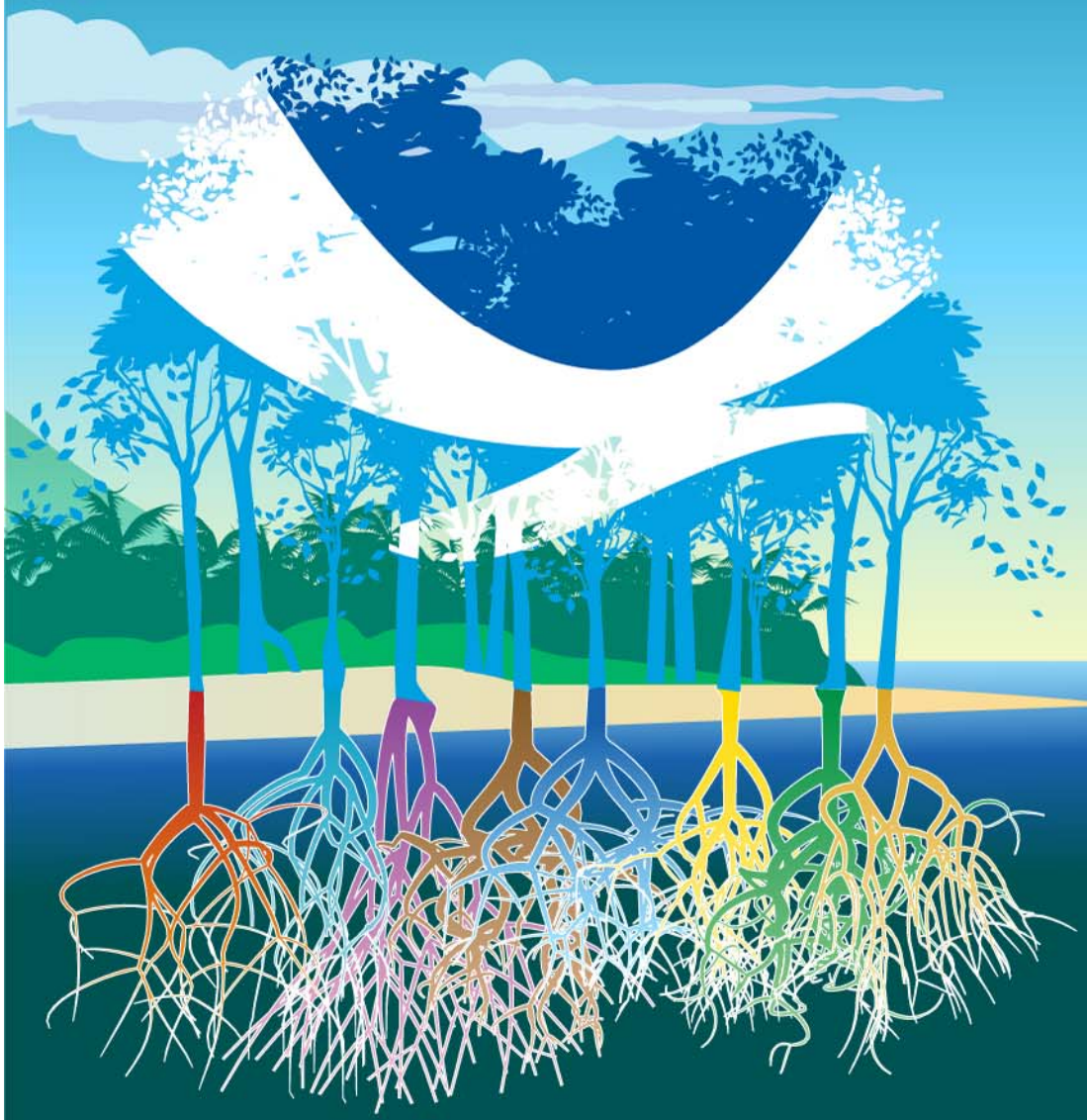
NOAA Water Supply and Water Resources



Drought Monitor Forum
Austin, TX

SM5⁄8✪€– fi5⁄8ᒪR–5⁄8ᒪR

–5⁄8ᒪR✪€1⁄85⁄8 —11ᒪR3⁄8€–1⁄3ᴺL€1–

†Rs3⁄8ᒪR10⁄001Ⓜ€ᴸFᴺL

—10⁄001ᒪR1⁄33⁄81 –1⁄3ᴸF€– ▫○—

■1⁄8ᴺL12⁄35⁄8ᒪR ©£ 1⁄2aa¤

Outline

- River Forecast Center Overview
- Water Supply / Water Resources Outlook Project:
- Overview and History
- Current Capabilities
- Future Plans
- Other Drought Stuff

Colorado Basin River Forecast Center

One of 13 River Forecast Centers

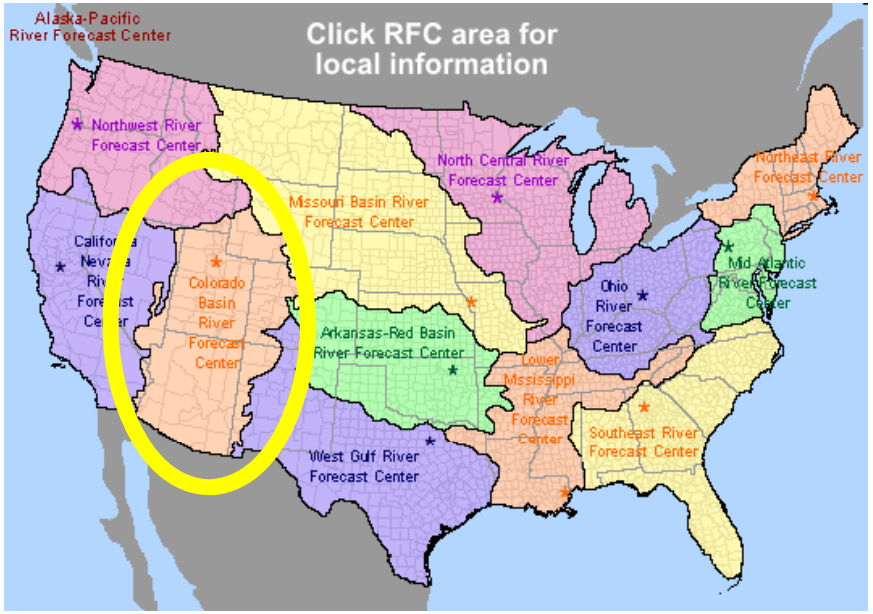
Established in the 1940s for water supply forecasting

Three primary missions:

1. Seasonal **Water supply forecasts** for water management

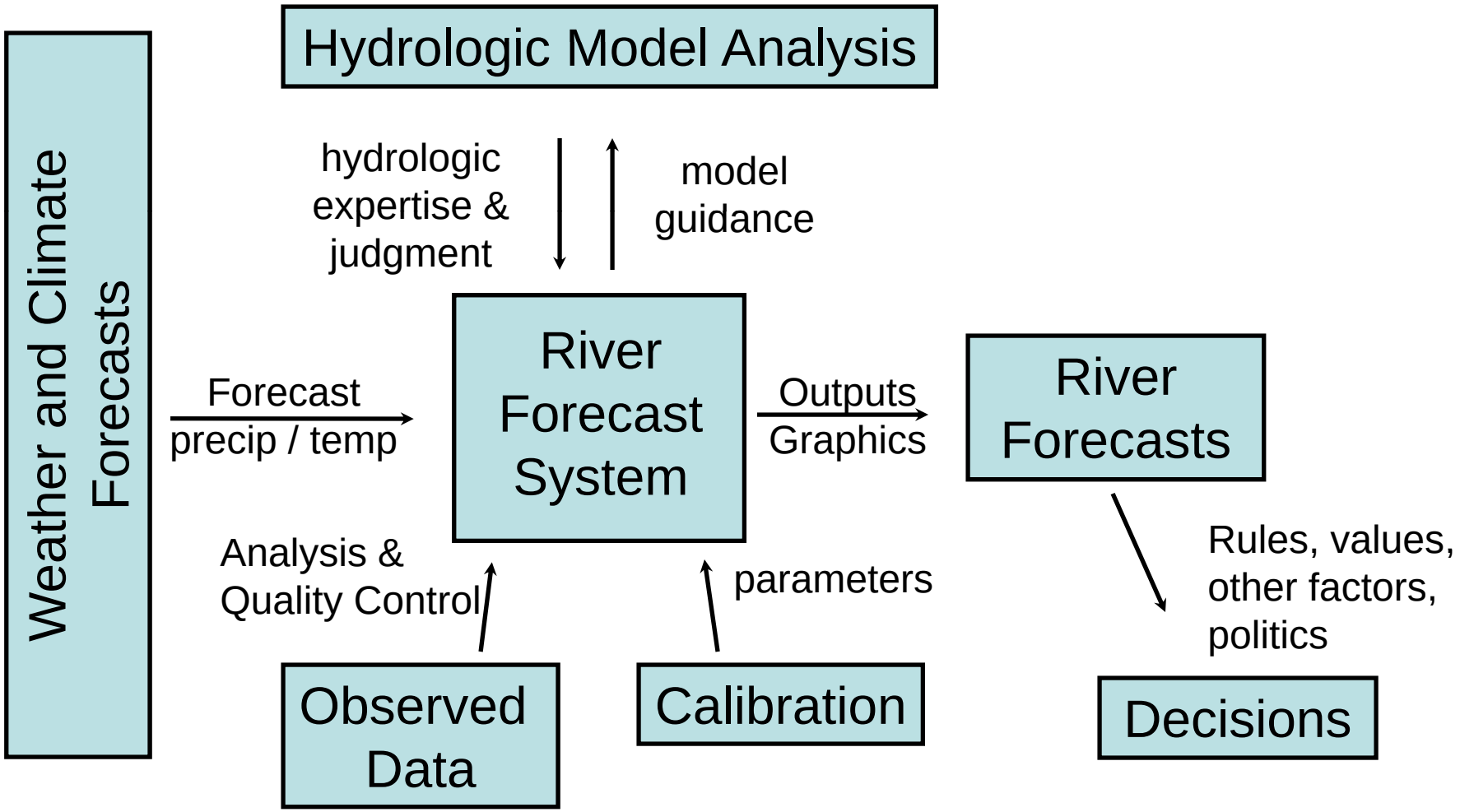
2. **Daily forecasts** for flood, recreation, water management

3. **Flash flood warning support**



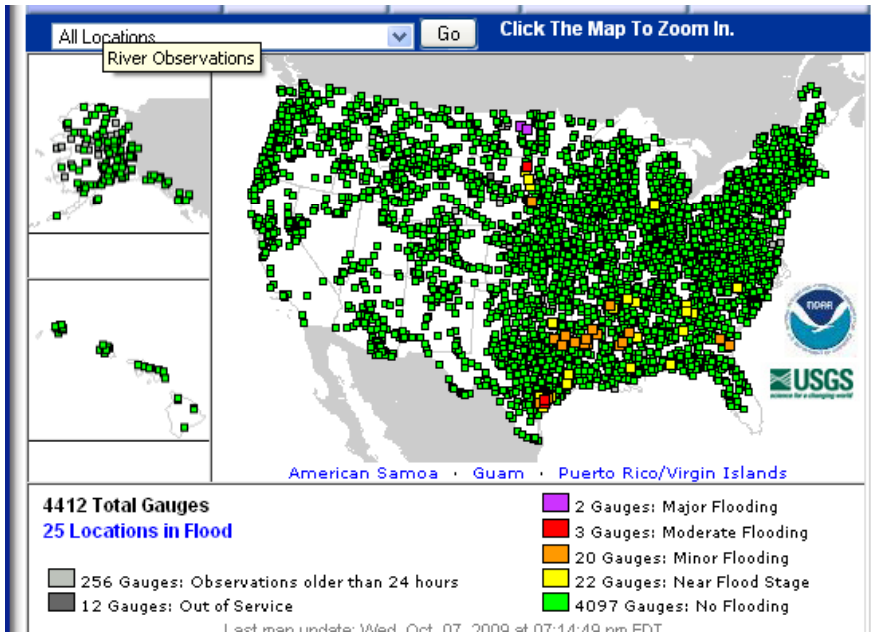
www.cbrfc.noaa.gov

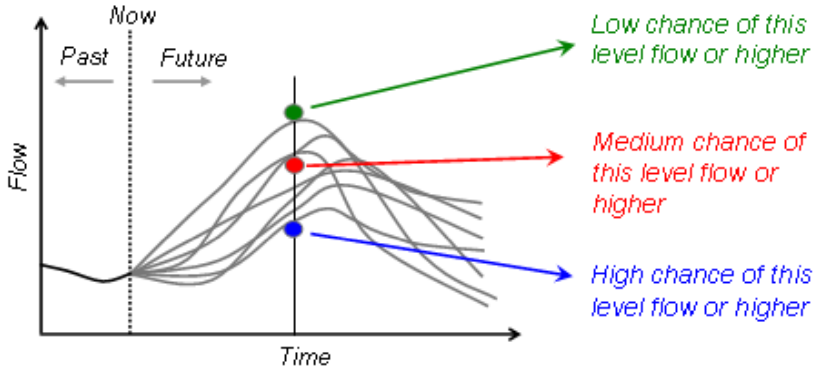
Generalized RFC Forecast Process

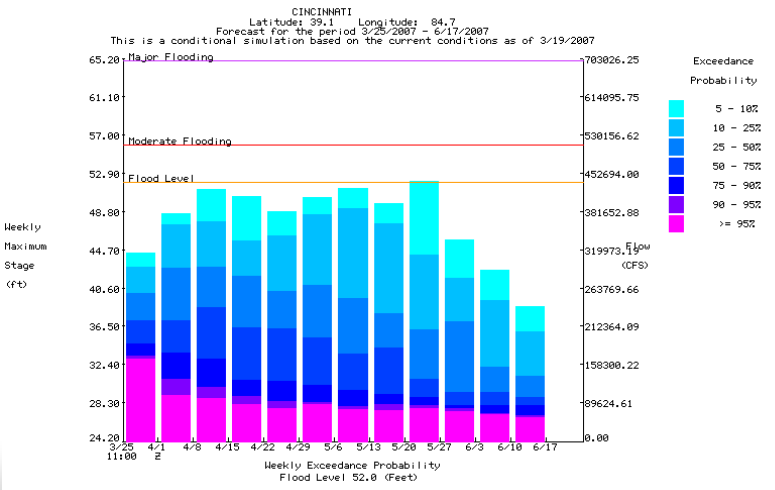


RFC Ensemble Streamflow Prediction

RFCs routinely make multi month forecasts integrating initial soil moisture and snow conditions with weather and climate forecasts:







Web Services Project

Goal: Develop "one stop shop" for NWS water supply and water resources forecasts

Milestones (past):

- April 2005: Working group formed, planning meeting held
- January 2006: Initial website launched
- September 2006: Included AB, WG, and MB RFCs in development
- January 2007: Common database developed
- September 2007: Move software to NWRFC web farm
- December 2007: Launched verification and ensemble services
- May 2008: Partnered with OHRFC to enhance / expand Water Resources Outlook
- January 2009: Launched "version 3" including google map interface, national water resource outlook, climate variability and change relationships.
- July 2009: Held organizational meeting in Park City, UT to explore next steps and relationships with RISAs

Current Status: Website Operations

6 Western RFCs

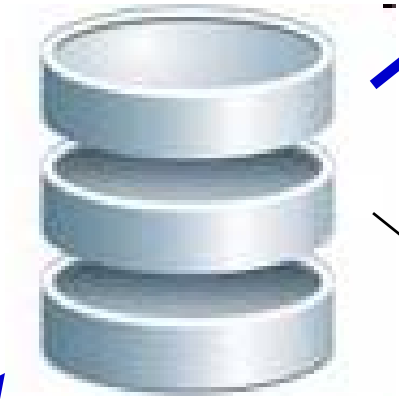
Water Supply Forecasts

All (13) RFCs

Ensemble Streamflow Forecasts

Historical Streamflow

Metadata



Central Database

Website

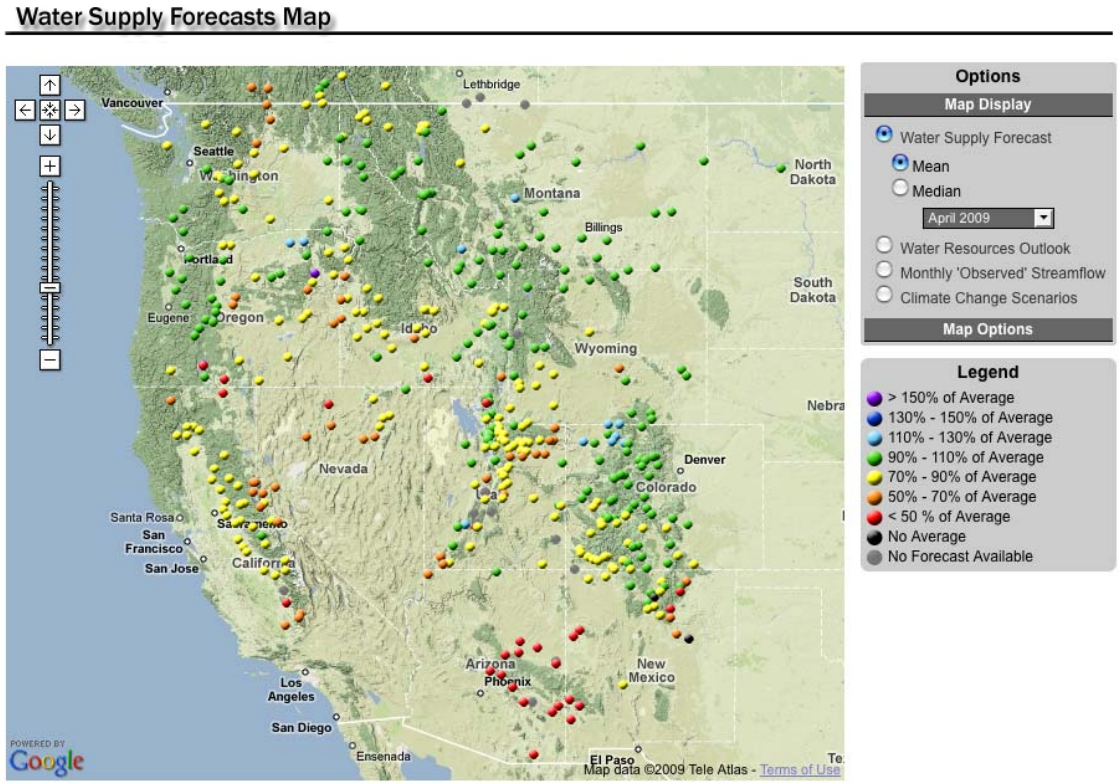
NIDIS Web Services

®

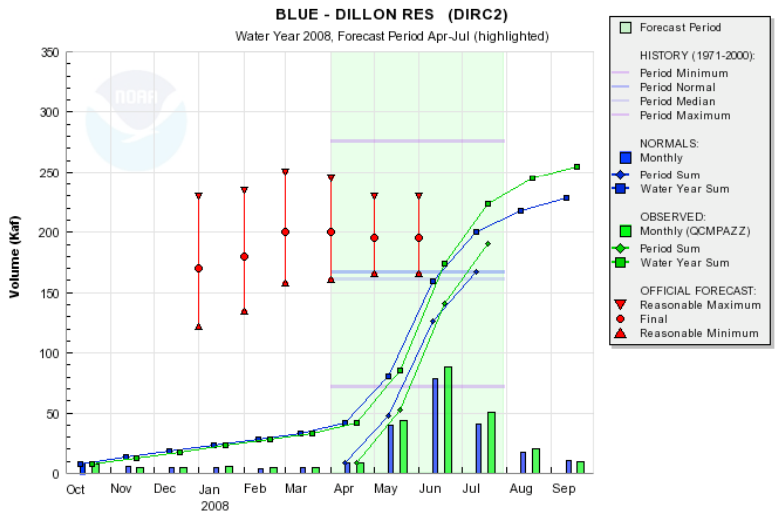
Current Status: Western Water Supply

Tools Available:

- Forecast Analysis
- Verification
- Ensemble Forecasts
- Climate Variability Relationships
- Climate Change Scenarios
- Data Access



Jun 01 2008 Forecast: 195 Kac ft
Range: 166-230 Kac ft (99.4 - 137.7% of normal)



Options

Water Supply Forecasts
Ensemble Forecasts
Observations
Graph Options

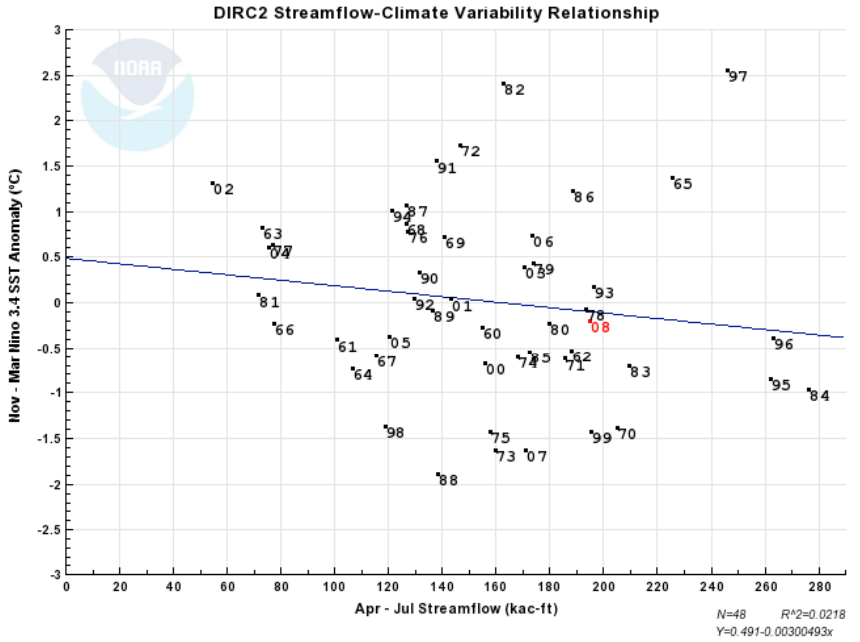
Start Water Year: 2008
End Water Year: 2008
Period: Apr-July

- [x] Period Median
- [x] Period Normal
- [x] Period Maximum
- [x] Period Minimum
- [x] Forecast Period
- [x] Require Maximum
- [x] Grid

CBRFC/NWS/NOAA 11/10/08 17:32:30 UTC

Flow Relationship with Climate Variability

Climate Index: Nino 3.4 SST Anomalies | Index Start: November | Index End: March | Display the Previous: 100 Years

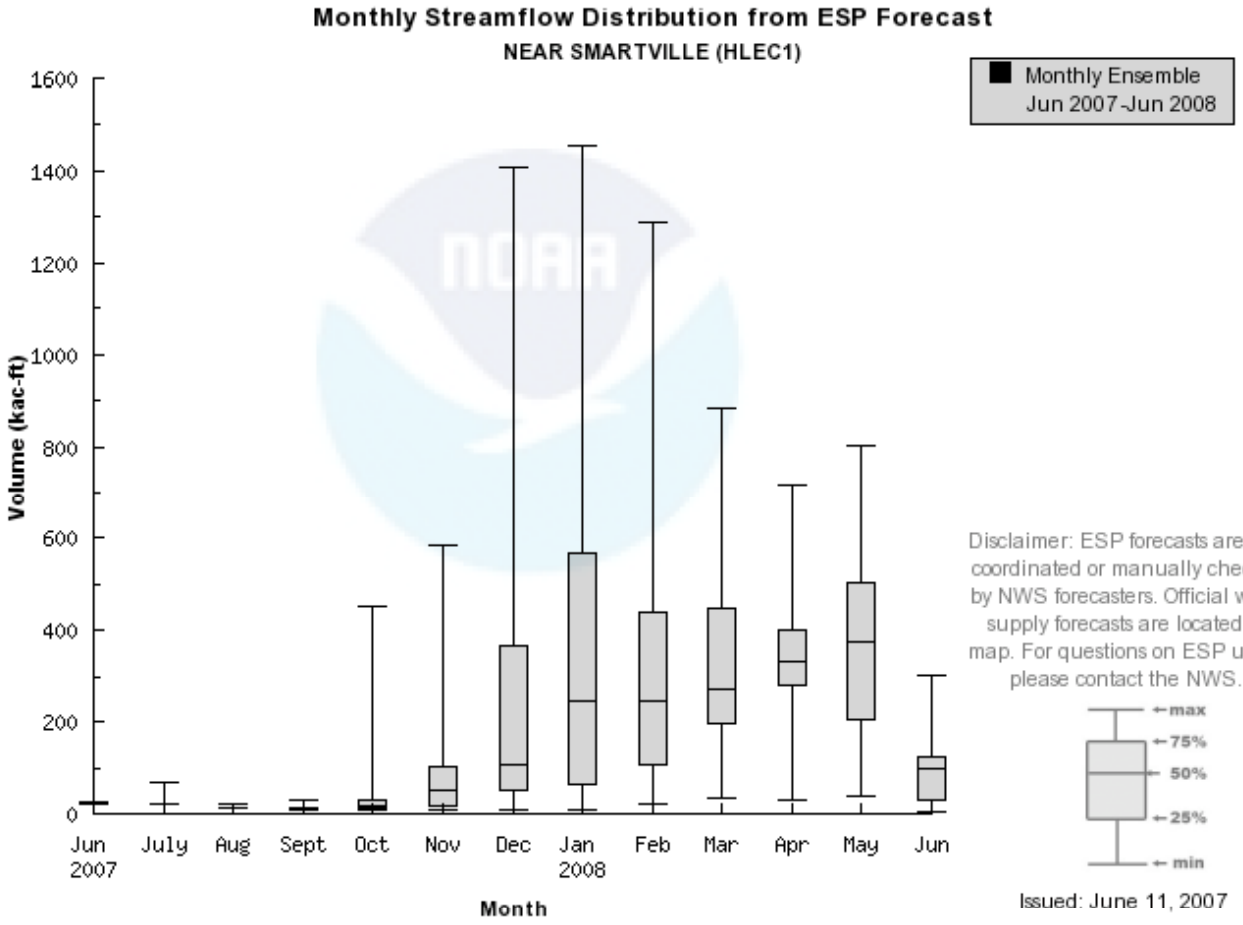


Flow Forecast in context with similar Historic Years (Apr - Jul, 1960 - 2008)

Rank	Year	Flow (kaf)	Percent Normal
Highest (1)	**1984**	**276.13**	**165.3**
10	1978	193.49	115.9
11	2008	190.92	114.3
12	1986	188.57	112.9
13	1962	187.93	112.5
14	1971	185.42	111.0
Forecast	**2009**	**180.00**	**107.8**
15	1980	179.88	107.7
16	1979	173.99	104.2
17	2006	173.65	104.0
18	1985	172.69	103.4
19	2007	170.82	102.3
Lowest (50)	**2002**	**54.56**	**32.7**

Location: **Yuba at Near Smartville, California** (HLEC1 - CNRFC) change location clear location

Ensemble Streamflow Prediction Forecasts



Disclaimer: ESP forecasts are not coordinated or manually checked by NWS forecasters. Official water supply forecasts are located on map. For questions on ESP usage, please contact the NWS.

Issued: June 11, 2007

Options

Forecasts

Current Forecast
June 11, 2007

Forcing Year

ENSO Conditional Forecast

Archives

Season Options

Graph Options

About Ensemble Streamflow Prediction

Ensemble forecasts provide range of possible outcomes giving forecast users a measure of forecast uncertainty. Ensemble forecasts may be used to support decision support systems to quantitatively weigh forecast uncertainty against the potential risks and gains associated with decisions. Ensemble forecasts may also support contingency forecasts and qualitative demands for forecast confidence. The methodology

Site Options

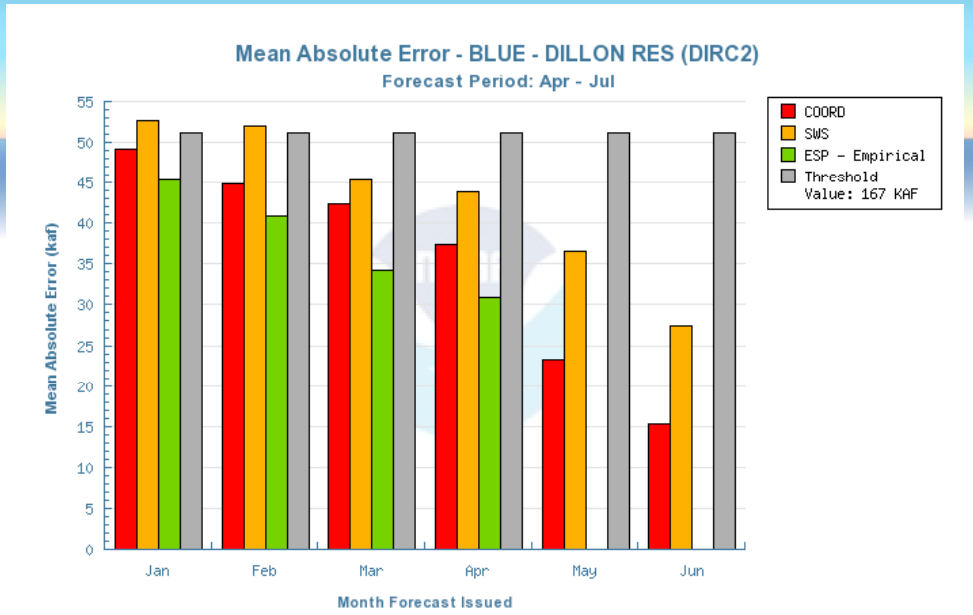
Previous 5 Locations Viewed

HLEC1, KRMC2, LUCI1, BFFU1, VCRC2

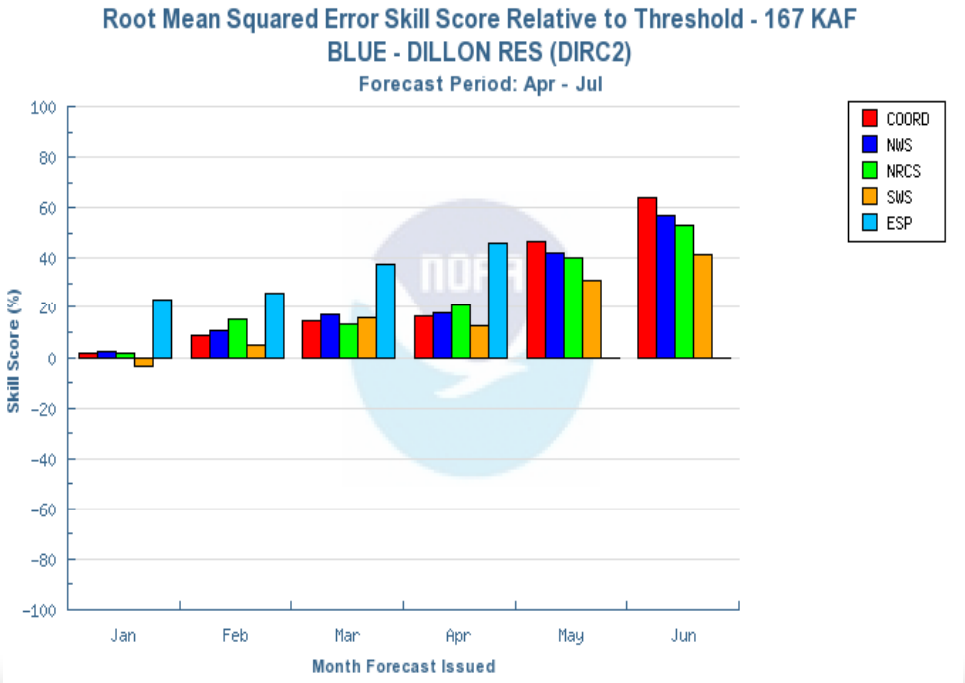
Print Graph | Display Raw Data

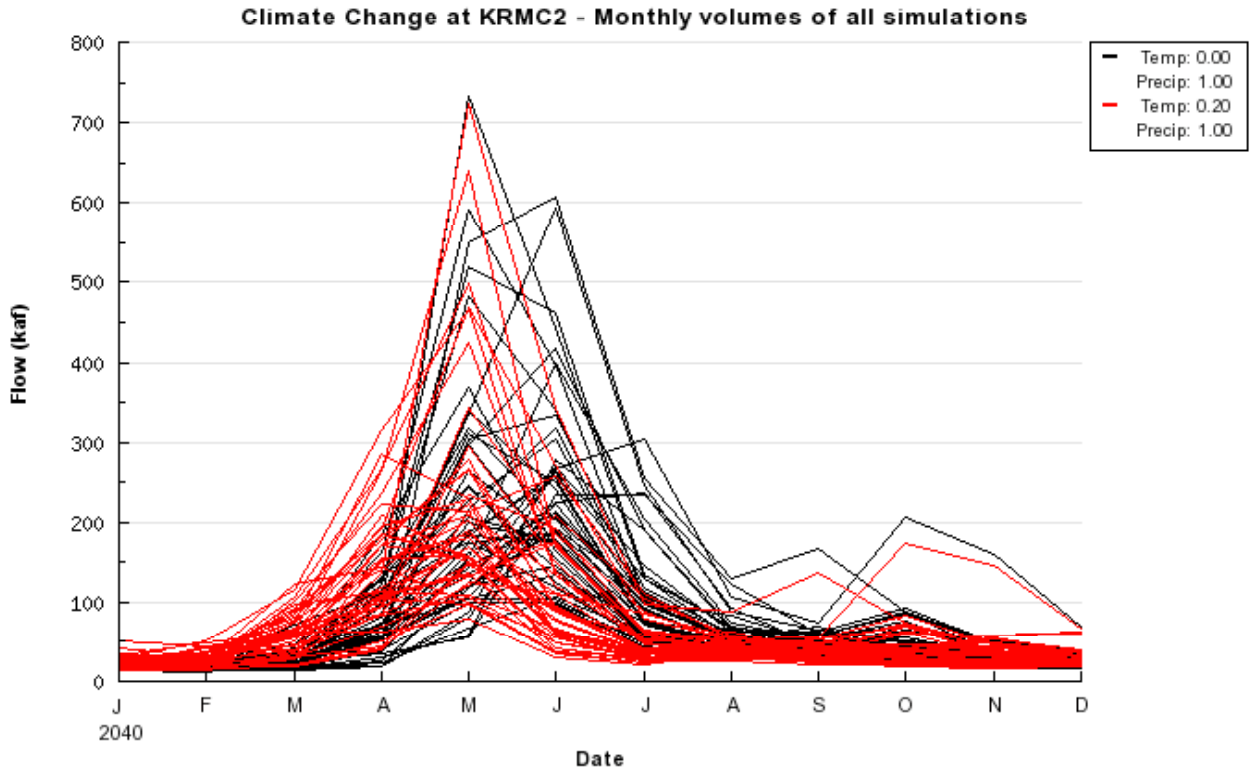
Key Verification Result #1:

ESP generally outperforms all other forecasts



- ESP reforecasts made over 1980-2005 with no forecaster intervention
- Compared to archived official forecasts and tools
- Suggests well calibrated continuous RFC models could be the foundation of water supply forecast system
- Important implications for future of water supply forecast process





Options

Graph Options

Type: Spaghetti

Scenarios: 2

Start Year: 2040 End Year: 2040

Scenario 1 Options

Scenario 2 Options

Display Graph

Graph

About Climate Scenarios

The NWS is testing the feasibility of generating climate change scenarios at select water supply forecast points. Climate change scenarios examine the sensitivity of streamflow to arbitrary perturbations to the temperature and/or precipitation time series in the NWS river forecast system. The baseline time series for temperature and precipitation are the those used to calibrate the NWS streamflow and snow models. Temperature perturbations are linear in time while precipitation perturbations are exponential in time. Scenarios are pre-generated but plots are customizable to examine any combination of scenarios requested by the user.

Scenarios are not intended to be predictions of future streamflow. Instead the scenarios show the impact of specific temperature or precipitation perturbations on the simulated hydrology of the selected basins. It is important to note that while the NWS model computes evapotranspiration at each model time step, it does not currently account for changes in potential evapotranspiration from changes in temperature. Basin scenarios are accessible by following the link on the pop up box that appears when you click on one of the points where scenarios are available.

Site Options

Previous 5 Locations Viewed

KRMC2, LUCI1, BFFU1, VCRC2, DIRC2

Print Graph

Forecast and Observations Data Checkout

Id	Shef	BW Month	EW Month	Cdate	Vdate	Source	Ftype	Dist	e95	e90	e
DIRC2	QCSFAZZ	7	10	2004-01-02	2004-01-01	ESP	R	empirical	99.185	105.81	12
DIRC2	QCMFAZZ	7	10	2004-01-01	2004-01-01	COORD	F		0	205	
DIRC2	QCSFAZZ	7	10	2004-02-02	2004-02-01	ESP	R	empirical	101.632	107.926	11
DIRC2	QCMFAZZ	7	10	2004-02-01	2004-02-01	COORD	F		0	191	
DIRC2	QCSFAZZ	7	10	2004-03-02	2004-03-01	ESP	R	empirical	98.869	104.091	11
DIRC2	QCMFAZZ	7	10	2004-03-01	2004-03-01	COORD	F		0	179	
DIRC2	QCMFAZZ	7	10	2004-06-01	2004-04-01	NWS	O				
DIRC2	QCMFAZZ	7	10	2004-06-01	2004-04-01	SWS	O				
DIRC2	QCMFAZZ	7	10	2004-05-01	2004-04-01	SWS	O				
DIRC2	QCSFAZZ	8	10	2004-05-01	2004-04-01	ESP2	R	normal	122.70984	116.46977	106
DIRC2	QCSFAZZ	8	10	2004-05-01	2004-04-01	ESP5	R	logweibull	116.64248	110.89159	101
DIRC2	QCSFAZZ	8	10	2004-05-01	2004-04-01	ESP3	R	lognormal	120.46293	113.84177	103
DIRC2	QCSFAZZ	8	10	2004-05-01	2004-04-01	ESP7	R	loglogisti	305.29809	218.47962	145
DIRC2	QCSFAZZ	8	10	2004-05-01	2004-04-01	ESP1	R	empirical	147.97944	108.45392	98.
DIRC2	QCSFAZZ	8	10	2004-05-01	2004-04-01	ESP6	R	weibull	116.82679	111.07505	101
DIRC2	QCSFAZZ	8	10	2004-05-01	2004-04-01	ESP4	R	wakeby	142.54127	116.06455	96.

Options

Data Type

- ○ Monthly Observed Streamflow
- ○ Seasonal Characteristics
- ◉ Seasonal Forecast
- ○ ESP Forecasts
- ○ Monthly Observed Means
- ○ Climate Indicies

Time Constraints

Output

View Data | Save Data

USGS science for a changing world

USGS Home
Contact USGS
Search USGS

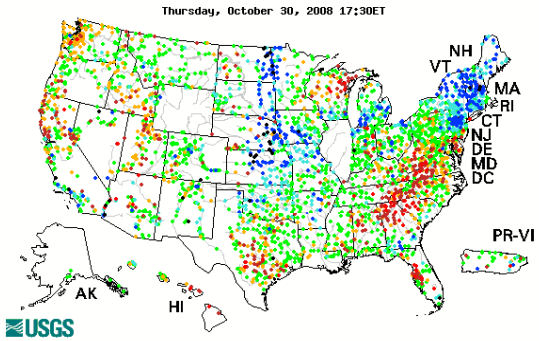
WaterWatch -- *Current Water Resources Conditions*

Current Maps/Graphs: Current Streamflow | Flood Watch: | Drought Watch: | Recent/Historical Maps/Graphs: | Search WaterWatch: Go

Map | United States | *Special Features* | Contents | Additional Information

WaterWatch -- *Current water resources conditions*

Map of real-time streamflow compared to historical streamflow for the day of the year (United States)



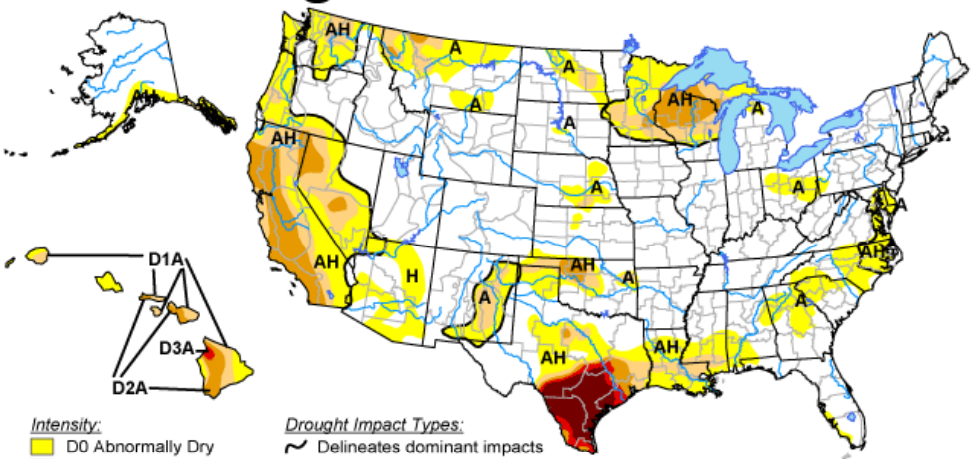
Choose a data retrieval option and select a location on the map

○ List of all stations in state, ◉ State map, or ○ Nearest stations

Explanation - Percentile classes						
Low	<10 (Much below normal)	10-24 (Below normal)	25-75 (Normal)	76-90 (Above normal)	>90 (Much above normal)	High

U.S. Drought Monitor

July 28, 2009
Valid 8 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

USDA | National Drought Mitigation Center

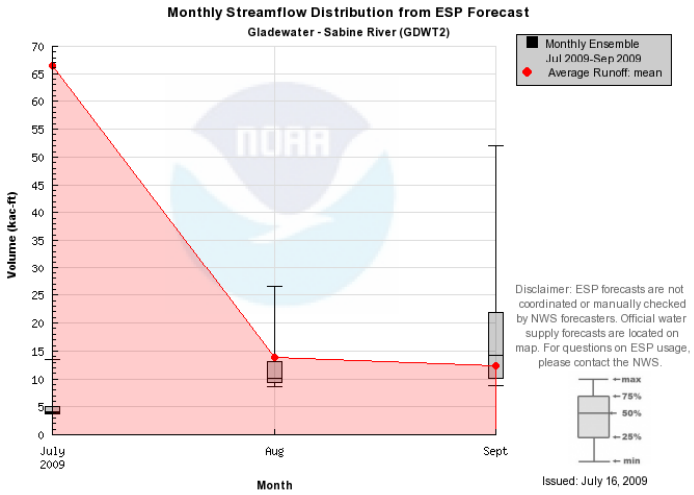
Released Thursday, July 30, 2009

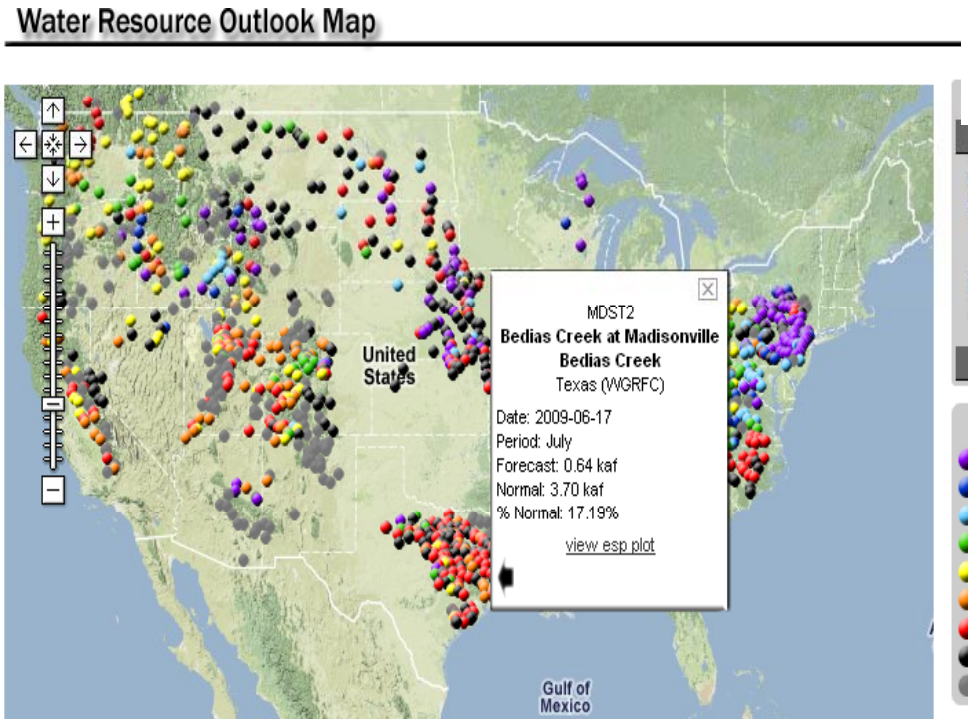
Author: Mark Svoboda, National Drought Mitigation Center

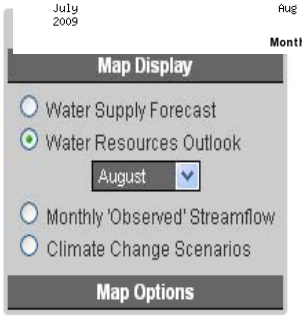
Current Status: National Water Resources Outlook

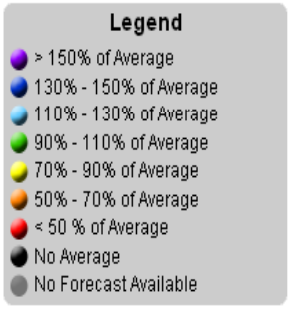
Tools Available:

- Ensemble Forecasts
- Data Access



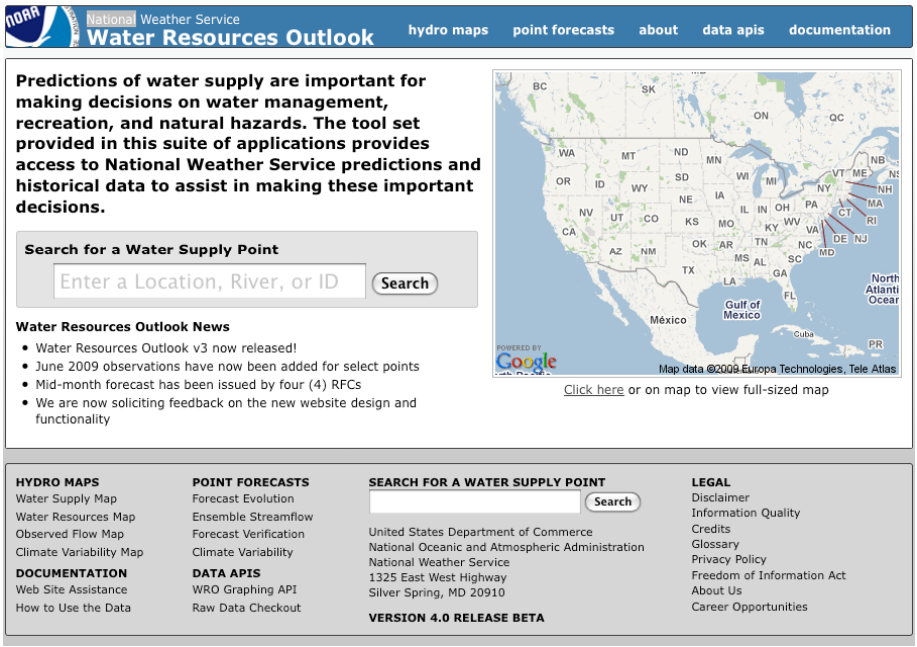






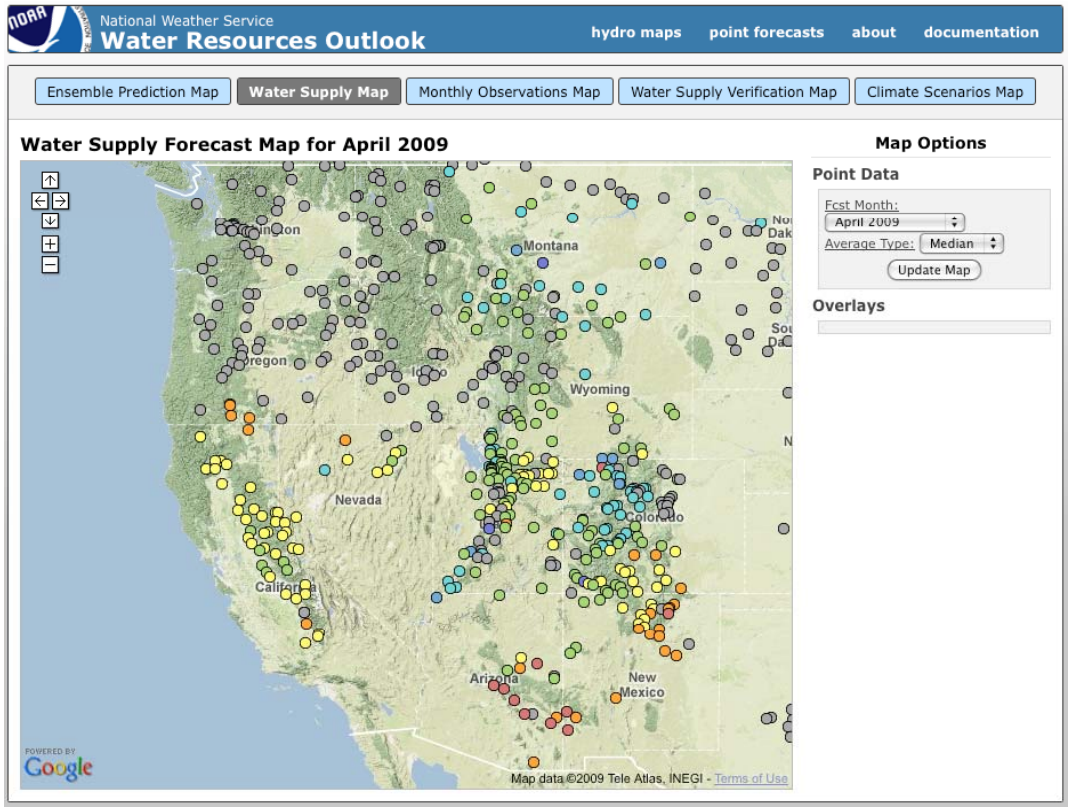
Future Plans (from July 09 organizing meeting)

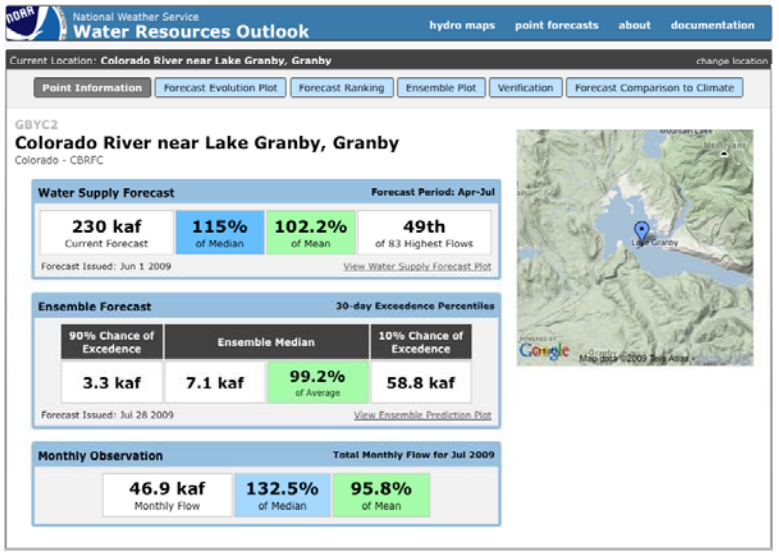
1. **Web Development** – Building “version 4” to address performance issues and simplify first level pages.
2. **User Interactions –** Partnering with CLIMAS and WWA to develop a “social science toolkit” to systematically collect user feedback. Proposed testing in CO during 2010 and possibly SERFC following.
3. **Institutional Support –** Working with NWS OSIP process to identify long term maintenance and support.



on

Coming Soon: Version 4





Improved performance

Improved visualization

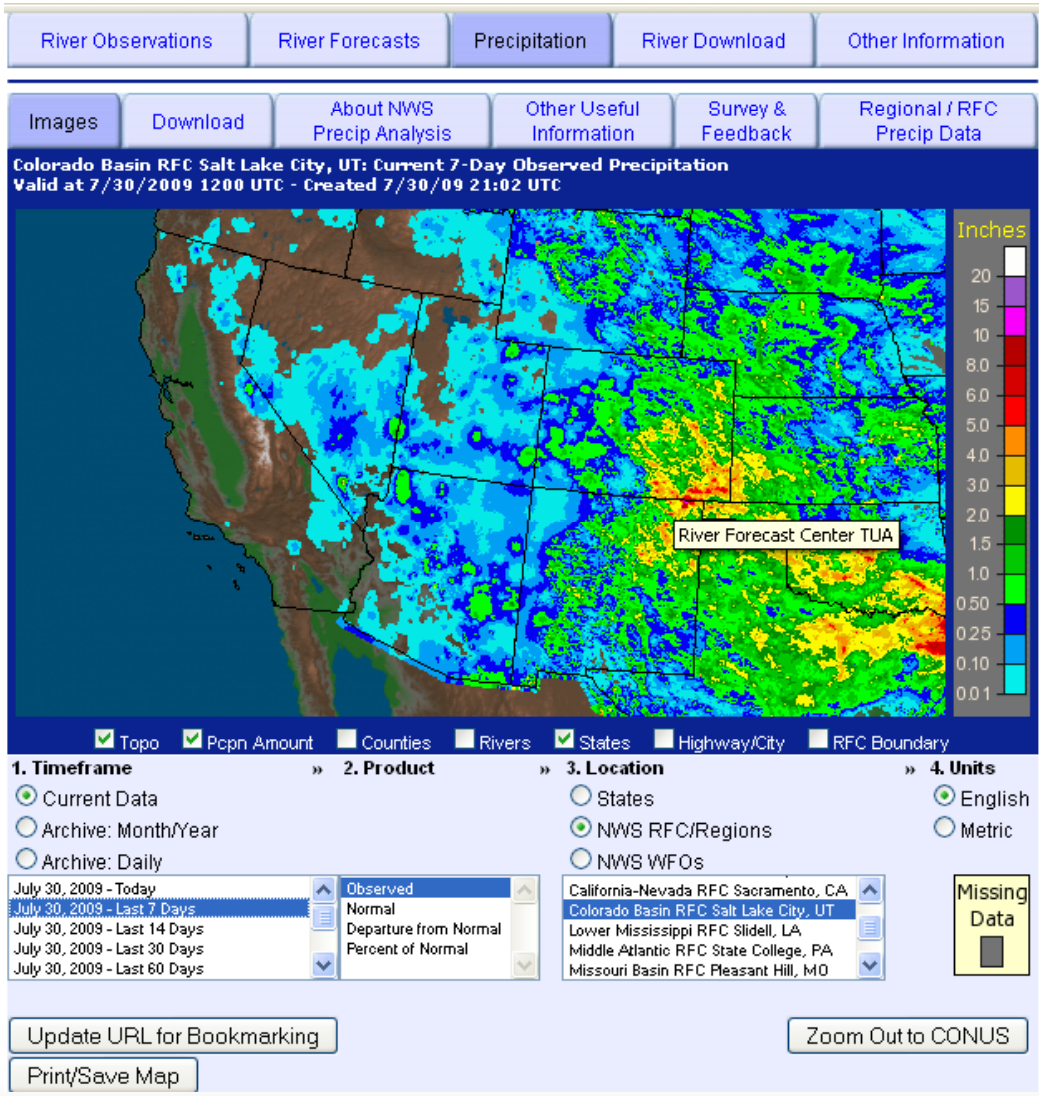
Web services

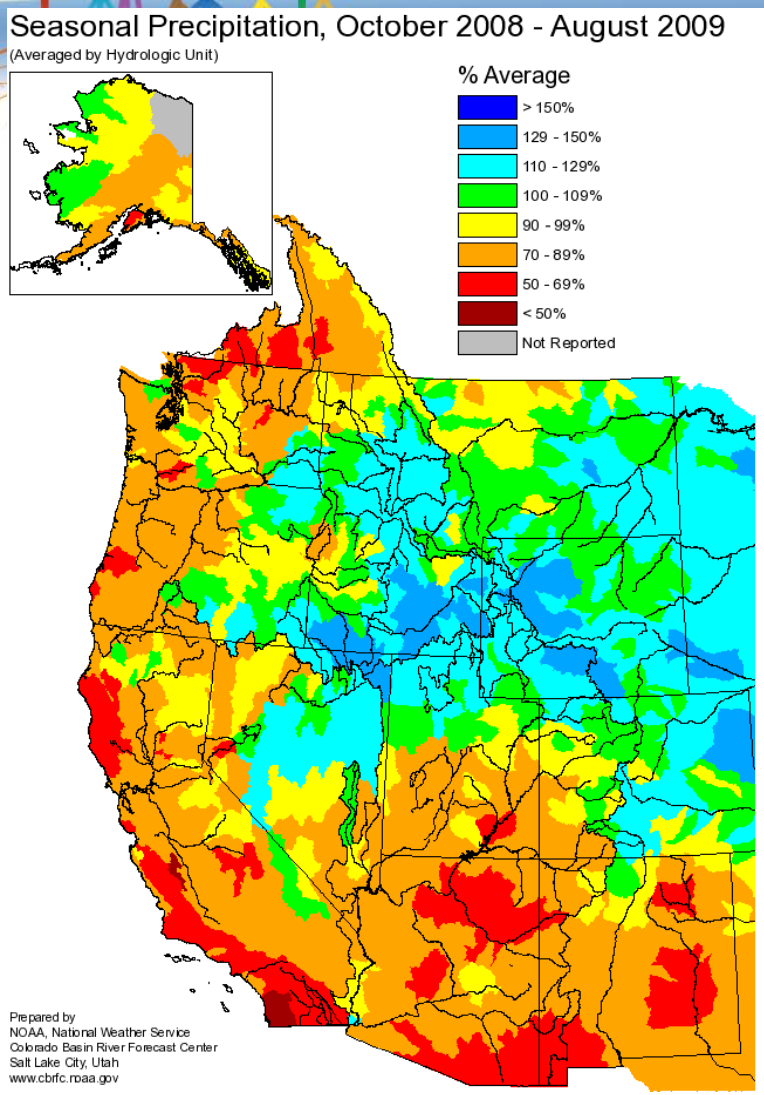
GIS

Tangent: Other RFC – Drought Related Products

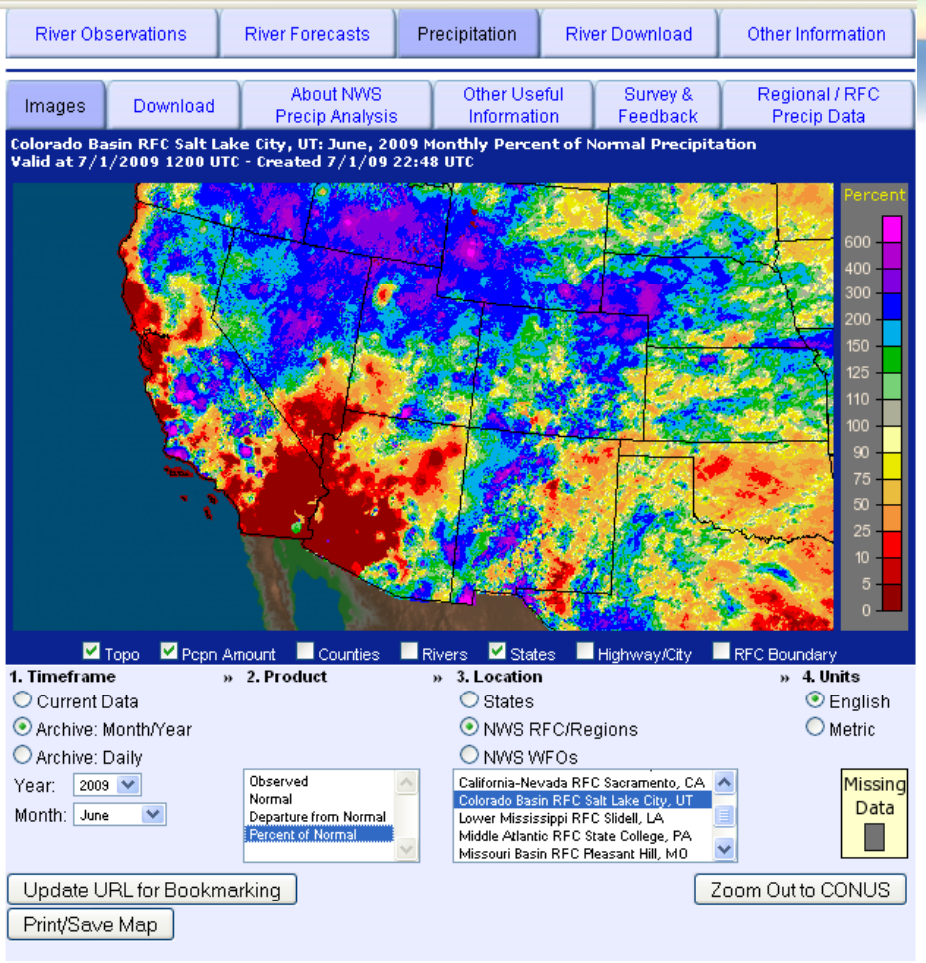
Precipitation

- High quality precipitation **analyses** and forecasts are key to RFC operations
- RFC staff quality control precipitation from gauge reports and radar and satellite estimates.
- Precipitation estimates for specific locations, spatially gridded, and basin averages are produced hourly to monthly.
- Weather and climate **forecasts** are also used in the forecast process





Source: www.cbrfc.noaa.gov



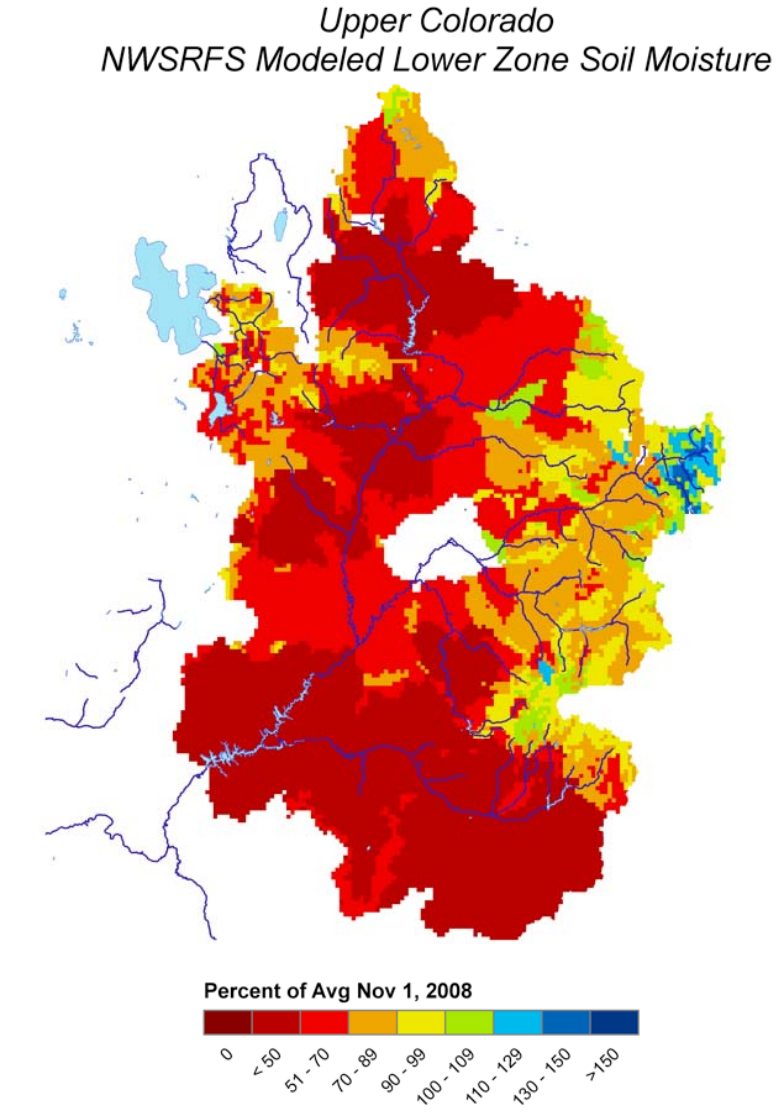
Source: water.weather.gov

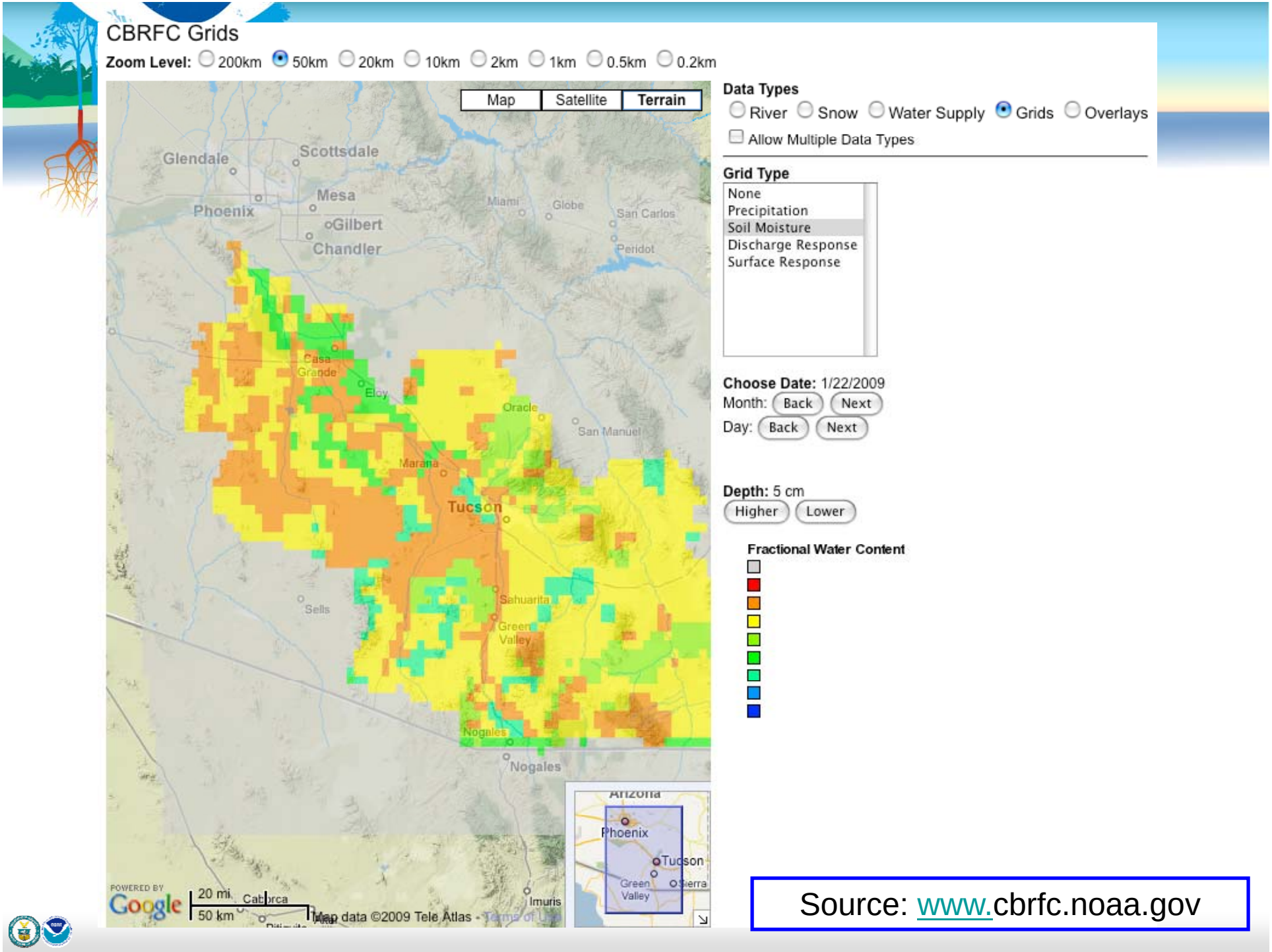
Soil Moisture

Soil moisture and snow states initialize hydrologic models

RFCs continually adjust simulated model states to force models to match observed streamflow

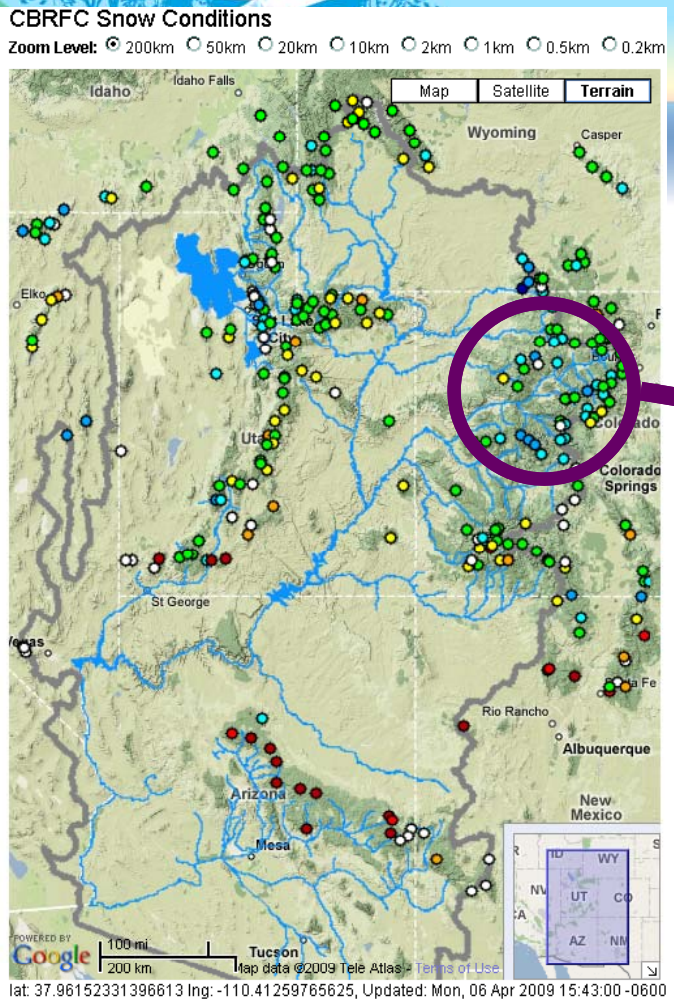
Traditional RFC models are basin scale. However, new generation of models is spatially gridded

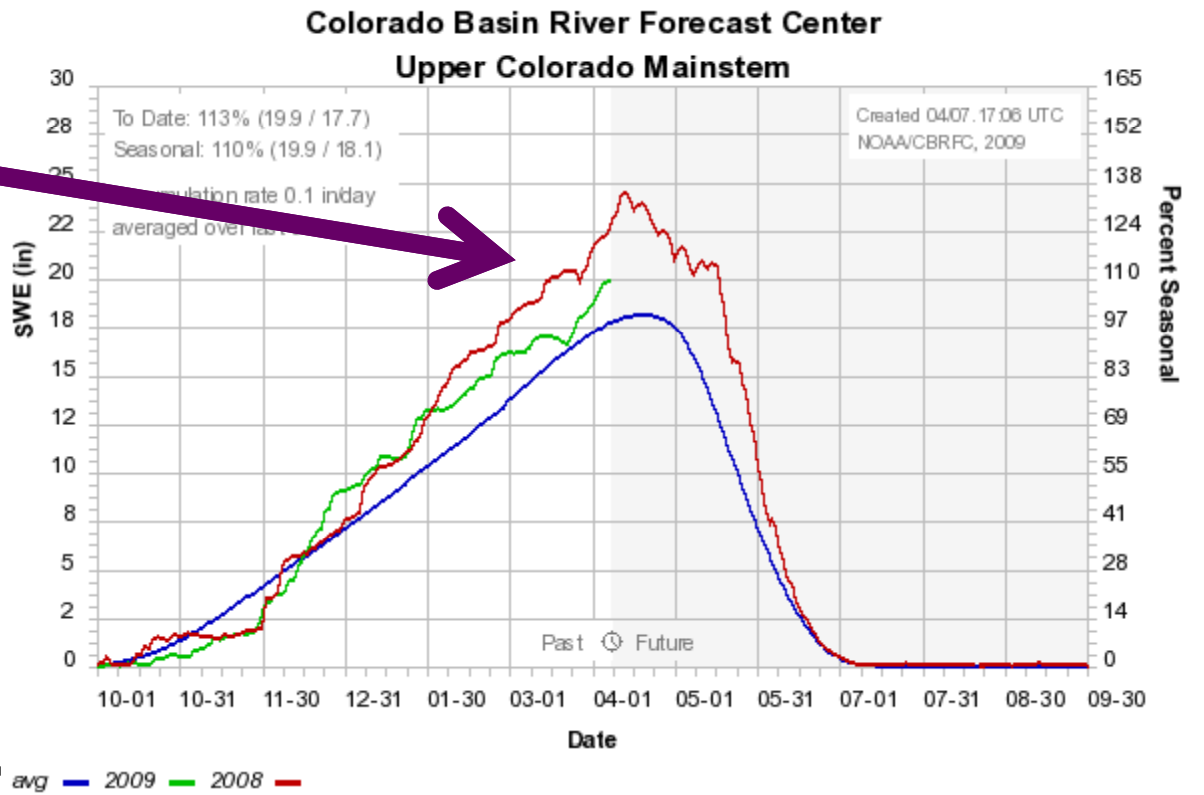




Source: www.cbrfc.noaa.gov

Snow





April 7th

Currently snow falls between average and 2008.

Web Reference:
http://www.cbrfc.noaa.gov/snow/station/sweplot/sweplot.cgi?BLSC2+WLLC2+LKIC2+PHTC2+SCSC2+AROC2+BTSC2+HOOC2+CPMC2+SUMC2+FMTC2+VLMC2+IVHC2+KLNC2+IDPC2+SOSC2+NLSC2+MESC2-Upper+Colorado+Mainstem?avg.2009.2008

Closing Thoughts

- River Forecast Centers (RFCs) provide **objective** forecast and guidance products for streamflow (and precipitation, snow, soil moisture) across many lead times

- RFCs in the western United States also provide seasonal water supply forecasts

- RFC interactions with and relevance to drought problems increasing

Kevin Werner

CBRFC Service Coordination Hydrologist
Phone: 801.524.5130
Email: kevin.werner@noaa.gov