

# NOAA Water Resources Monitor and Outlook

1

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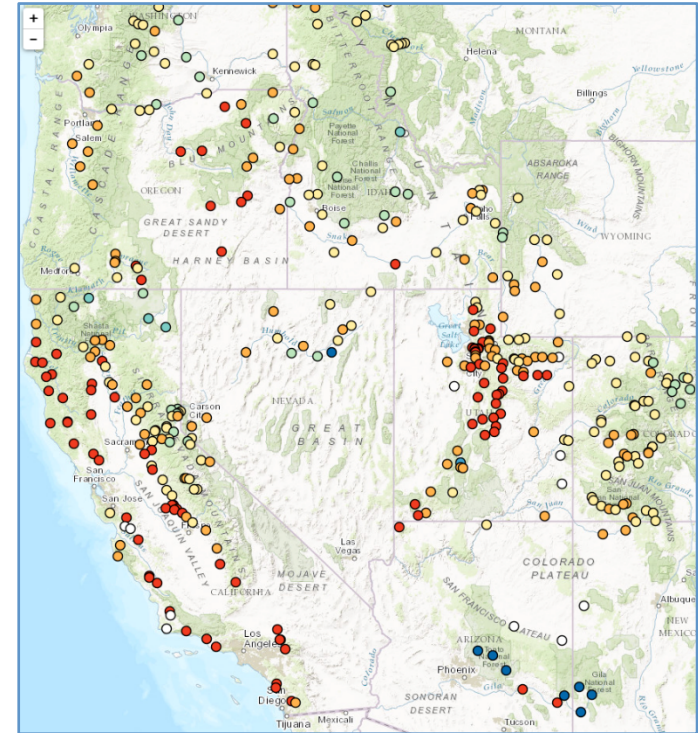
Heather Yocum - University of Colorado Boulder

Jeff Zimmerman - NWS Western Region

Headquarters

Kevin Werner - NWS Headquarters

Veva Deheza – NIDIS



***AMS 2017; 25 January, 2017***

## Overview

- Back ground on water supply forecasting
- Need for a consistent product across basins
- enhancements to existing products; prototypes

## 13 NOAA River Forecast Centers (RFCs)

- Streamflow forecasts at hundreds of locations across the country



## Water Supply Forecasts in the West

- Driven by mountain snow melt
- 6 RFCs provide water supply forecasts to support water resources managers decisions
- Many large water suppliers in the West get water from more than one major basin

# Water Supply Forecasts

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## Used for

- Reservoir operations
  - Irrigation/Food Supply
  - Power generation/Price of electricity
  - Flood control
- Water supply to communities
- Endangered species
- Recreational uses/Tourism
- Drought information
- Major users: Fed, state and quasi-govt managers who in turn provide information to others

## Increasing in importance of water supply'

- Population increasing in water scarce areas
- Impacts of climate change
- Growing demand due to environmental vulnerabilities
- Power generation
- Competing demands
- More and more scrutiny, requests for more and more information
- In the west, serve > 25M water users



# Ensemble Streamflow Prediction (ESP)

## Probabilistic Forecasts

4

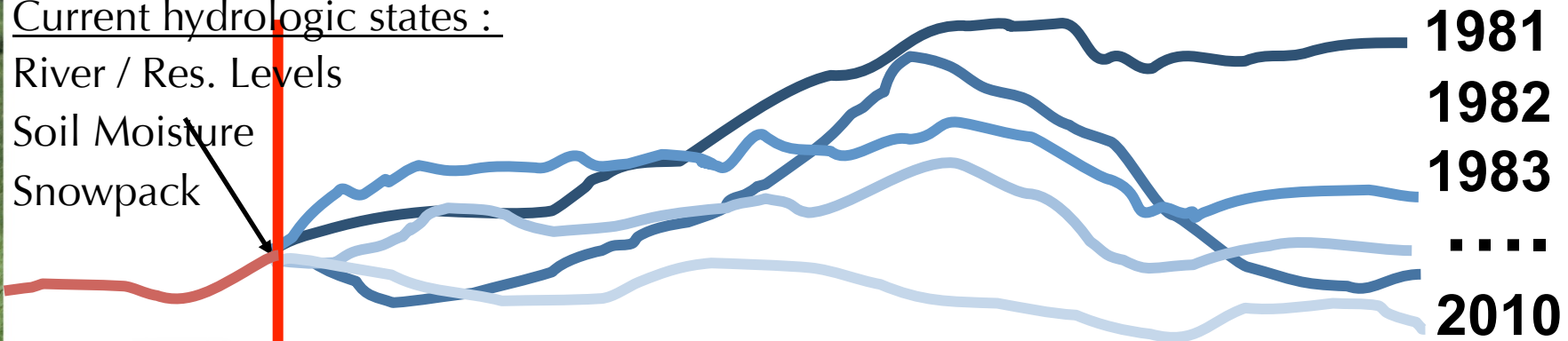
- Start with current conditions (from the daily model run)
- Apply precipitation and temperature from each historical year (1981-2010)
- A forecast is generated for each of the years (1981-2010\*)  
*as if, going forward, that year will happen*
- This creates 30 possible future streamflow patterns.  
Each year is given a 1/30 chance of occurring

Current hydrologic states :

River / Res. Levels

Soil Moisture

Snowpack



Past <- -> Future Time

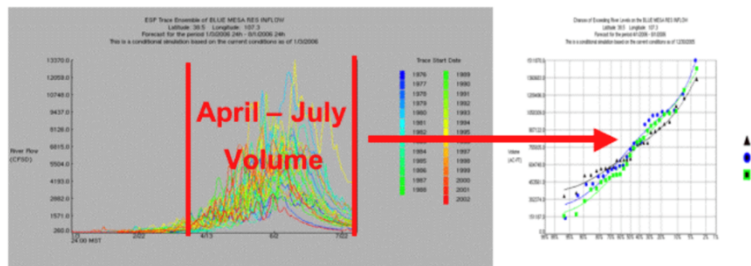


\*Being updated this to 1981-2015



# Ensemble Streamflow Prediction method (cont)

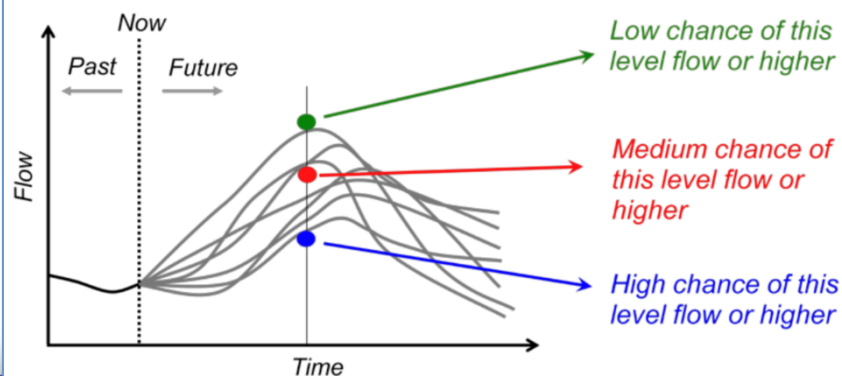
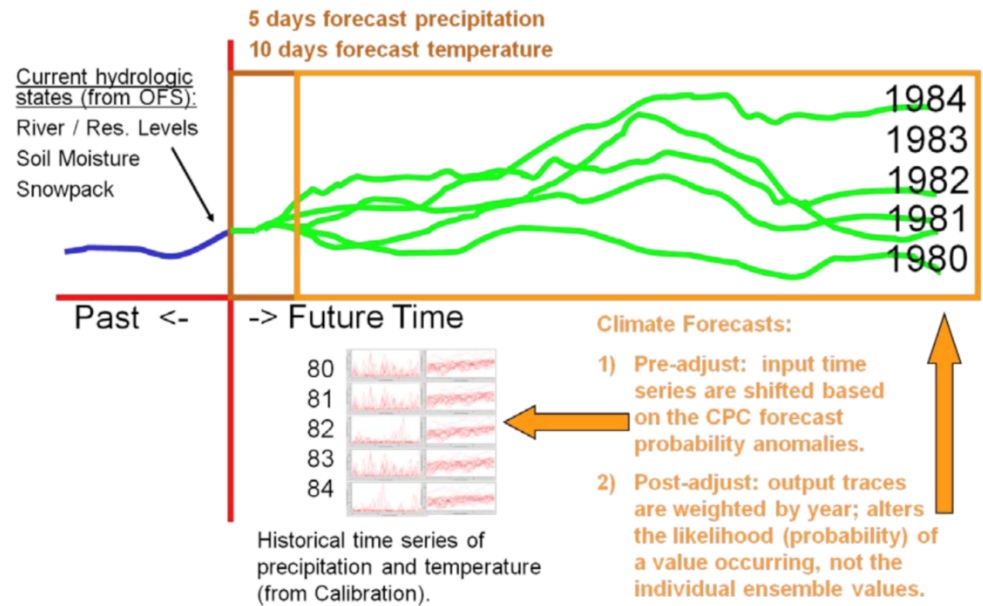
5



1. Select a forecast window
2. Select a forecast variable
3. Model derives a distribution function
4. 50% exceedance value = most probable forecast
5. Correct for model bias

# Statistics based on all years.

# Exceedance Probabilities	Conditional Simulation	Historical Simulation	Historical Observed
0.900	438320.500	328520.656	262730.375
0.750	552369.562	499977.531	435810.375
0.500	711742.375	751782.938	691946.625
0.250	877104.812	973699.188	935549.938
0.100	1080490.375	1170393.125	1157333.250



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Science, Service & Stewardship

# Need for a consistent product and enhancements

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- Challenges: Each RFC has a separate webpage for its forecast area
  - Challenge for states with multiple basins, e.g CO, UT, WY
- Feedback from user studies and stakeholder meetings that's not yet incorporated in products, better:
  - Documentation & user guide
  - Verification information
  - Potential to incorporate climate outlooks: NOAA CPC week 3-4, monthly, seasonal outlooks
  - Seasonal water outlook envisioned based on CPC outlooks and other analysis

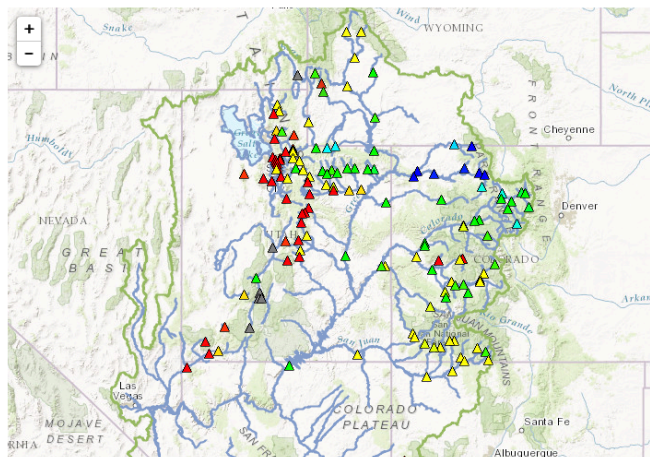
Need for a way to see contextual information and supporting data, now often on other sites:

- Snow information (observed)
  - Soil moisture information
  - Temperature and precipitation
  - Reservoir conditions
- mid-2007



News Most recent presentations of Water Supply Briefings can be found here: [Read More...](#)

## Conditions Map [Help](#)



### River Conditions

### Snow Conditions

### Water Supply Forecasts

Official Forecast Date: 2016-6-1  
ESP Model Run Date: 2016-07-31

☒ Show ☐ Hide Other Types

- ☒ Official Percent Average
- ☐ Official Percent Median
- ☐ ESP Model Percent Average
- ☐ ESP Model Percent Median

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

Offices

☒ CBRFC

☐ WGRFC

☐ ABRFC

### Peak Flood Probability

### Reservoir Conditions

### Daily Precipitation

### Monthly Precipitation

### Soil Moisture

### Map Options

Local forecast by "City, State" or ZIP Code  
Enter location:  [Location Help](#)

NOAA / NWS News and Local CNRFC Information  
New "About CNRFC" Section Added - Learn more about the CNRFC and our various products on our new "About CNRFC" pages under the "About Us" menu above, or click the direct link here.

October 2016 Datum Change - On Oct 3, 2016 the CA Department of Water Resources will change the reporting of river stage data collected on 5 locations in the lower Sacramento River area from the current datum (NGVD29) to the NAVD83 datum. This will affect critical stages at these locations. For more information on these changes, please check out this [webpage](#) hosted by CDEC (California Data Exchange Center).

**NORMAL** All River Guidance (Flood Forecast) Points Are Currently and Forecast to Remain Below Critical Stages **NORMAL**

Recently-issued CNRFC Text Products:  Text Product Description ( ID ) Date/Time Issued to Web

Home Page Version: Interactive Map | Legacy

Download Files [Show Data Table](#) [Enlarge Map](#) [Feedback](#) [Map Search](#) [GO](#)

Geographic Overlays: ☒ CNRFC Boundary ☐ States ☐ Counties ☐ Lakes ☐ Rivers ☐ Drainage Basins ☐ National Parks ☐ Burn Areas 2015 ☐ 2014 ☐ 2013

Point Data Filters: Elevation Filter: <500 to 15000 ft

Map of the Colorado Basin showing river conditions, snow conditions, and water supply forecasts. The map displays the Colorado River and its tributaries, with various colored triangles indicating different forecast categories. A legend on the right explains the symbols and forecast types.

www.cnrfc.noaa.gov

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## Northwest River Forecast Center Water Supply Forecasts



Search  
Enter NWS ID:

### Map Overlays

☒ NWRFC Boundary

☐ NWRFC Basins

☐ NWS HSAs

☐ Counties

### ESP WS Volumes

☒ Status

☐ Percent of Normal

☐ Rank (ASC)

☐ Rank (DESC)

☐ Exceedance (%)

☐ Percentile (%)

☐ Runoff Status

☐ Runoff % of Normal

### Water Supply Forecast

Period: APR-SEP

(% Normal)

☐ No Normal, No Data

☐ 0-25

☐ 26-50

☐ 51-75

☐ 76-100

☐ 101-125

☐ 126-150

☐ 151-175

☐ > 175

☐ No Normal, No Data

☐ 0-25

☐ 26-50

☐ 51-75

☐ 76-100

☐ 101-125

☐ 126-150

☐ 151-175

☐ > 175

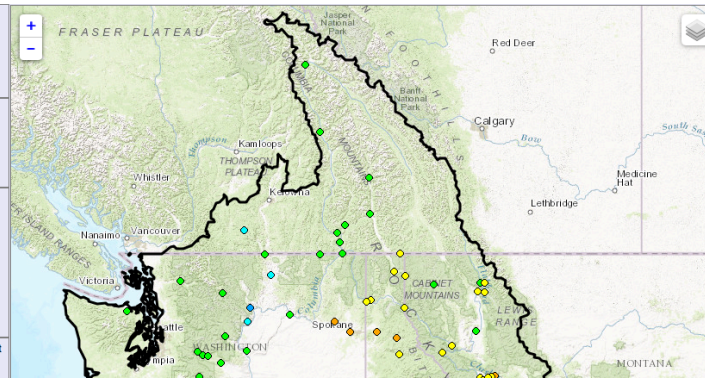
☐ No Normal, No Data

☐ 0-25

☐ 26-50

☐ 51-75

☐ 76-100



COLUMBIA - JOHN DAY DAM (JDAO3)  
Forecasts for Water Year 2016

10 days QPF: Ensemble: 2016-09-15 Issued: 2016-09-15

Official Forecast

Forecast Period: 90% 50% Average 10%

APR-SEP 81740 81811 90 81954 80714

JAN-JUL 104959 105030 95 105173 110866

JAN-JUL 95398 95398 97 95398 95856

OCT-SEP 119411 119462 95 119625 126095

Stations Display: 5 days QPF: Ensemble: 2016-09-15 Issued: 2016-09-15

Water Supply L APR-SEP 81672 81780 90 82046 80714

APR-JUL 72179 72179 92 72179 78433

JAN-JUL 104891 104999 95 105265 110866

JAN-JUL 95398 95398 97 95398 95856

OCT-SEP 119343 119451 95 119717 126095

5 days QPF: Ensemble: 2016-09-15 Issued: 2016-09-15

APR-SEP 81545 81732 90 82121 80714

APR-JUL 72179 72179 92 72179 78433

JAN-JUL 104764 104951 95 105339 110866

Water Supply L APR-SEP 81672 81780 90 82046 80714

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# Need for a consistent product and enhancements

8

- Challenges: Each RFC has a separate webpage for its forecast area -> next slide
  - Challenge for states with multiple basins, e.g CO, UT, WY
- Feedback from user studies and stakeholder meetings that's not yet incorporated in products; they request better:
  - Documentation & user guide
  - Verification information
  - Potential to incorporate climate outlooks: NOAA CPC week 3-4, monthly, seasonal outlooks
  - Seasonal water outlook envisioned based on CPC outlooks and other analysis

Need for a way to see contextual information and supporting data, now often on other sites:

- Snow information (observed)
  - Soil moisture information
  - Temperature and precipitation
  - Reservoir conditions
- mid-2007



Water Year: 2016



Period: April July



Forecast Date: 2016-04-21

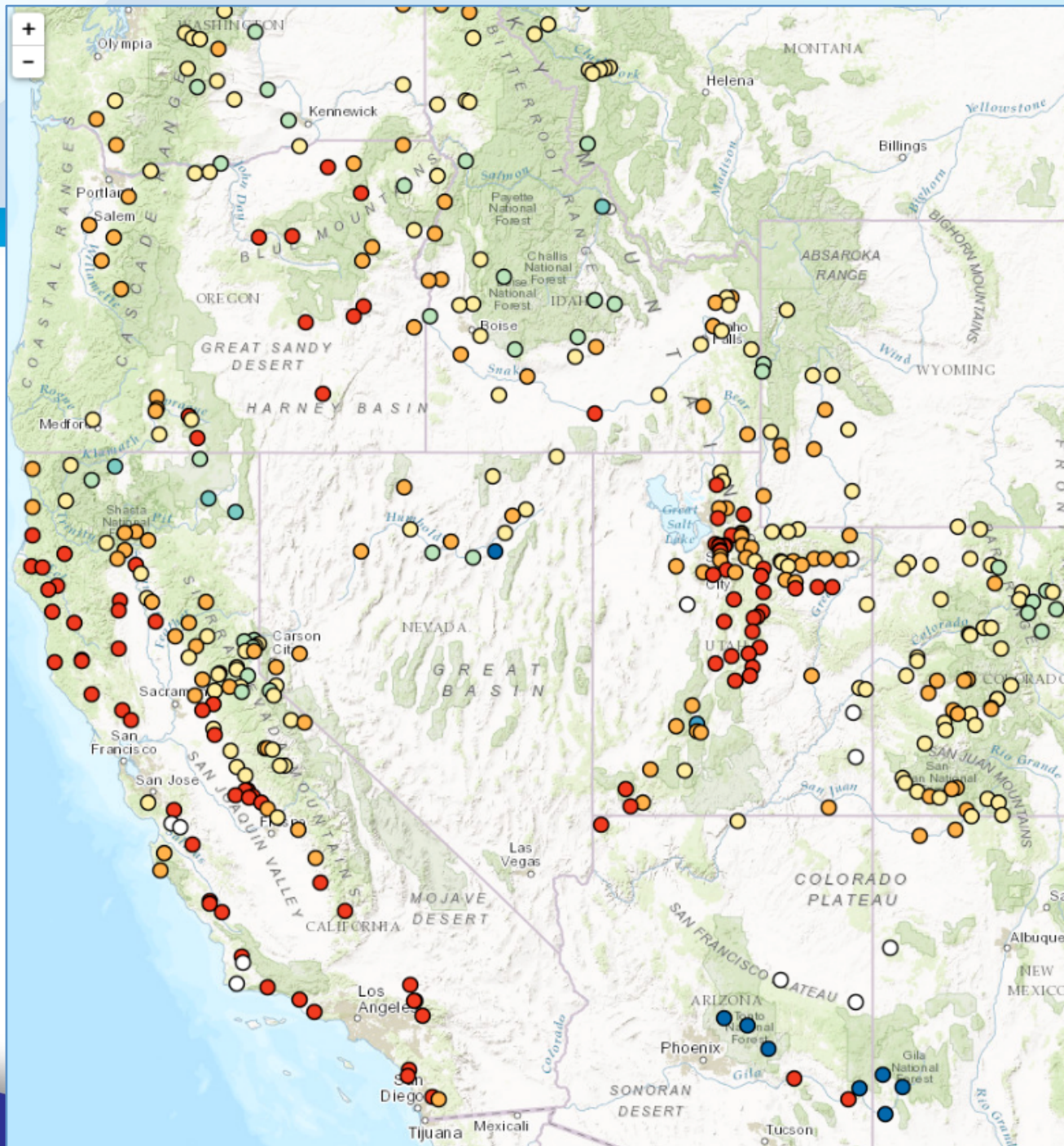
Data Type: Percent Average

- ☐ No Data
- ☒ < 50%
- ☐ 50 - 70%
- ☐ 70 - 90%
- ☐ 90 - 110%
- ☐ 110 - 130%
- ☐ 130 - 150%
- ☐ > 130%

A single source for  
westwide water  
resource products  
(prototype for  
national)

Landing page image

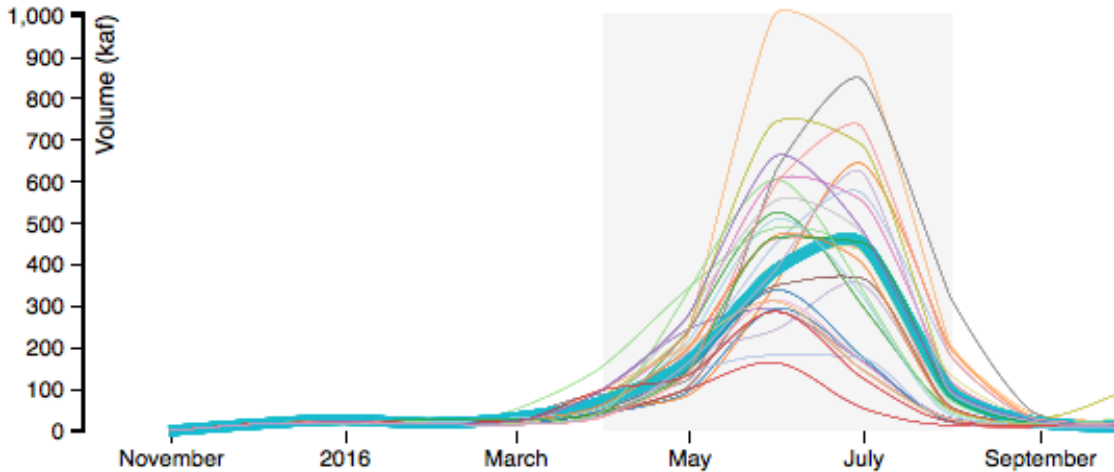
- At a glance status
- Select a forecast  
point for  
additional  
information



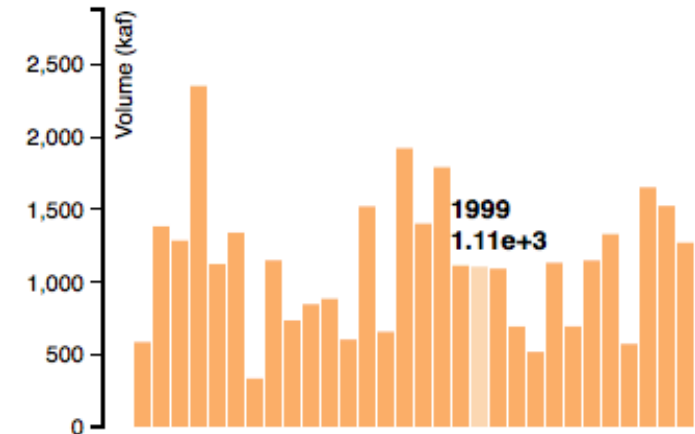


# Prototypes: forecast traces

Forecast Traces

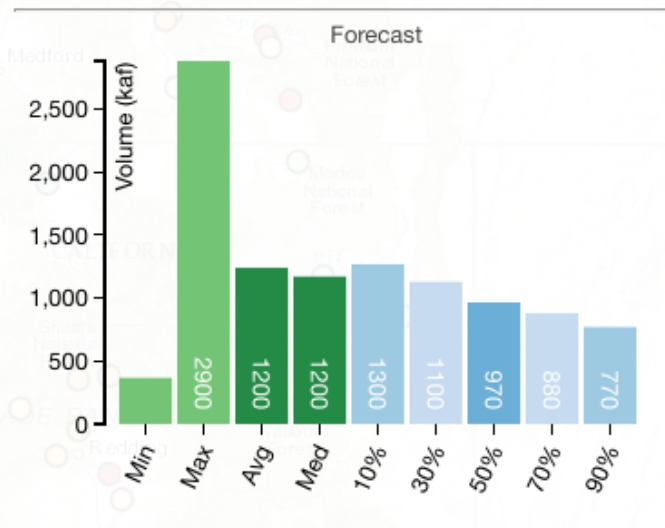


Trace Totals for Period



## Forecast Point Details

### Yampa - Deerlodge Park



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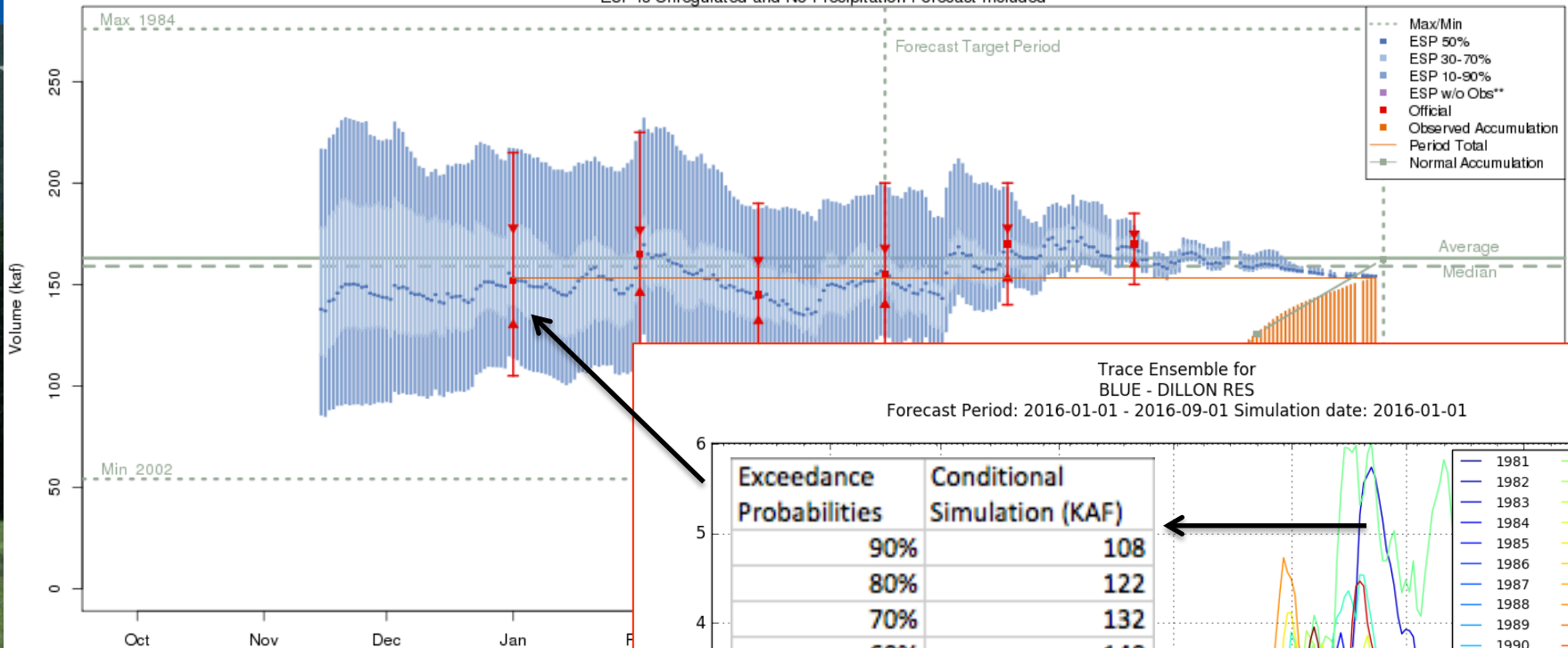
Science, Service & Stewardship  
Science, Service & Stewardship



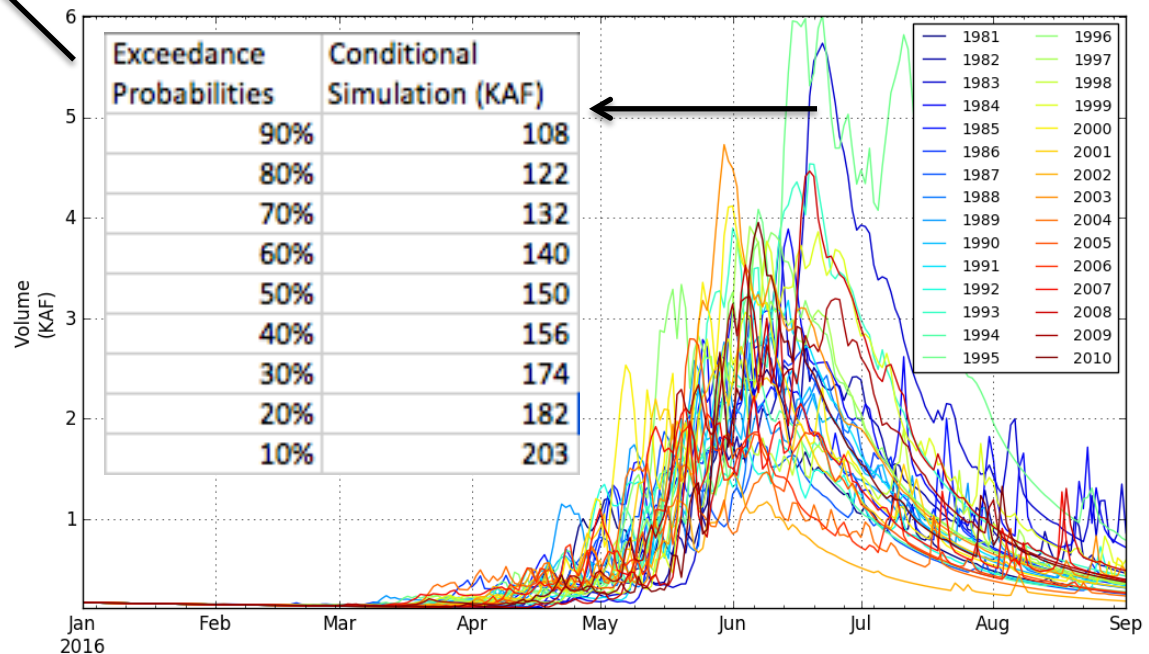


# Communicating Forecast

**Blue - Dillon Res (DIRC2)**  
**2016-06-01 Apr-Jul Official 50% Forecast: 170 kaf (104% of average)**  
 ESP is Unregulated and No Precipitation Forecast Included



Trace Ensemble for  
 BLUE - DILLON RES  
 Forecast Period: 2016-01-01 - 2016-09-01 Simulation date: 2016-01-01

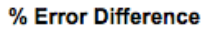


## 12

[Help](#) Double Click Map to Zoom

January  
February  
March  
April  
May  
June

**Blue indicates that the current year forecast had lower error than the ESP model**



- No Data  
● -45 - -35  
● -35 - -25  
● -25 - -15  
● -15 - -5  
● -5 - 5  
● 5 - 15  
● 15 - 25  
● 25 - 35  
● >40



# Benefits & upcoming features

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## Benefits:

- One location for all forecasts westwide, eventually nationally
- Updated daily; Options for user-customization
- Based on user needs & feedback, including User defined periods,
- Documentation & user guide
- Verification information

## Upcoming Features:

Supporting data, currently not easily viewed from RFC pages:

- Snow information (observed)
  - Soil moisture information
  - Temperature and precipitation
  - Reservoir conditions
- 
- Climate outlooks: NOAA CPC week 3-4, monthly, seasonal outlooks
  - Seasonal water outlook envisioned based on CPC outlooks and other analysis



# Comments on observations

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- River Forecast Centers depend on obs and data with partner agencies, not just data from NOAA: USGS streamflow gages; obs and forecasts for smaller streams by Dept. Ag/NRCS; NRCS soil moisture; NASA remote sensing
- Snow obs & data are critical (NRCS snotel, NOAA/NASA SNODAS, etc)
  - In the west, snow is a reservoir
- Additional SNOTEL sites in areas that are poor in data have the potential to improve the water supply forecasts.
- “We always need more snow information”

# Thank you

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**Andrea J. Ray, NOAA/ESRL Physical  
Sciences Division,**

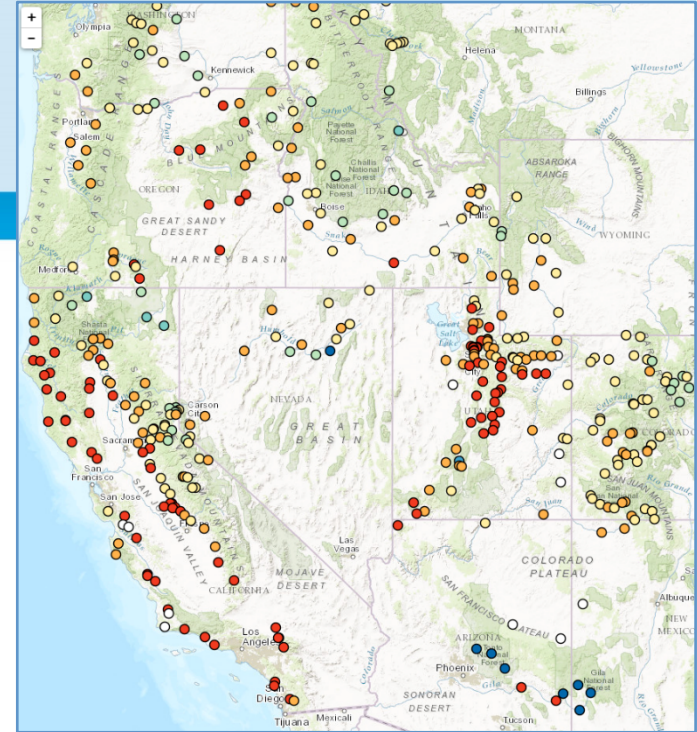
**[Andrea.ray@noaa.gov](mailto:Andrea.ray@noaa.gov)**

**303-449-9733**

**Michelle Stokes, NOAA Colorado Basin  
River Forecast Center**

**[Michelle.stokes@noaa.gov](mailto:Michelle.stokes@noaa.gov)**

**801-524-5130 ext 322**



- For more info:  
[CBRFC.noaa.gov/WRMO](http://CBRFC.noaa.gov/WRMO),  
beta available in mid-2017

- Blank



- BLank

# The Take Away

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- Overall, CBRFC forecasts performed well throughout much of the basin this season
  - Dry and warm February and March conditions, coupled with dry soil moisture conditions, impeded runoff
  - An unusually wet May negatively impacted forecast performance in the Green River Basin
- Great Basin forecasts were impacted by early runoff in March, but some areas in the north did benefit from May precipitation
- Lower Colorado River Basin did not realize forecasted wet El Niño conditions