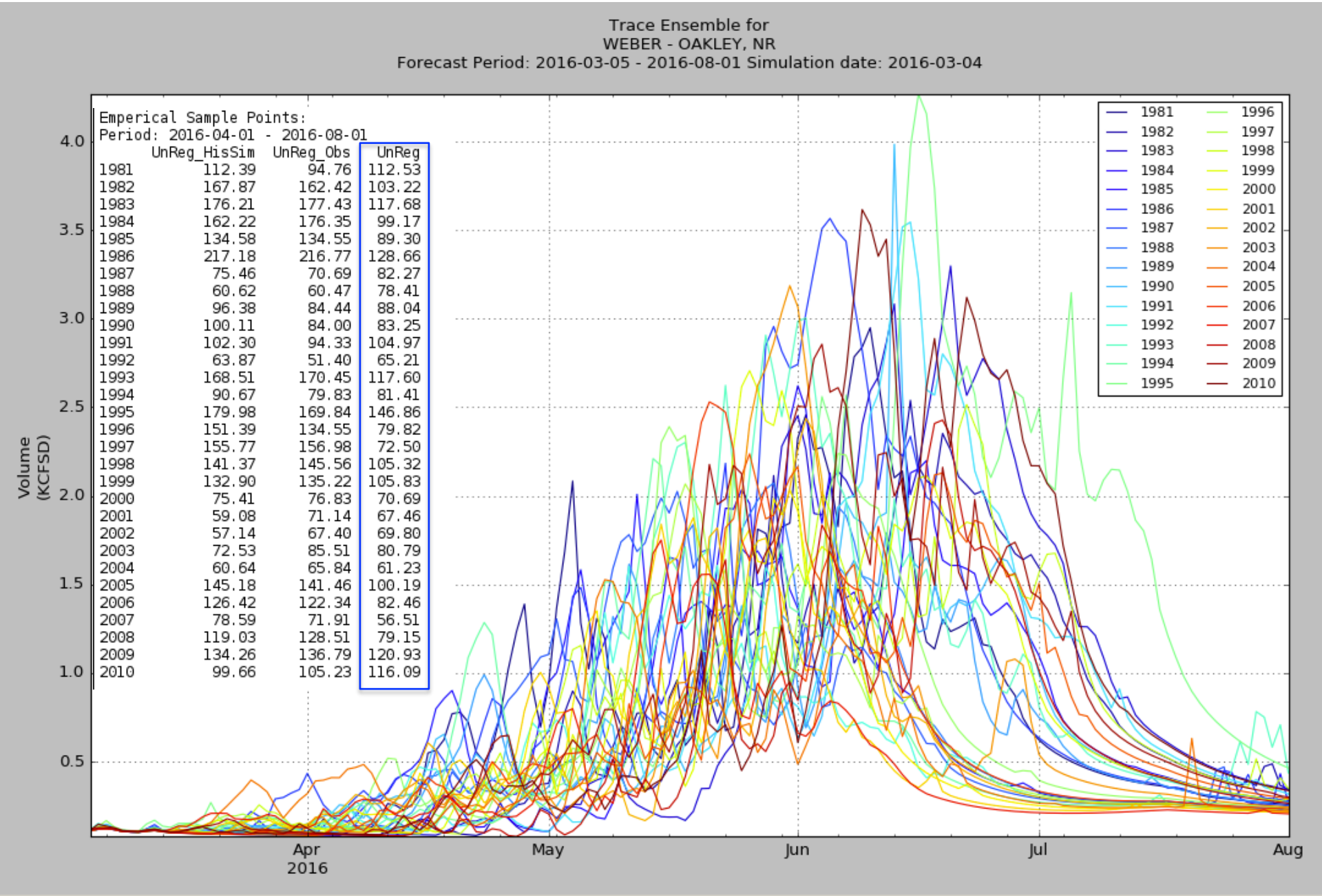
- Below 25%
- 25% - 35%
- 35% - 45%
- 45% - 55%
- 55% - 65%
- 65% - 75%
- 75% - 85%
- 85% - 95%
- 95% - 105%
- 105% - 115%
- 115% - 125%
- 125% - 135%
- 135% - 145%
- 145% - 155%
- 155% - 165%
- 165% - 175%
- Above 175%
- NA



Primary Drivers of the Forecast



We get 30 possible stream flow scenarios based on the 1981-2010 period…



…and a range of possible forecast probabilities

Weber River near Oakley

Emperical Sample Points:
Period: 2016-04-01 - 2016-08-01

	UnReg_HisSim	UnReg_Obs	UnReg
1981	112.39	94.76	112.53
1982	167.87	162.42	103.22
1983	176.21	177.43	117.68
1984	162.22	176.35	99.17
1985	134.58	134.55	89.30
1986	217.18	216.77	128.66
1987	75.46	70.69	82.27
1988	60.62	60.47	78.41
1989	96.38	84.44	88.04
1990	100.11	84.00	83.25
1991	102.30	94.33	104.97
1992	63.87	51.40	65.21
1993	168.51	170.45	117.60
1994	90.67	79.83	81.41
1995	179.98	169.84	146.86
1996	151.39	134.55	79.82
1997	155.77	156.98	72.50
1998	141.37	145.56	105.32
1999	132.90	135.22	105.83
2000	75.41	76.83	70.69
2001	59.08	71.14	67.46
2002	57.14	67.40	69.80
2003	72.53	85.51	80.79
2004	60.64	65.84	61.23
2005	145.18	141.46	100.19
2006	126.42	122.34	82.46
2007	78.59	71.91	56.51
2008	119.03	128.51	79.15
2009	134.26	136.79	120.93
2010	99.66	105.23	116.09

If each year were to repeat from time forward

Chances of Exceeding Volume KAF for
WEBER - OAKLEY, NR
Forecast Period: 2016-04-01 - 2016-08-01
Simulation date: 2016-03-01

Period: 2016-04-01 - 2016-08-01

	UnReg_HisSim	UnReg_Obs	UnReg
90%	60.62	66.00	65.43
80%	73.11	71.30	71.05
70%	82.21	81.08	79.35
60%	99.84	89.04	81.75
50%	115.71	113.79	85.65
40%	133.72	134.55	99.78
30%	144.04	140.06	105.22
20%	160.93	161.33	115.38
10%	175.44	175.76	120.60

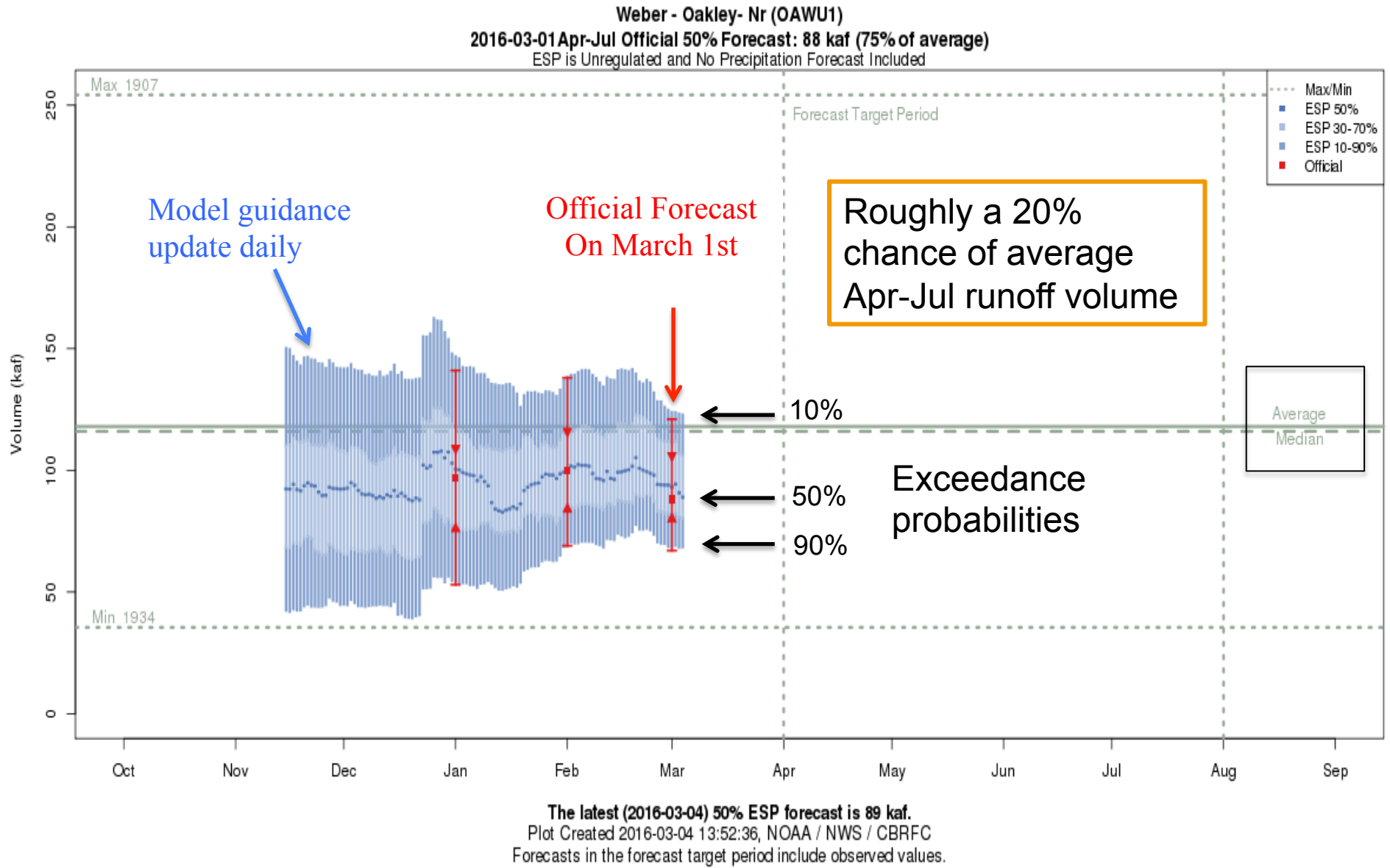
Exceedance Probabilities

April-July Average: 118 KAF

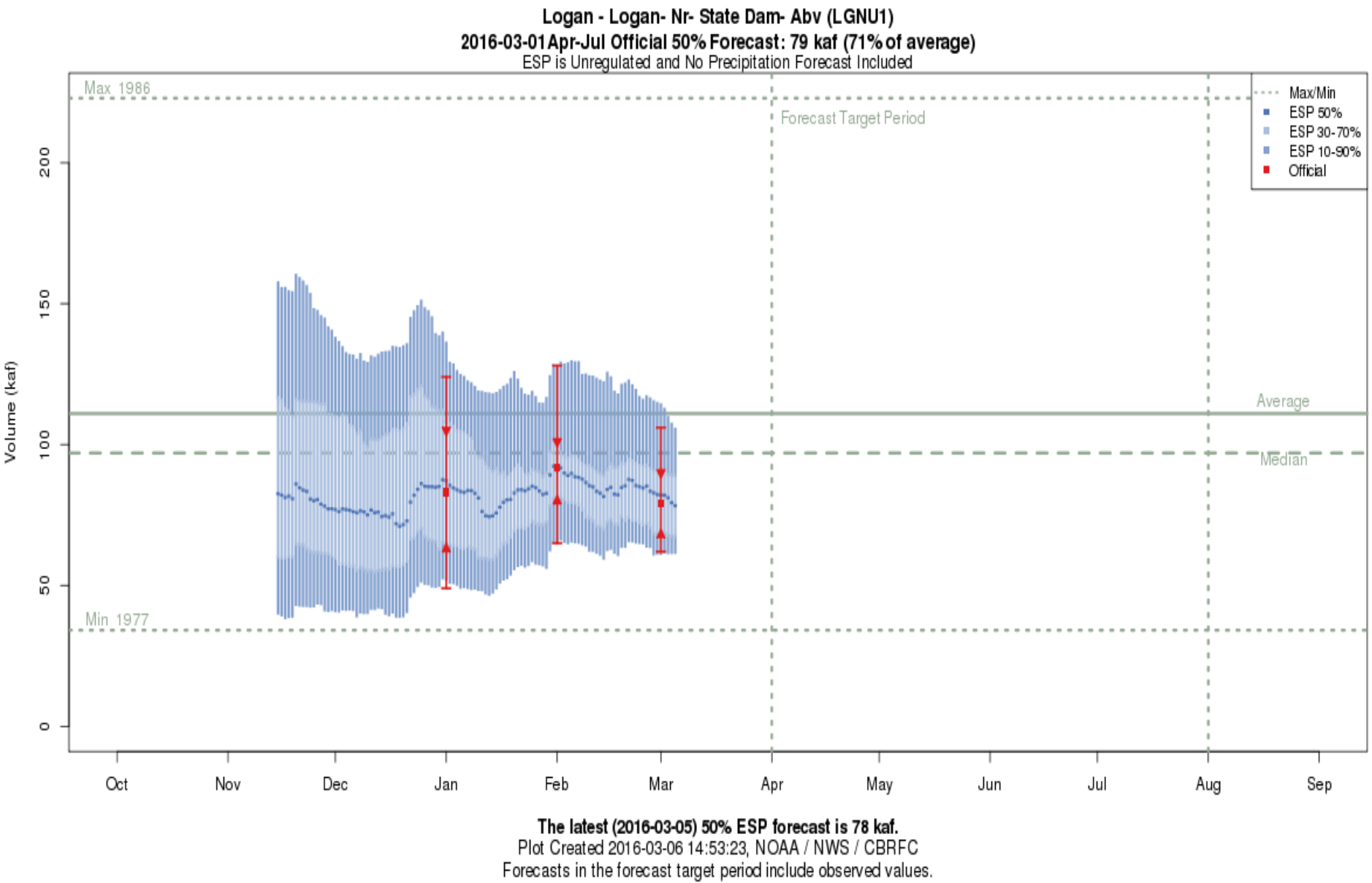
Weber River near Oakley forecast evolution plot

Daily Ensemble Streamflow Prediction (ESP) Model Run & Official

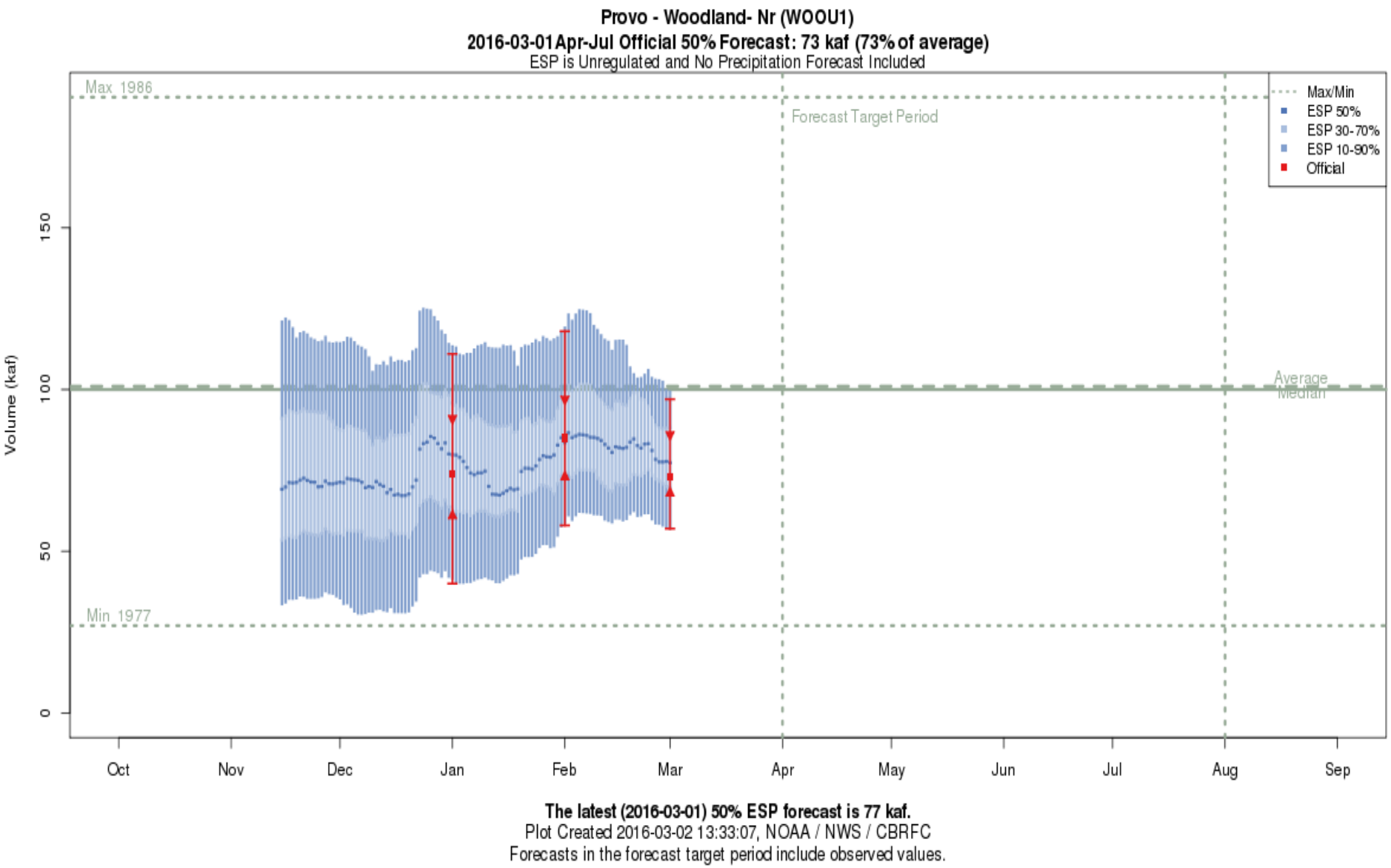
Available at: www.cbrfc.noaa.gov Select: Water Supply Click: Point of Interest



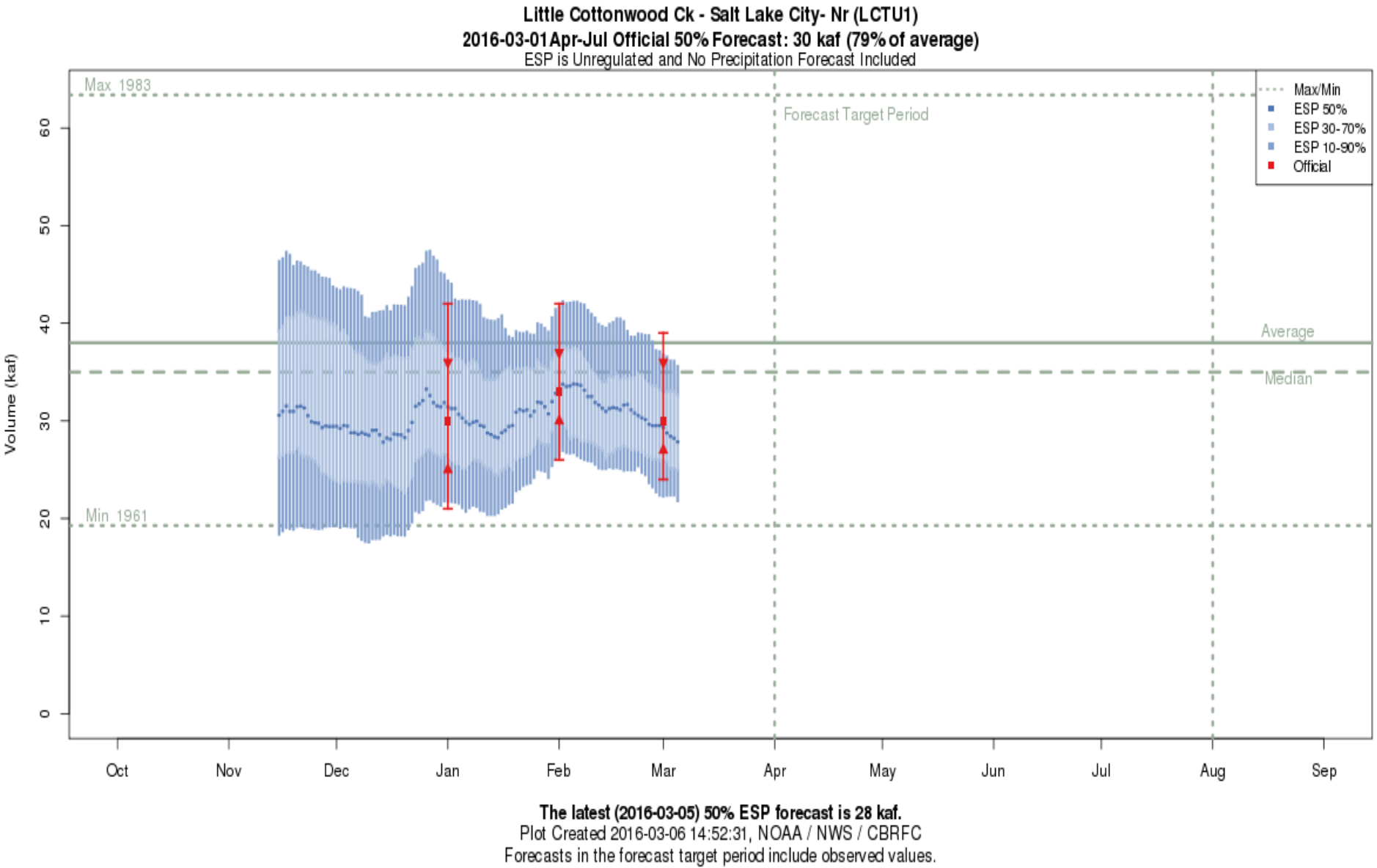
Logan River near Logan forecast evolution plot



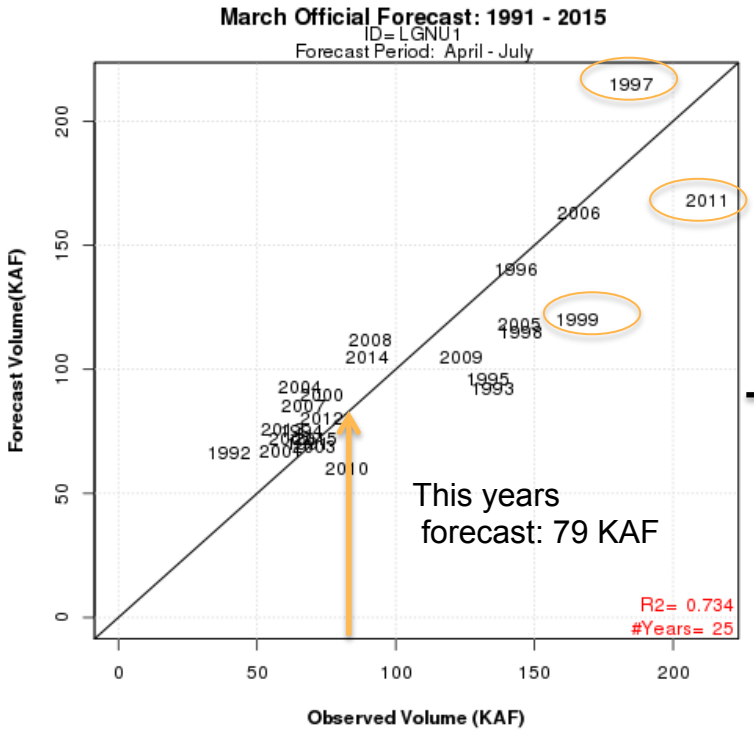
Provor River near Woodland forecast evolution plot

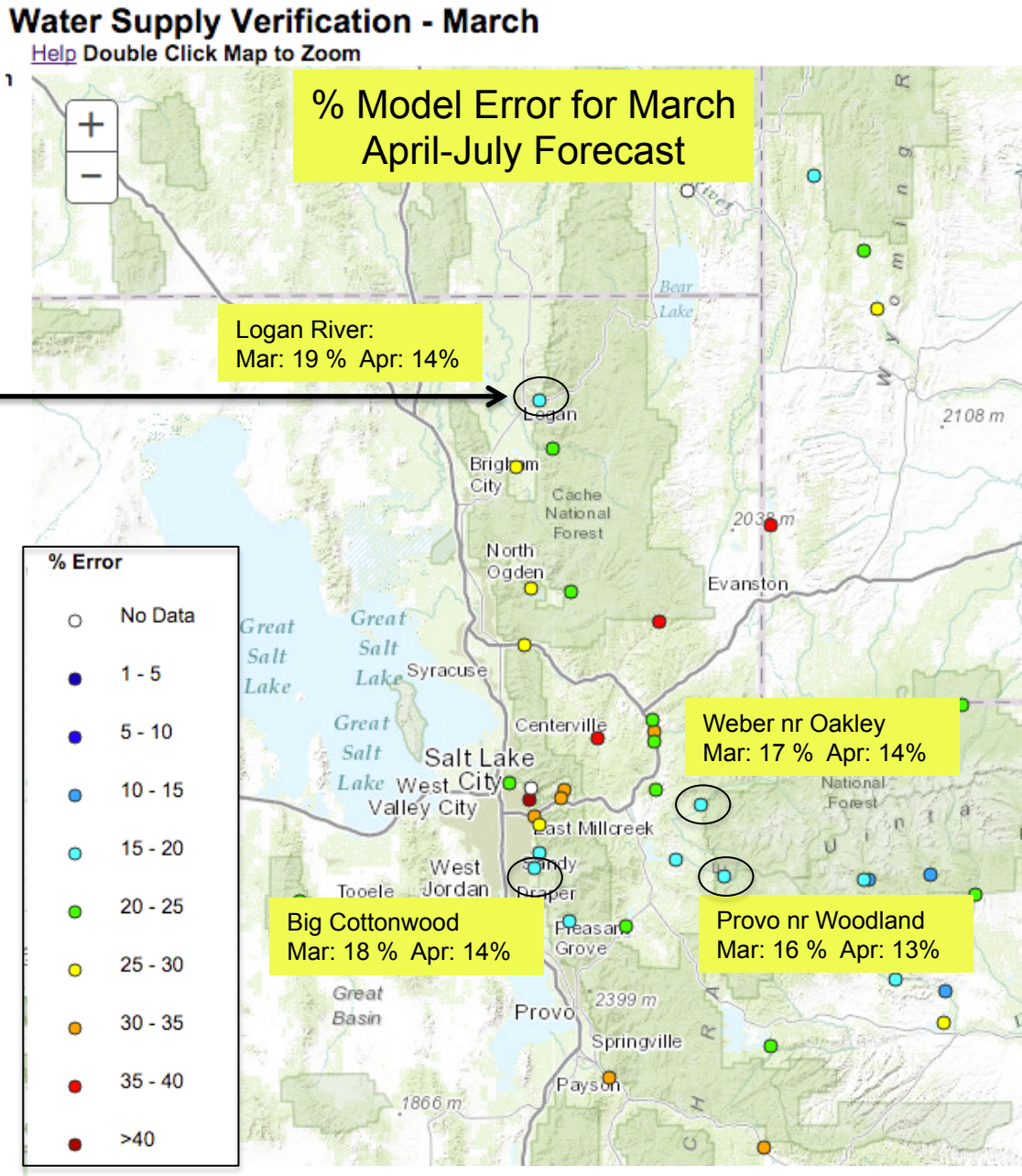


Little Cottonwood Creek near SLC forecast evolution plot



Forecast Accuracy ? How good are these forecasts in March ?





We Do Better:

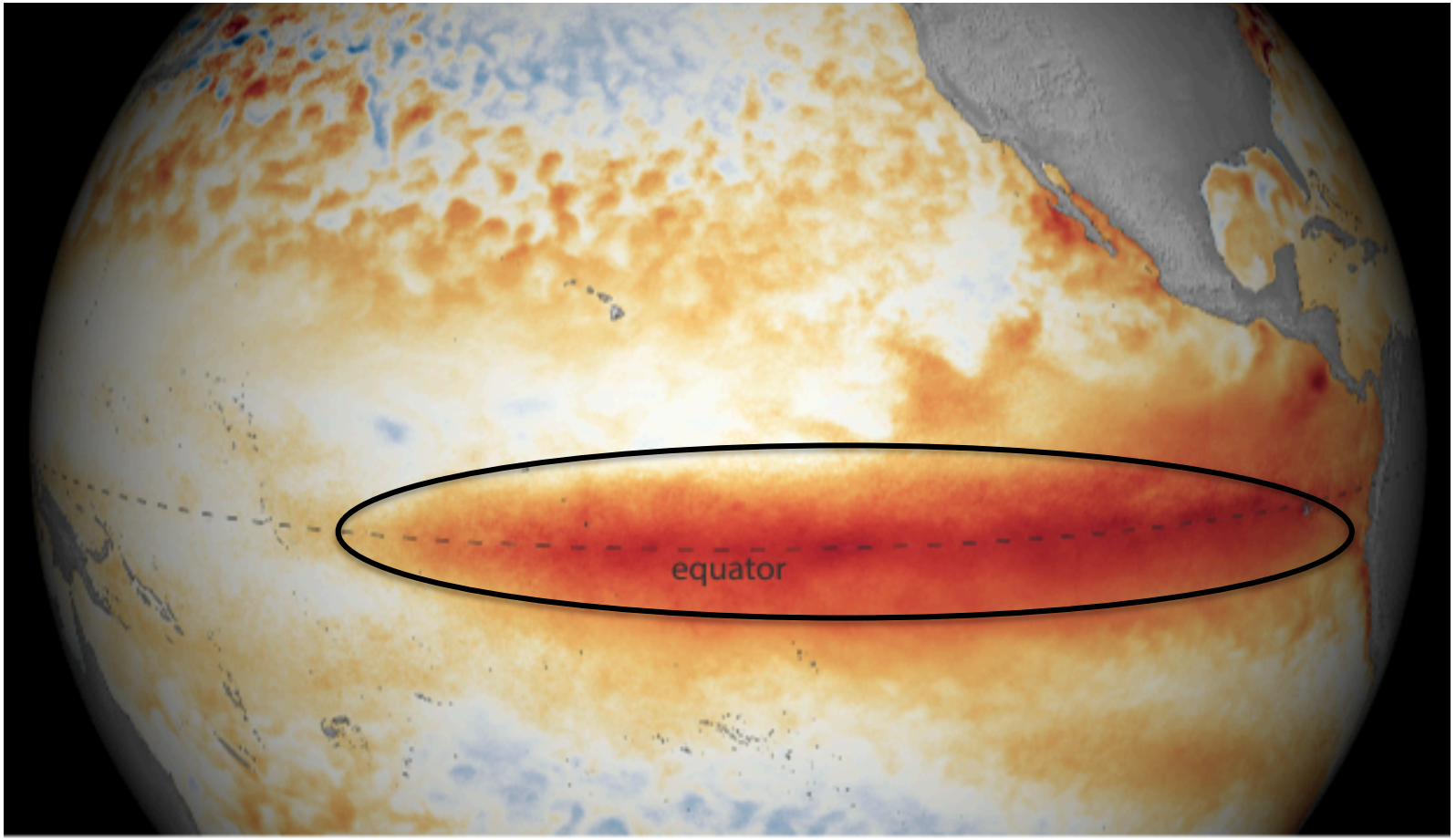
- Headwaters
- Primarily snow melt basins
- Known diversions / demands

We Do Worse:

- Lower elevations (rain or early melt)
- Downstream of diversions / irrigation
- Little is known about diversions / demands

El Niño Event

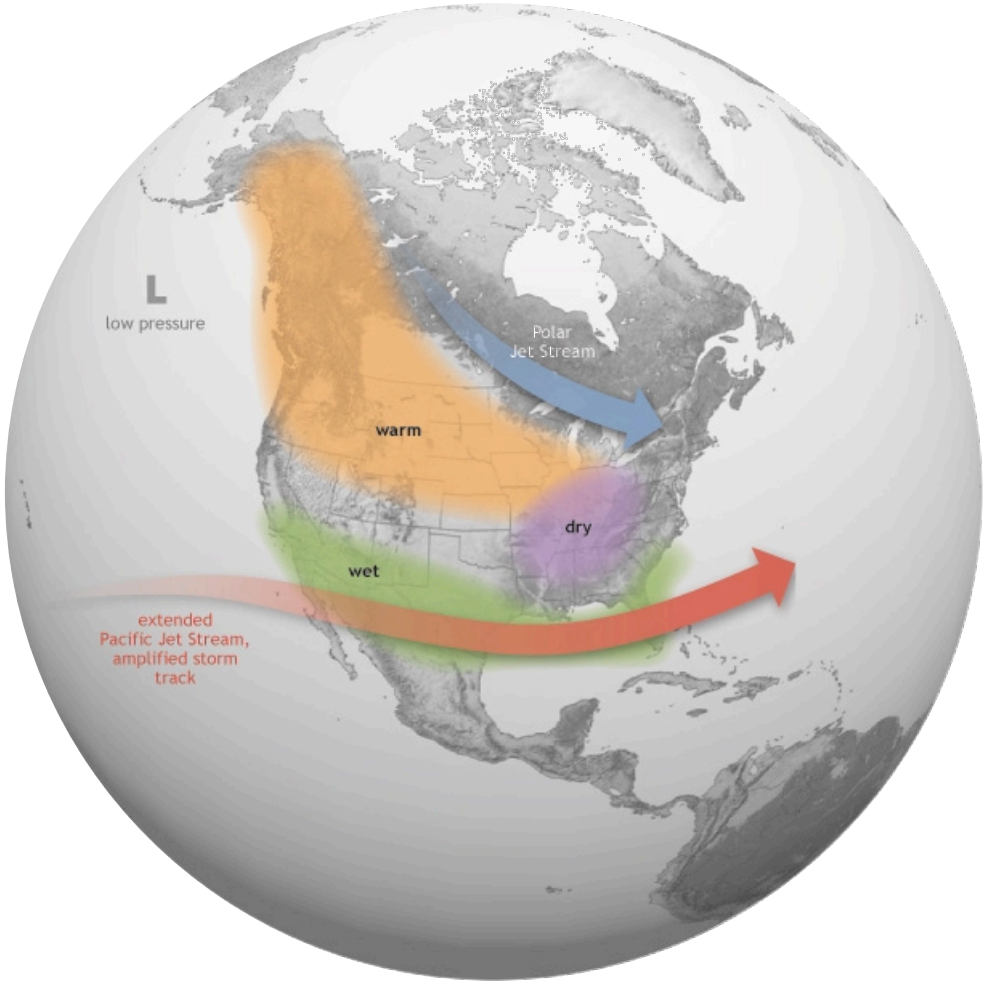
- Characterized by unusually warm temperatures in Pacific Ocean near the equator
- Impacts the Jet stream strength, location, and storm tracks.
- The 2015-2016 will go down as one of the strongest on record (82-83, 97-98)



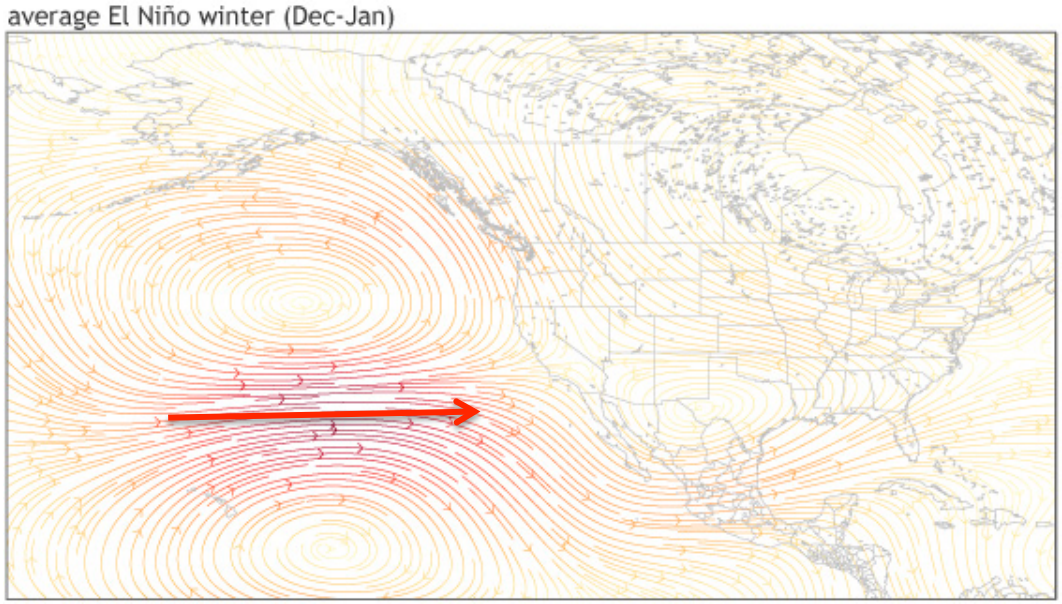
El Niño – What happened ?

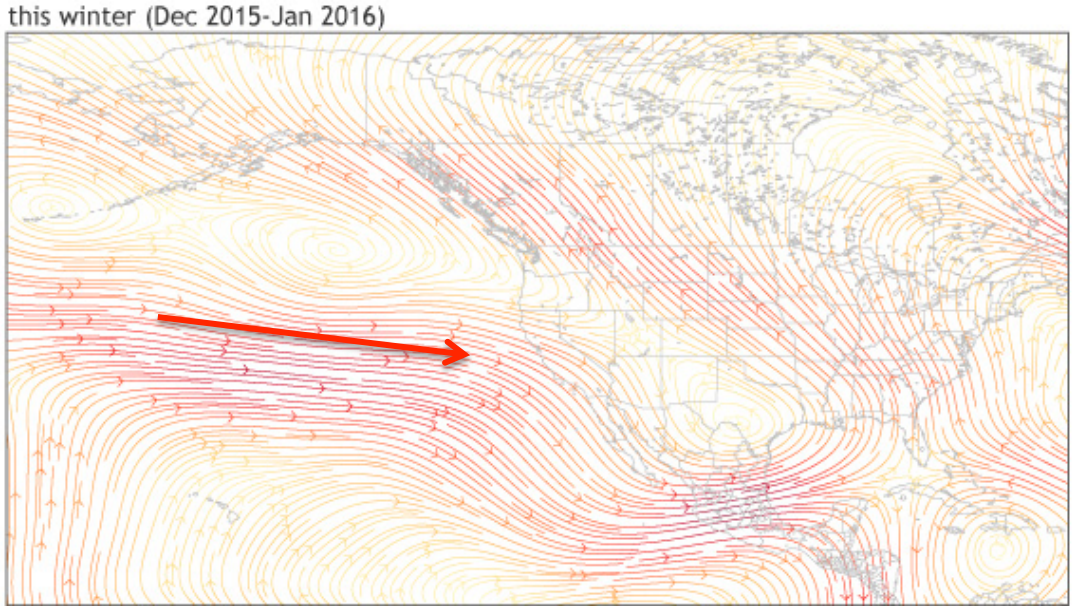
Typical Impacts

- Enhanced southern jet stream / increased precipitation southern tier of the U.S.
- Warmer / drier conditions more common over the northern tier of the U.S.
- Primary impact period follows the peak - Impacts typically the Dec – March period.



El Niño – What happened ?

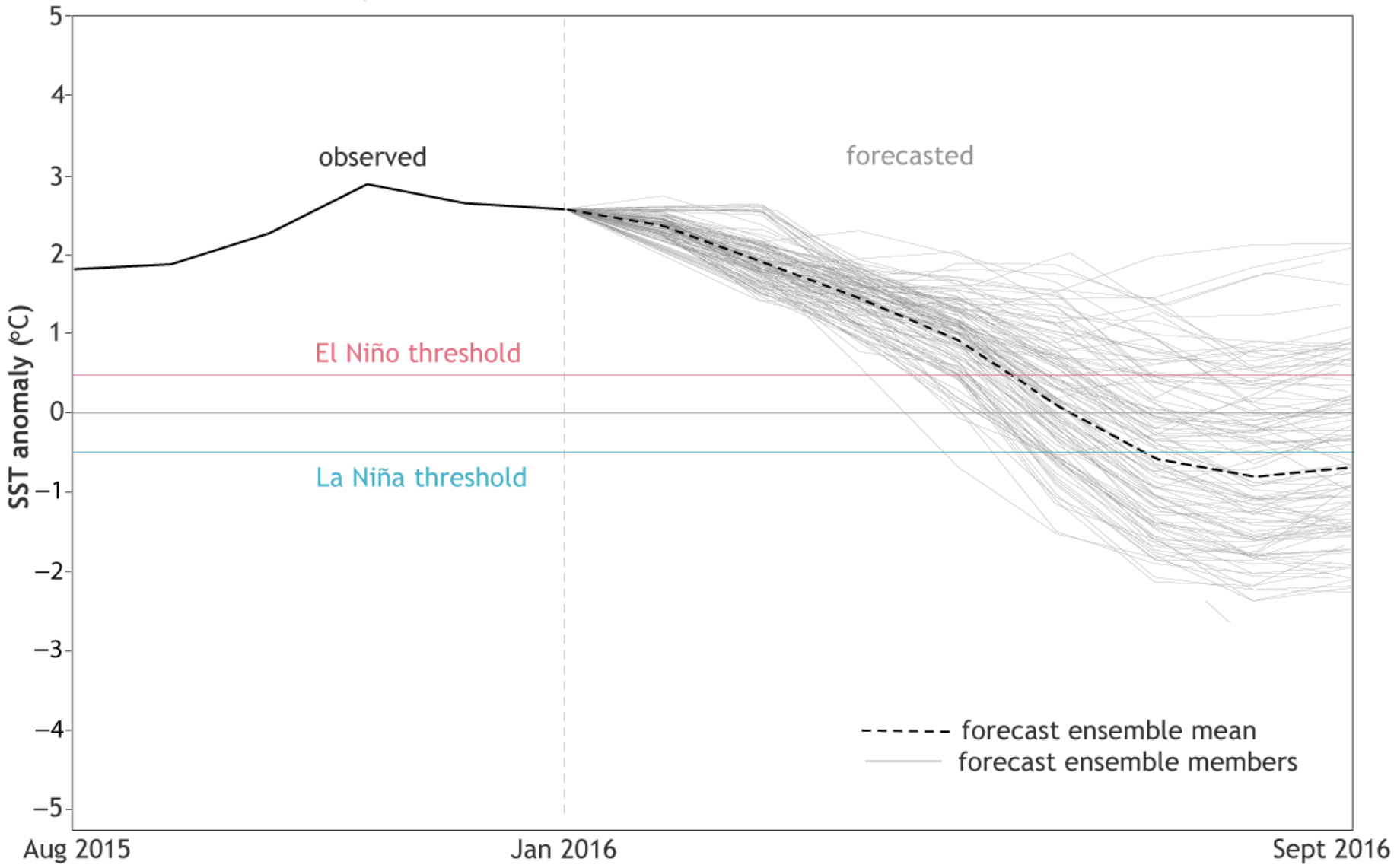




Jet Stream displaced farther north than what typically occurs

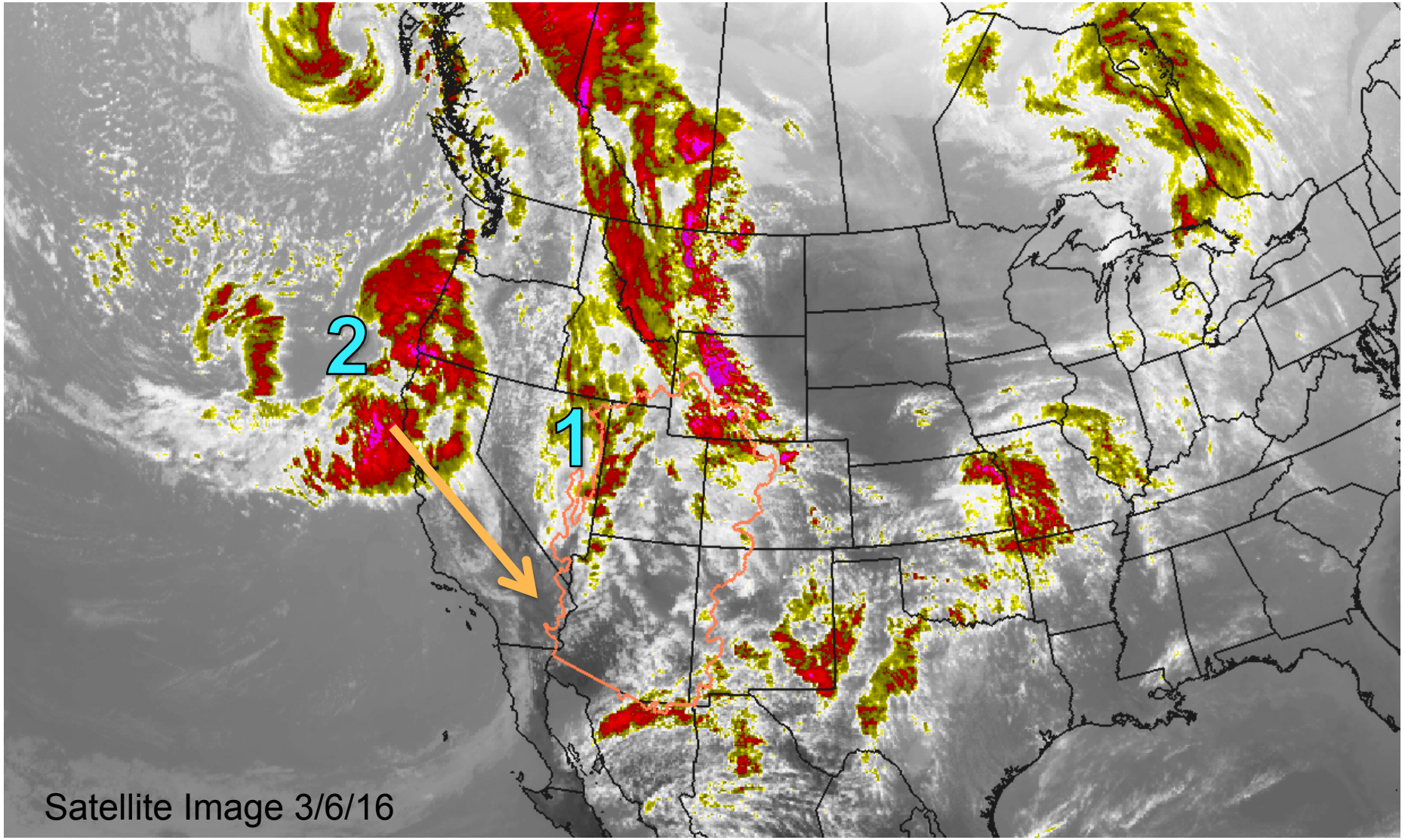
Images from Climate.gov's ENSO blog entry on February 24th by Michelle L'Heureax

What next ? Is La Niña on the horizon ?



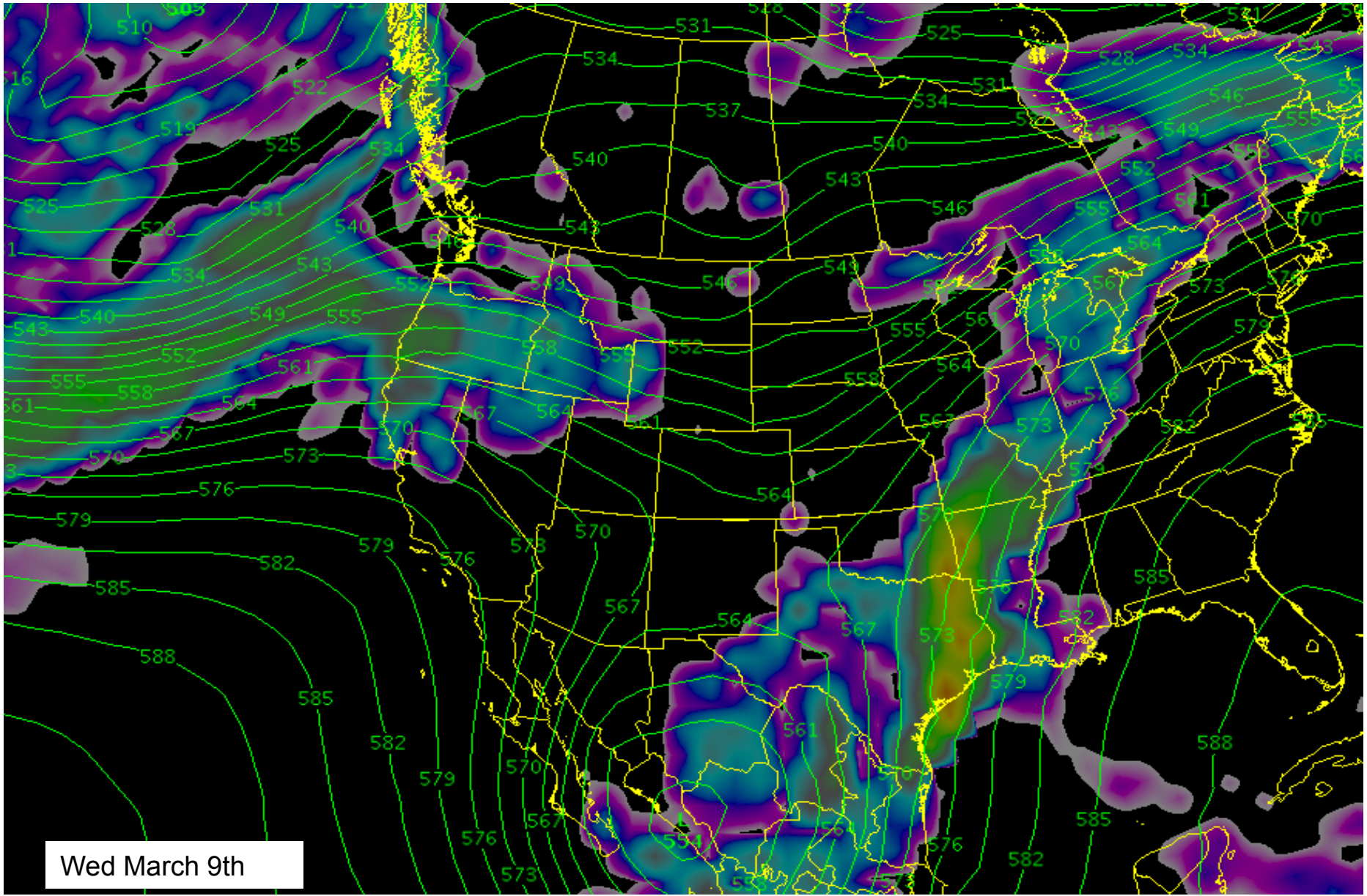
Weather pattern Change, what's in it for us ?

1 - Storm system moved in late Sunday – impacting us now.
2 – Storm system will head south, southern Arizona / northern Mexico –No impacts for us



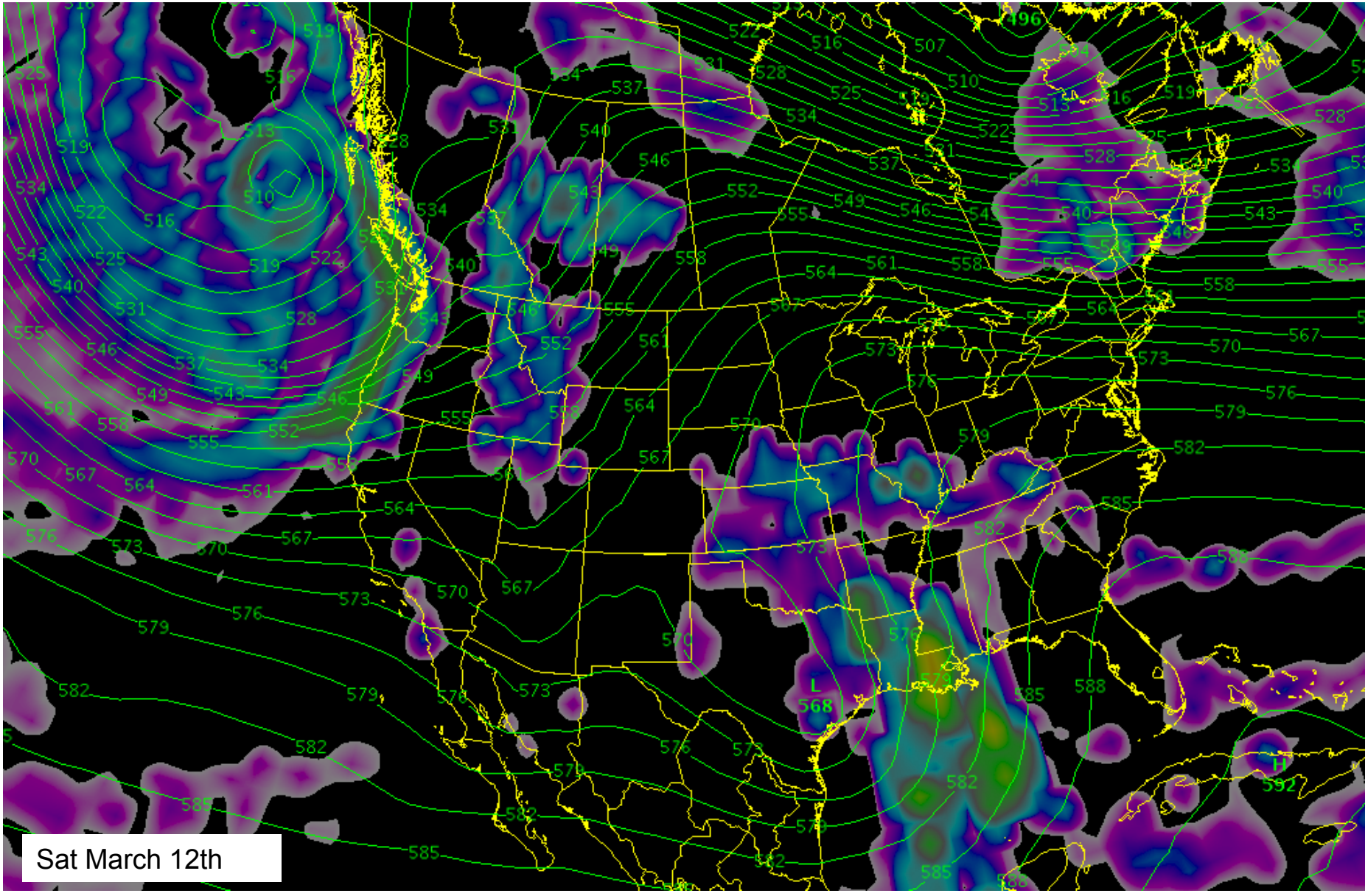
Weather outlook

Mid week system brushes by to the north. Minor precipitation to Bear River Basin in ID/WY



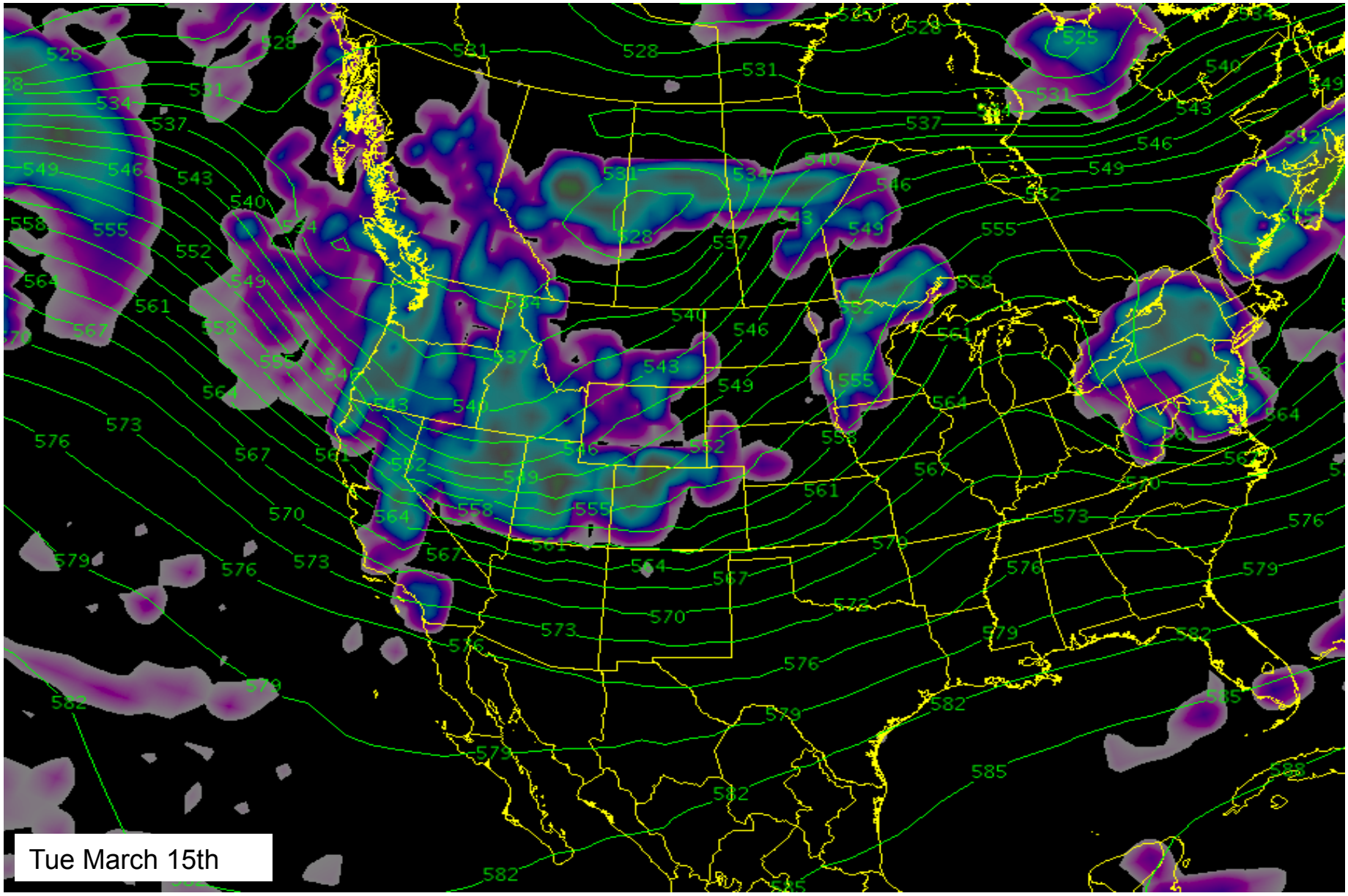
Weather outlook

Another fast moving weak system 2nd half of the weekend. Not likely a big precipitation producer.



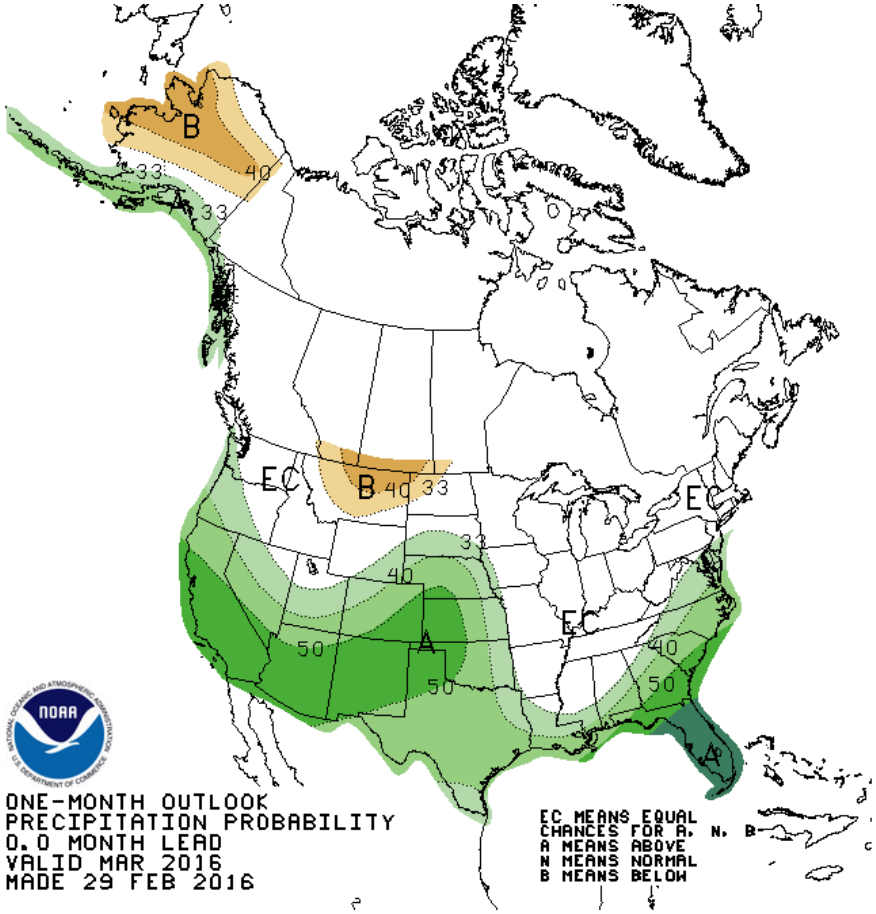
Weather outlook

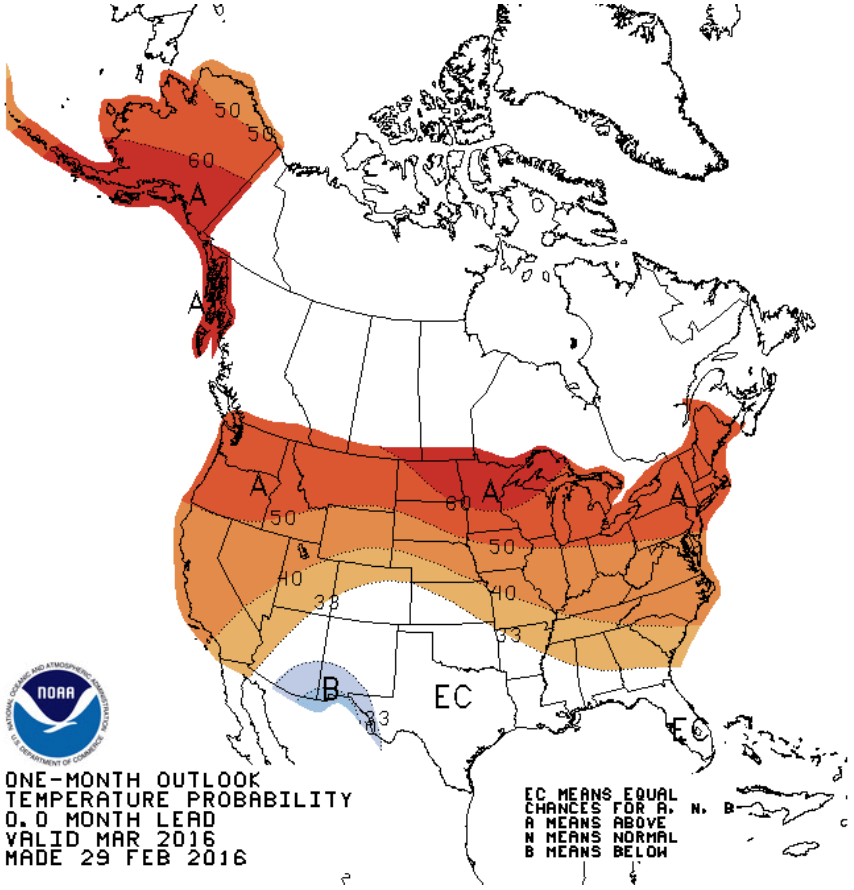
A more promising system with widespread precipitation. Lower confidence this far in the future.



Long range outlook: Climate Prediction Center

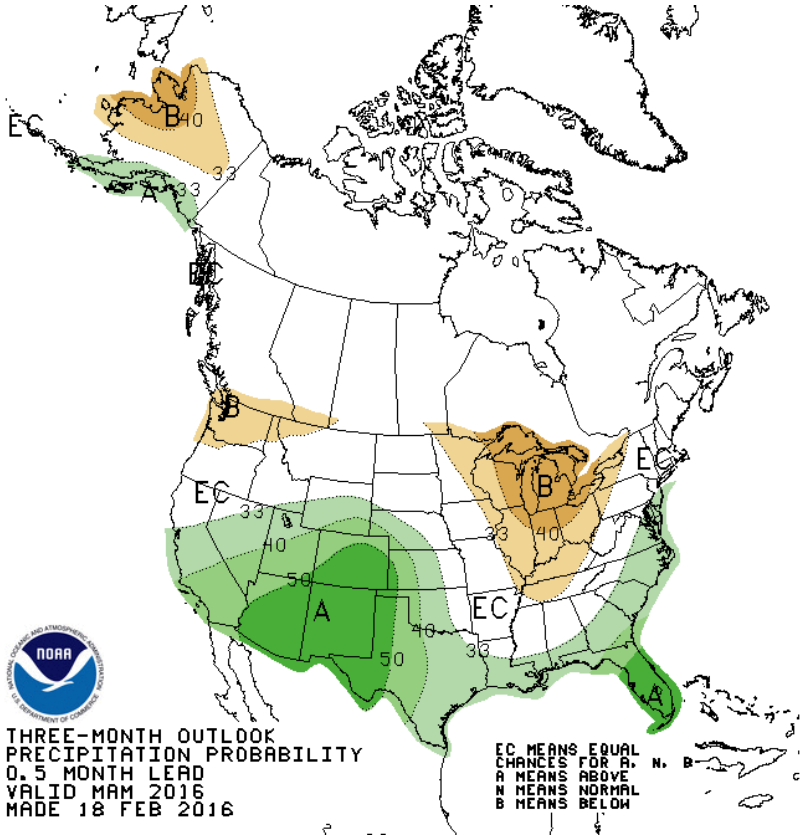
CPC outlook for March 2016

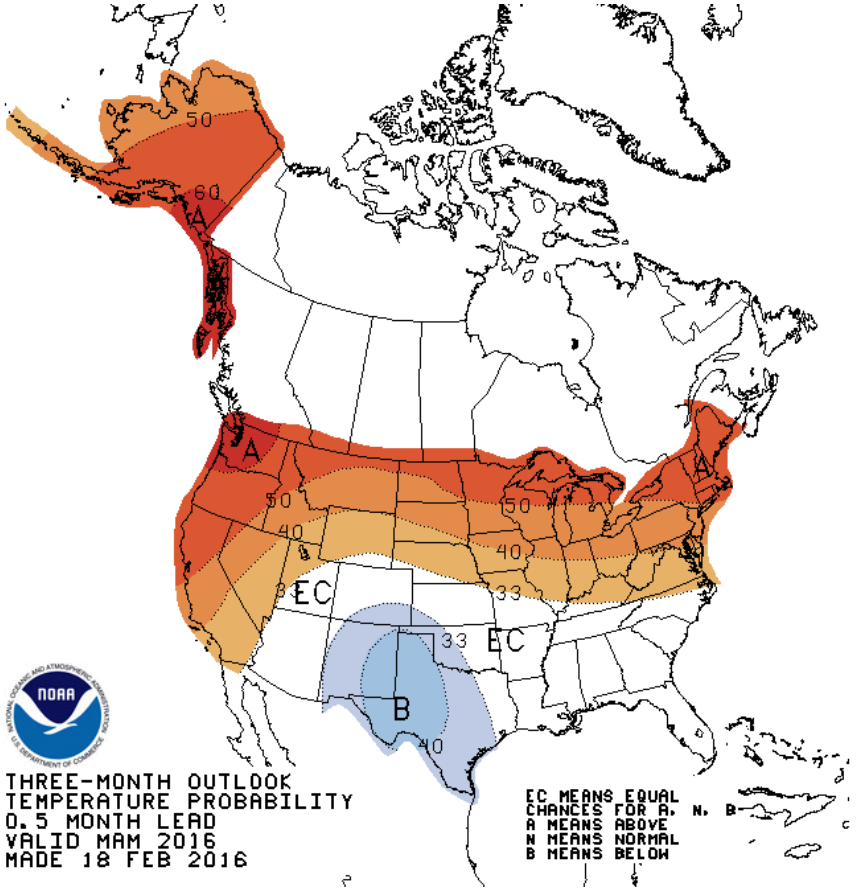




Long range outlook: Climate Prediction Center

CPC outlook for March - May 2016





Conclusions

Today's summary:

- Dry soil moisture conditions are reducing forecasts
- Highest elevation snowpack (>9500/10,000 feet) may not be as good as we think
- Melt has started in some areas – increases prospect for earlier runoff
- It is possible to still get average runoff but not likely (we need a wet spring)
- Progressive weather pattern, greater storm frequency, but will we build the snowpack?

Great Basin water supply focal point: Paul Miller paul.miller@noaa.gov
Sevier River Basin water supply focal point: Tracy Cox tracy.cox@noaa.gov

Upcoming Briefings:

3/10 @11am Peak Flow Webinar
4/7 @11am Colorado River Basin Water Supply
4/7 @1 pm Great Basin Water Supply