

# CBRFC Forecast Verification

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*NWS Colorado Basin River Forecast Center*



**CBRFC Stakeholder Forum**  
**February 24, 2014**



# Outline

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- Forecast Tool Evaluation
- Next Steps
- Current Verification Tools
  - Water Supply Forecasts
    - Official forecasts and reforecasts
  - Daily Forecasts
- Discussion



# Motivation / Goals

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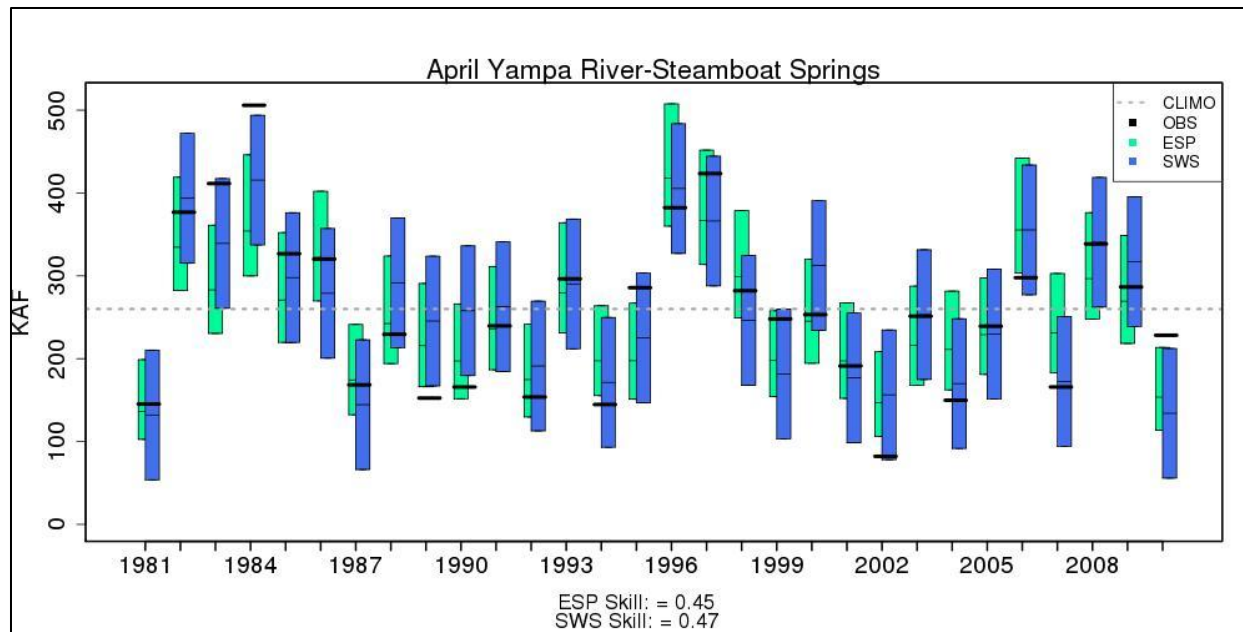
**Motivation:** ESP is well positioned for:

- Daily forecast updates leveraging daily updating observations (e.g. SNOTEL, other precipitation, temperature, and streamflow)
- Probabilistic forecasts for full hydrograph including peak flows, time to peak, volumes, etc.
- Incorporating both weather and climate prediction
- NOAA investing in improvements to ESP (but not SWS) including data assimilation, connection to ensemble weather and climate prediction, and bias correction.

**Key Question:** Is the current ESP forecast tool as skillful and reliable as SWS? What are the strengths and weaknesses of each forecast tool?

# Methodology

Reforecasts generated for first of month for winter and spring months 1981-2010 using similar assumptions



Assumptions: No weather climate forecast, 1981-2010 climatology, no bias adjustment,



# Methodology (con't)

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Reforecasts verified against unregulated streamflow observations:

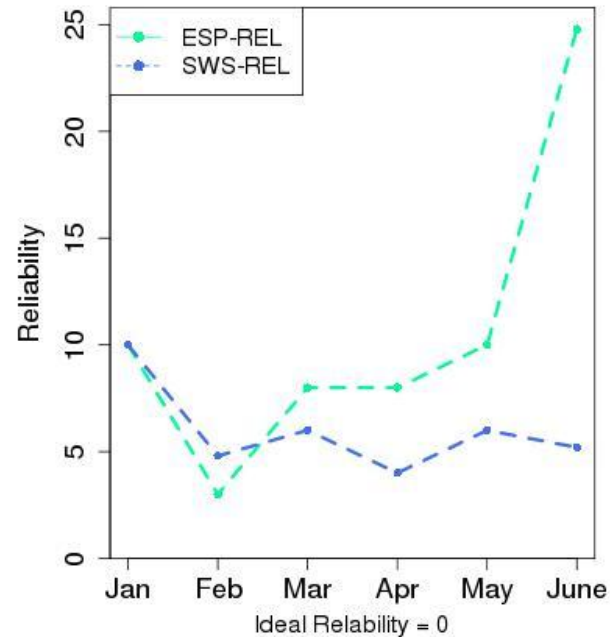
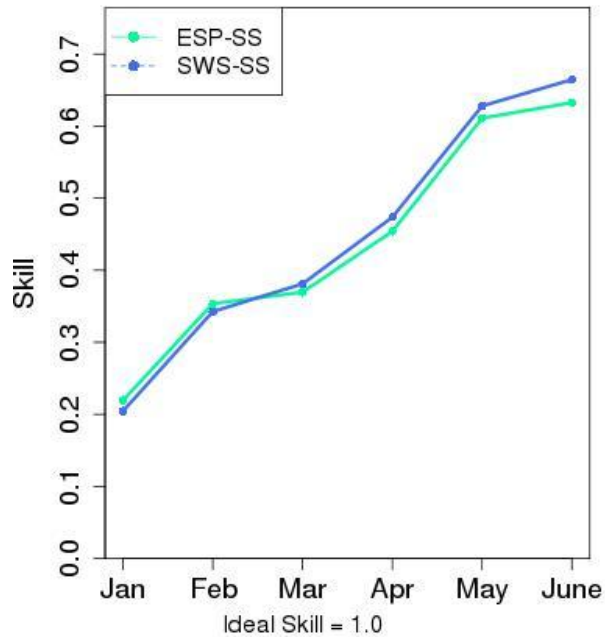
- Skill – MAE SS
- Reliability – Assessed against traditional 10,50,90% forecast thresholds

Results conditioned on:

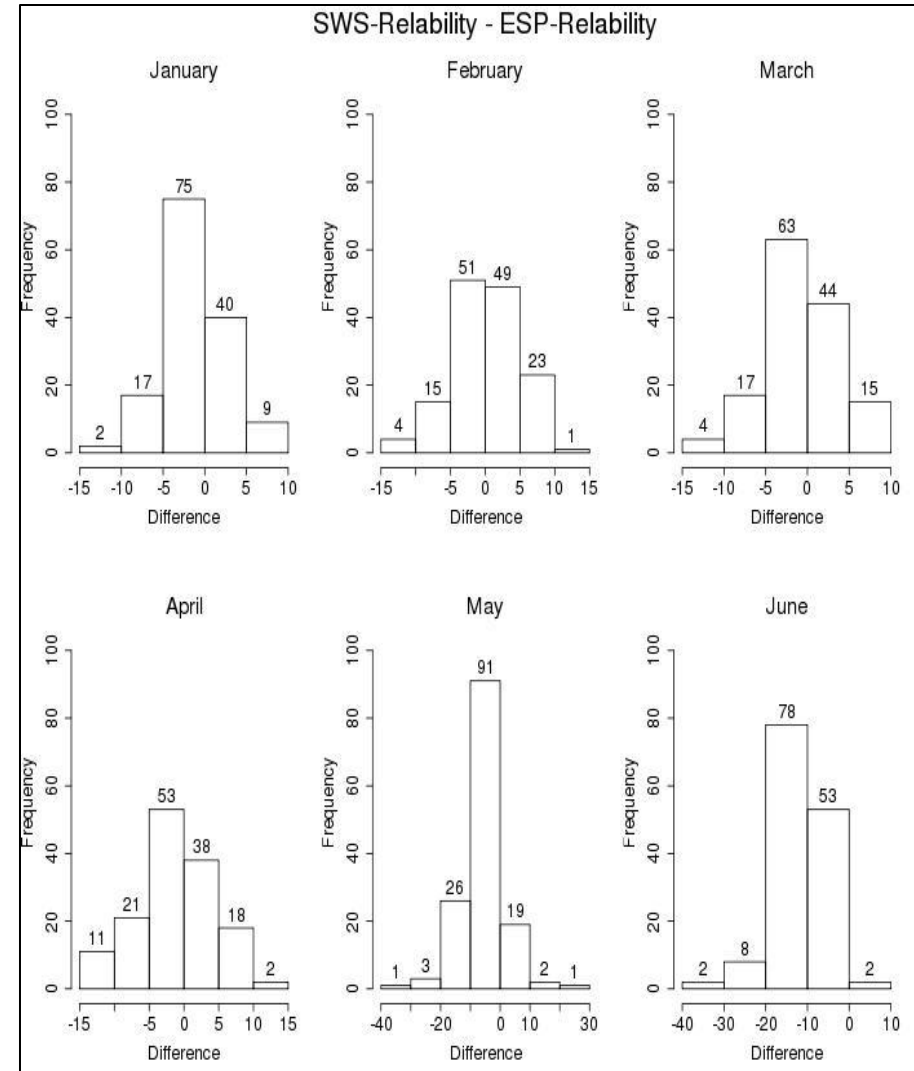
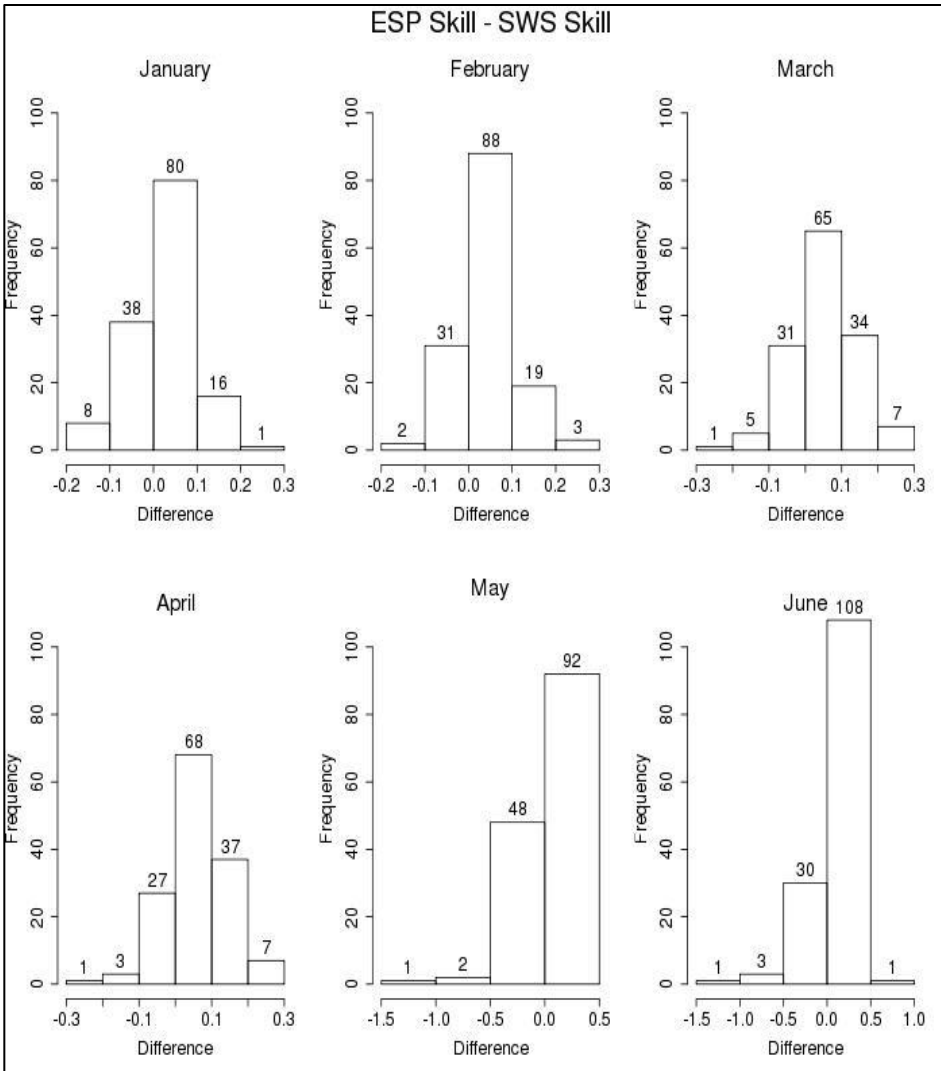
- Lead Time (e.g. Jan 1 issuance, Feb 1 issuance, etc)
- Forecast Point

# Results: Lead Time

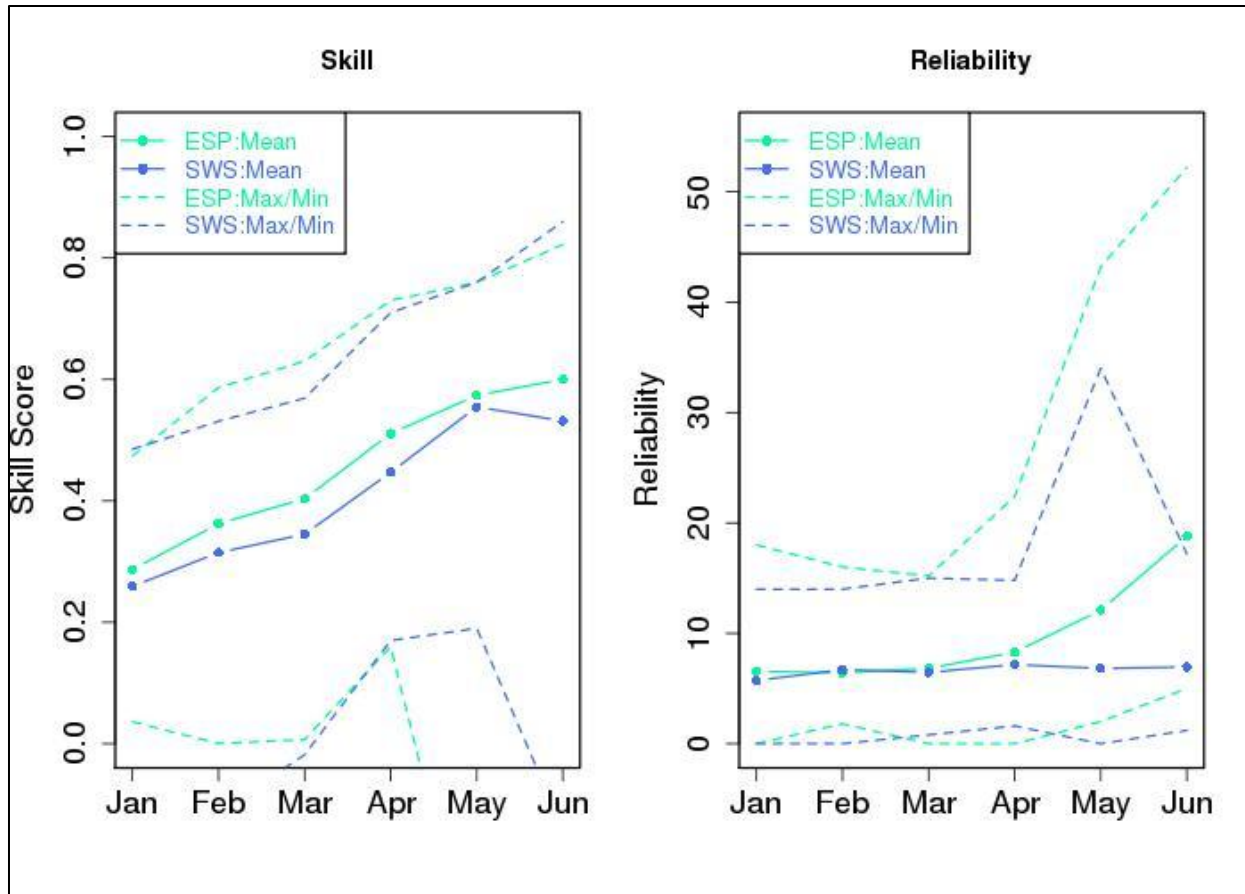
Yampa River-Steamboat Springs



# Results: Forecast Point



# Results: All Points







# Conclusions

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1. ESP and SWS have generally comparable skill. ESP generally slightly more skillful.
2. ESP and SWS have generally comparable reliability January through April. ESP is very under-dispersive during the runoff season (e.g. May and June forecasts).
3. ESP and SWS likely have strengths in specific regimes that we have not fully understood.



# So What?

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CBRFC is using verification for:

1. Tool development and application (e.g. ESP and post adjustment)
2. Annual lessons learned
3. Identification of errors in forecast process



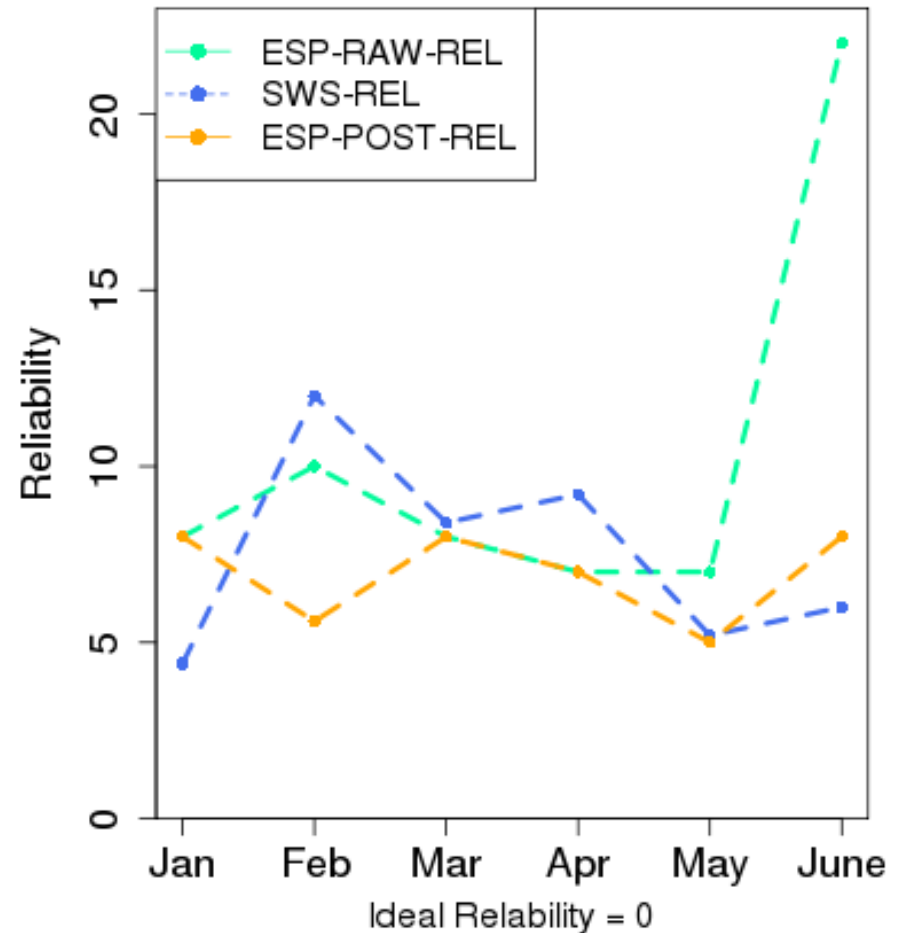
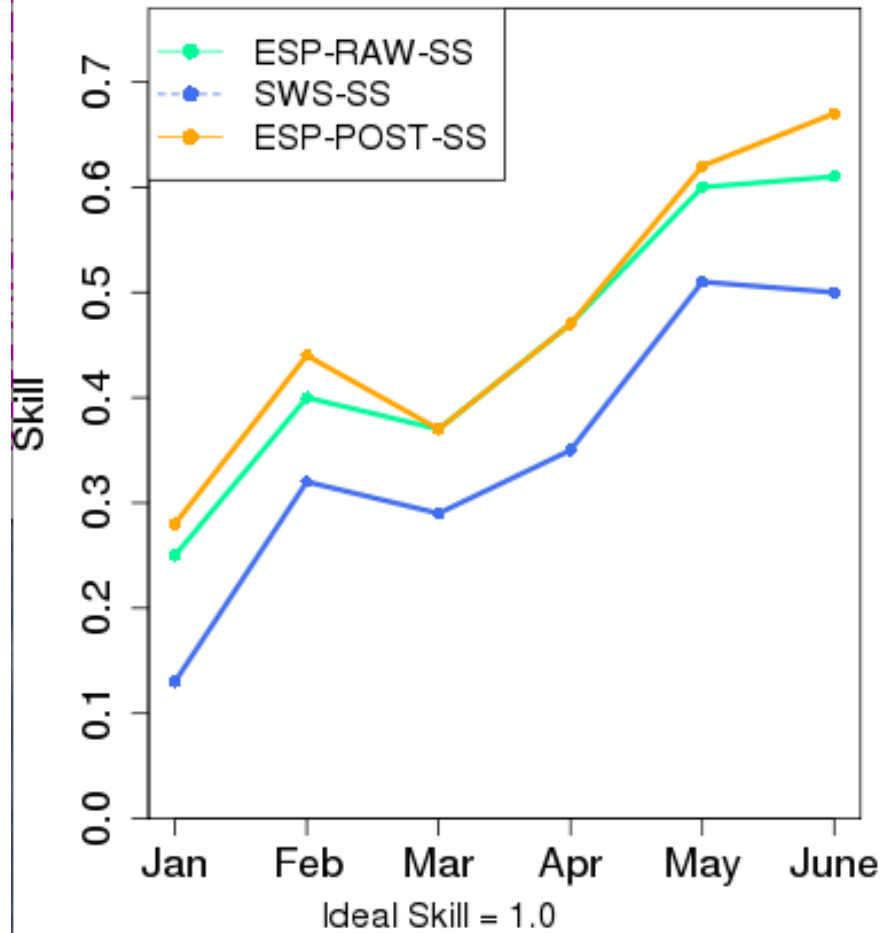
# Next Steps

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1. Study validates a focus on ESP particularly given enhancements
2. Similar verification studies should assess improvements proposed to ESP:
  1. Bias adjustment
  2. Headwater vs downstream points
  3. Incorporation of weather, climate forecasts
  4. Weather generator technique
  5. Incorporation of new data sets (e.g. MODIS)

# Example: Bias Adjustment

GLDA3



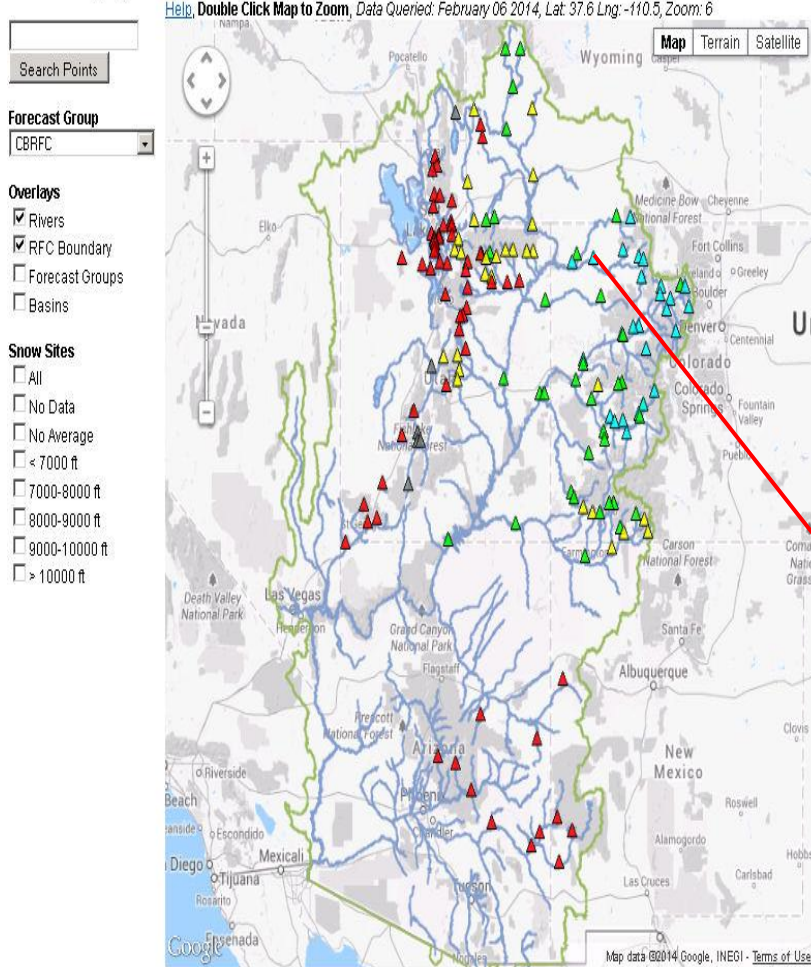


# Current Verification Tools

## Water Supply Forecasts



### Water Supply Forecasts



### Water Supply Forecasts

- Official Percent Average
- Official Percent Median
- ESP Percent Average
- ESP Percent Median
- < 70%
- 70-90%
- 90-110%
- 110-130%
- >130%
- Regulated
- No Forecast

### Snow

- Percentiles
- Percent Average
- Percent Median
- No Data
- < 25%
- 25-50%
- 50-75%
- 75-90%
- 90-110%
- 110-125%
- 125-150%
- 150-175%
- >175%

## COLORADO BASIN RIVER FORECAST CENTER

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- SNOW
- WATER SUPPLY
- RESERVOIRS
- WEATHER
- CLIMATE
- HELP
- OFFICE
- LINKS
- SEARCH

News: Registration open for Stakeholder Forum Feb 25-26. Read More...  
Next CBRFC Webinar March 6. Read More...

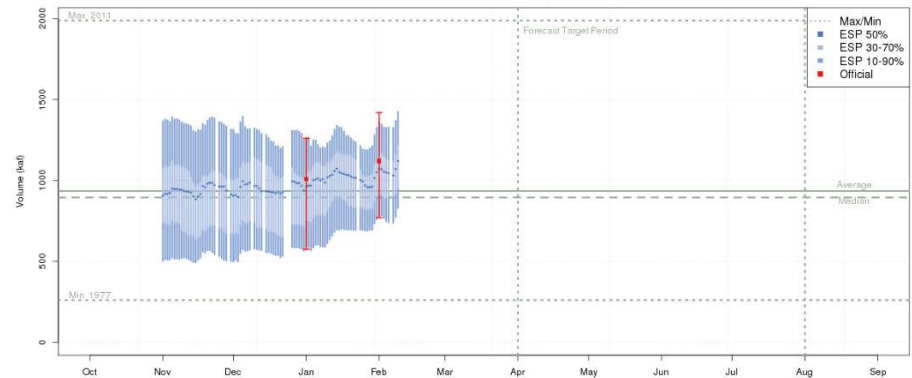
### MBL2 Water Supply Forecasts

Plot: Forecasts Observations Historical **Annual/Official Verification** Reforecast Verification

Water Year: 2013 2014  
Plot Options (on/off): GPF ESP Official Forecasts Observations Max/Min Historical Unapproved

### Yampa - Maybell- Nr (MBL2) Apr-Jul 2014 Runoff Forecast

2014-02-01 Official 50% Forecast: 1120kaf (120% of average)

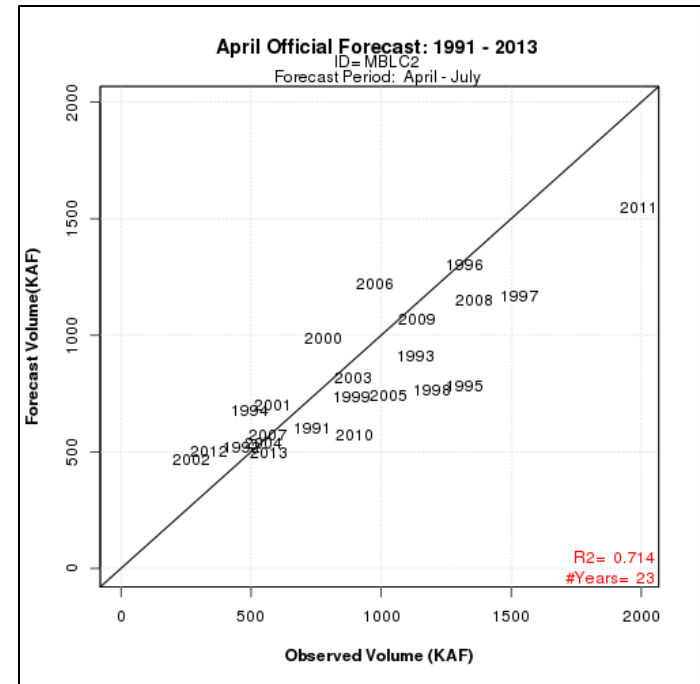
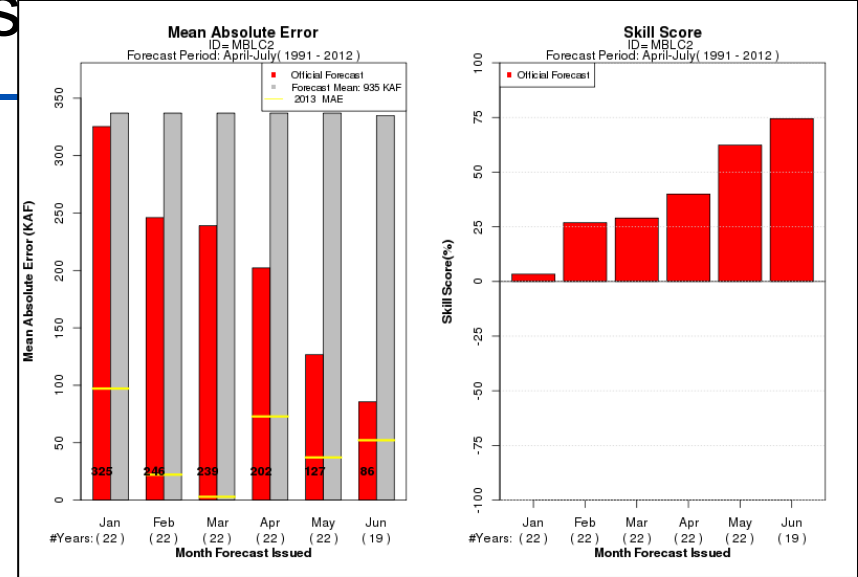
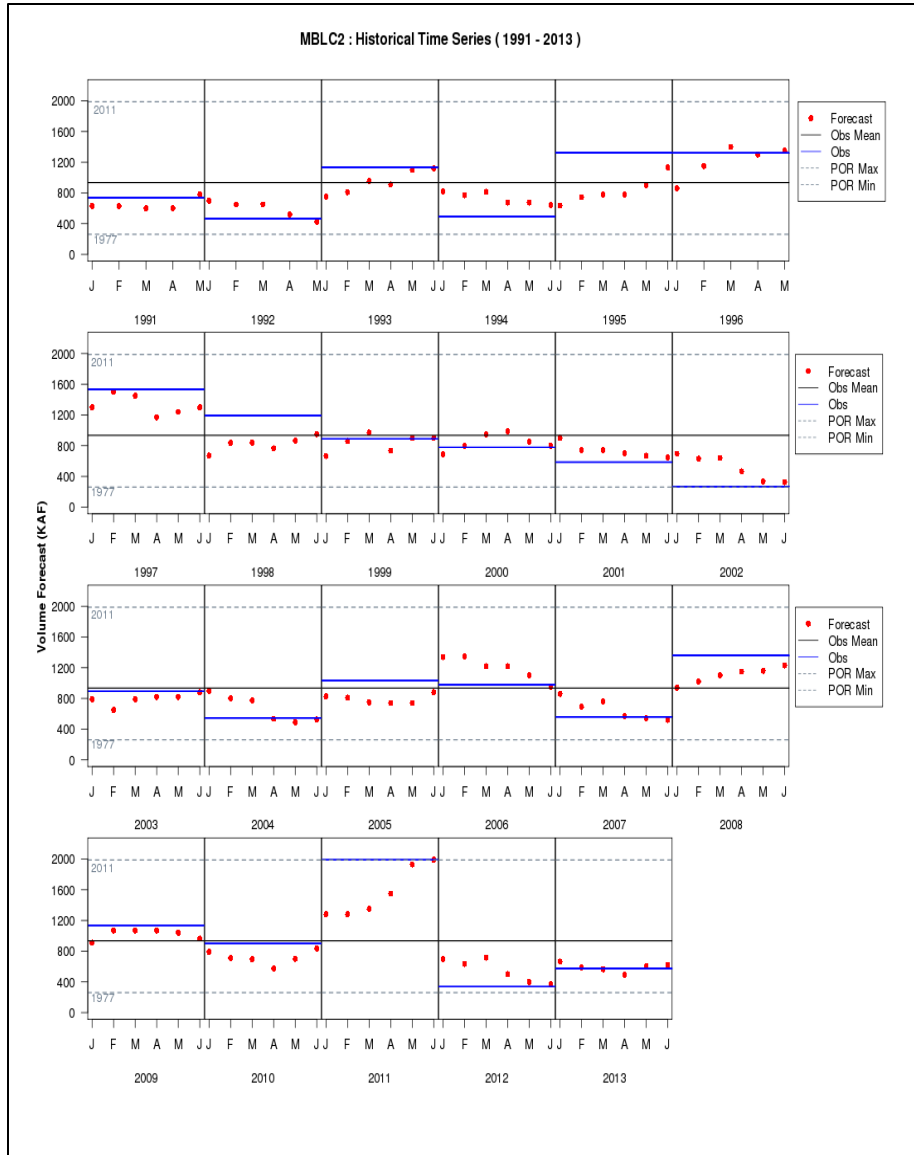


Plot Created 2014-02-11 14:58:32, Latest ESP Run from 2014-02-11, NOAA / NWS / CBRFC  
Today's 50% ESP forecast changed: 0.3% from yesterday and 10.4% from February 1  
Forecasts in the observed period include observed values



# Current Verification Tools

## Water Supply Forecasts







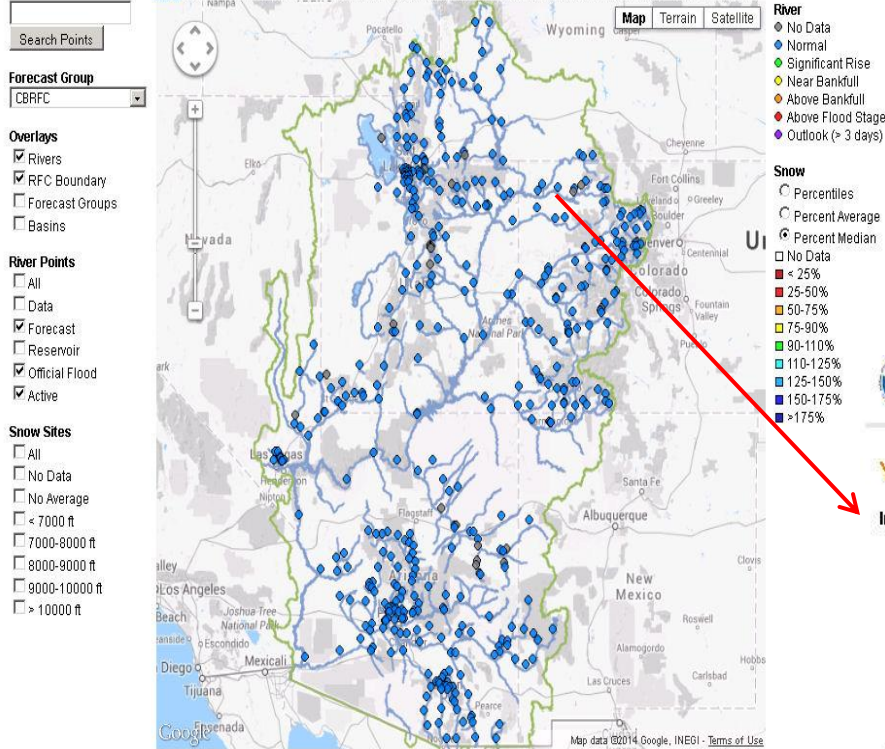
# Current Verification Tools

## Daily Streamflow Forecasts



### River Conditions

Help, Double Click Map to Zoom, Data Queried: Tue, 11 Feb 2014 10:15:02-0700, Lat: 37.6 Lng: -110.5, Zoom: 6



### COLORADO BASIN RIVER FORECAST CENTER

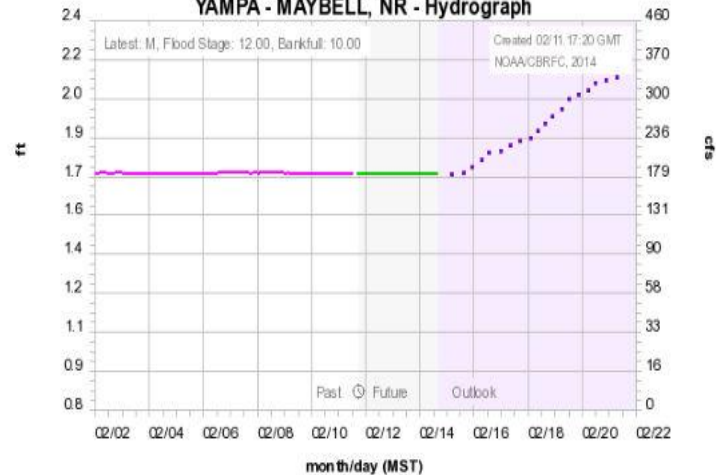
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### YAMPA - MAYBELL, NR (MBLC2)

Info: [Station](#) [Rating type](#) [Critical Stages](#) [Yearly Peaks](#) [Daily Stats](#) [Recent Verification](#) [Seasonal Verification](#) [USGS data](#)

### Colorado Basin River Forecast Center

### YAMPA - MAYBELL, NR - Hydrograph



Observed — Simulated — Forecast (02/11:16:00) — Outlook (increasing uncertainty) —

Historical Exceedance Probability (USGS): 90-75% 75-50% 50-25% 25-10%

Observed=QRIRGZZ, Simulated=QRIPAZZ, Forecast=QRIFEZZ F (02/11:16:00)

resoutid=

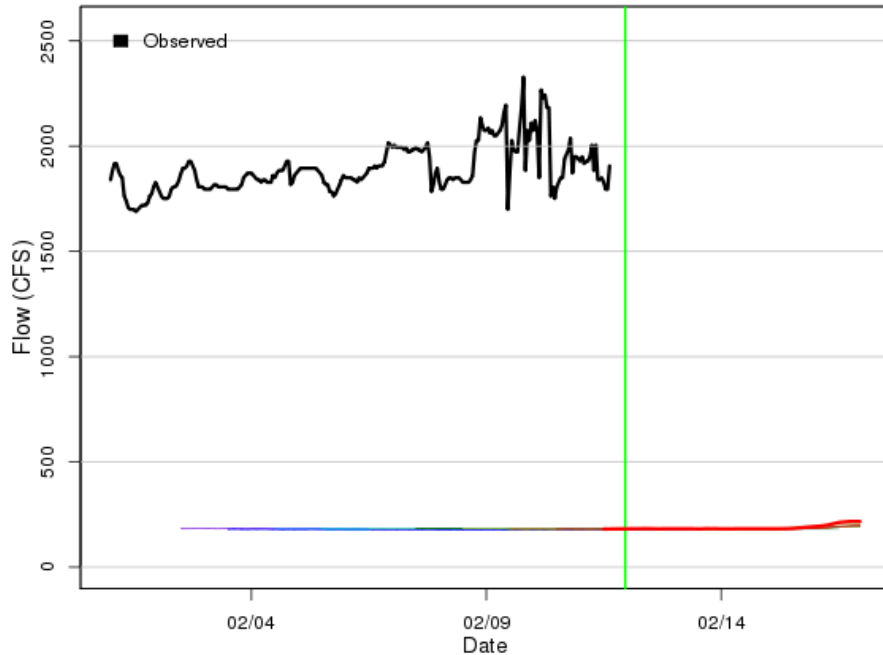


# Current Verification Tools

## Daily Forecasts

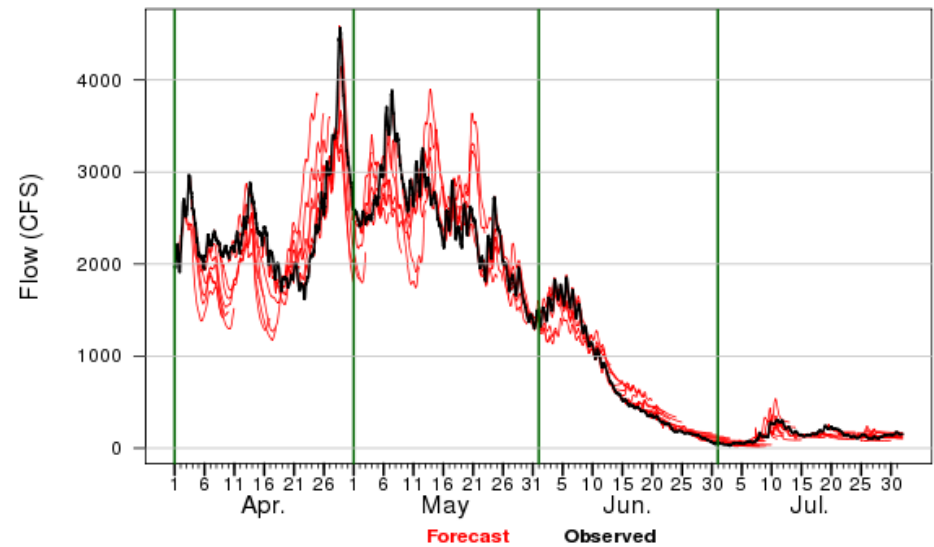


**YAMPA - MAYBELL, NR (MBLC2)**  
Recent streamflow forecasts



Plot created by the NOAA/NWS Colorado Basin RFC

**YAMPA - MAYBELL, NR (MBLC2)**  
Streamflow for 04/01/2012 to 07/31/2012



Plot created by the Colorado Basin RFC (NWS/NOAA)

	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	OVERALL
<b>MEAN ERROR (cfs):</b>	-28.1	-29.8	-28	-43.7	-74.9	-40.9
<b>MEAN ABSOLUTE ERROR (cfs):</b>	59.4	108.9	187.6	223.6	257.1	167.3
<b>RELATIVE ABSOLUTE ERROR (%):</b>	9.9	14.9	20.6	24.3	29.1	19.8

Stacie! Help fix please!!





# Online tour

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# Website Coming Attractions: Verification

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- Verification web consistency
  - DOCUMENTATION (we know)
  - Spatial view
  - One stop shop
  - Similar to defunct western water page
- Monthly verification (for USBR MTOM and others)



# Verification Discussion

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- How does CBRFC use verification?
- How easy is it find/understand the verification?
- How useful is the verification information presented here?
- How do you currently use or want to use verification?
- How good do forecasts need to be for your use?