

Introduction to the CBRFC

CBRFC Stakeholder Engagement Meeting

Wednesday, November 8





- **A quick overview of the CBRFC**
- **How is the CBRFC's hydrologic model set up?**
- **How does the CBRFC develop a water supply forecast?**
- **How does the CBRFC fit in with stakeholder operations?**

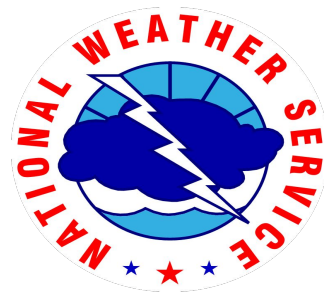


The Hierarchy and Mission - Colorado Basin River Forecast Center

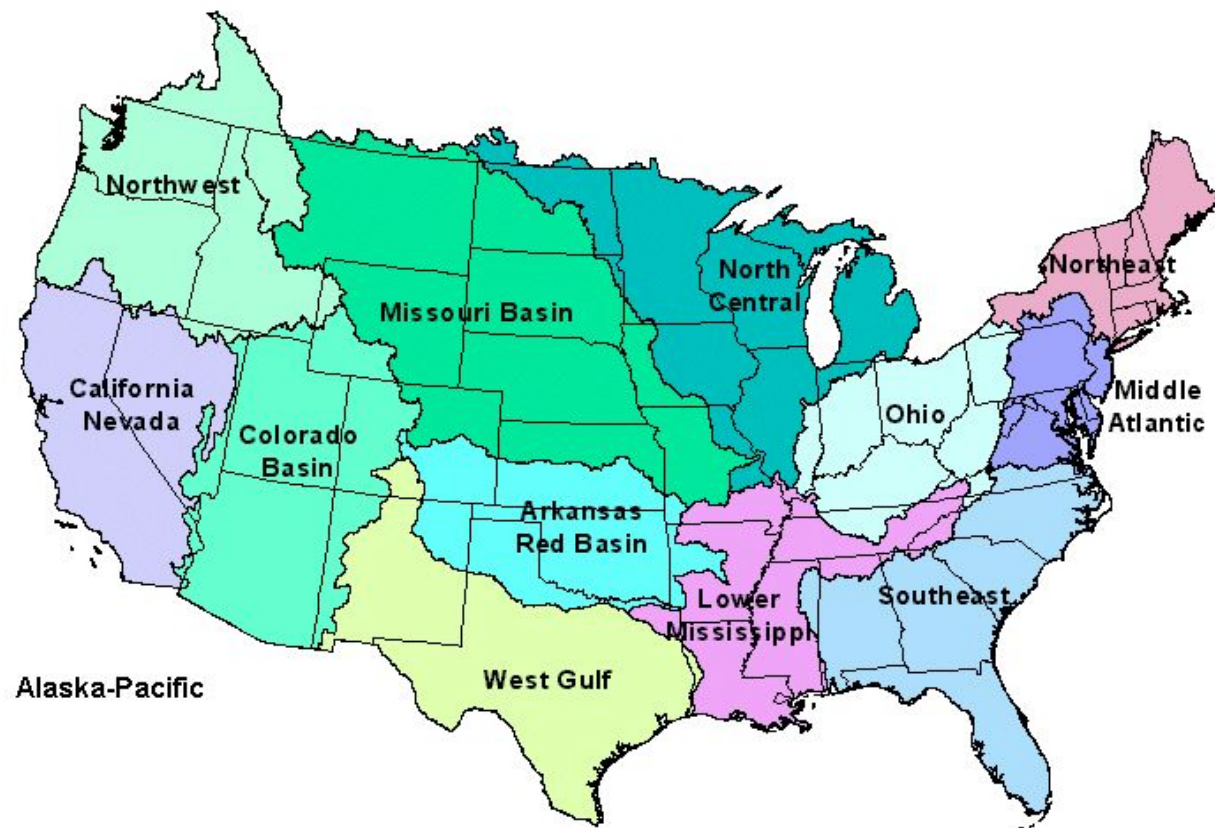
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Emphasis on understanding and predicting the Earth's environment.



Emphasis on protection of lives & property, decision support services associated with weather, water, and climate.



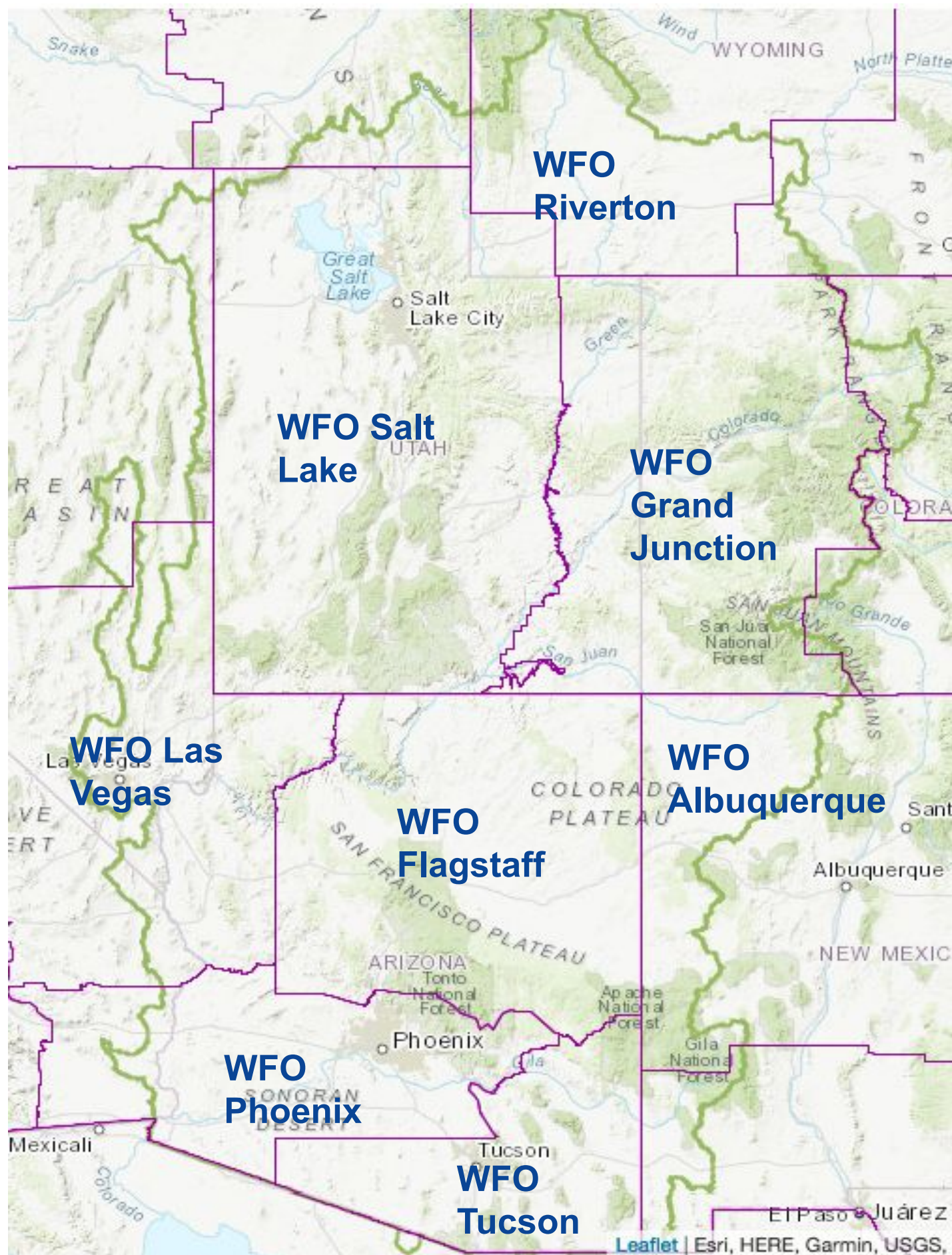
Emphasis on river basin hydrology

- Work with 122 Weather Forecast Office (WFO's)
- Support NOAA's hydrology services and products
- Provide Impact-Based Decision Support Services (IDSS)



Colorado Basin River Forecast Center

Wednesday, November 8



- Cover the entire Colorado River Basin and eastern half of the Great Basin
- Weather Forecast Offices are a primary stakeholder
 - Rely on WFOs to be our eyes on the ground
 - Convey our message to Emergency Managers
 - Flash flood experts
- Water Resource Agencies and Managers are also a primary stakeholder
 - Bureau of Reclamation
 - Other Federal partners
 - State and local water management groups
- The CBRFC is a great resource for information regarding streamflow and water supply forecasts



Colorado Basin River Forecast Center (CBRFC)

Provide a variety of hydrologic forecasts:

- Flood forecasts
- Water supply forecasts: Western US RFC's
- River stage & streamflow forecasts
- Peak flow forecasts

Forecasts provide decision support for:

- Flood warnings issued by NWS WFO's
- Reservoir management
 - Short term operations
 - Long term planning
- Agriculture
- River recreation
- Environmental flow targets

Colorado Basin River Forecast Center
National Weather Service

Home Rivers Snow Water Supply Reservoirs Weather Climate Help About News

Monday, March 21, 2022: CBRFC Peak Flow Webinar. Registration: [More Info](#)

Conditions Map Help

River Conditions

Data Updated: 03/14/19Z [Help](#)

Show [Hide Other Types](#)

Data

Forecast

Reservoir Inflow

Reservoir Outflow

Official Flood

Active

● Not Available

● Normal

● Significant Rise

● Near Action

● Above Action

● Above Flood Stage

● Outlook (> 3 days)

Popup Alerts

Old Hydrographs

▸ Snow Conditions

▸ Water Supply Forecasts

▸ Peak Flow Forecasts

▸ Reservoir Conditions

▸ Daily Precipitation

▸ Monthly Precipitation

▸ Soil Moisture

▸ Zoom Areas

▸ Search Points

Lat: 37.6 Lng: -110.5, Zoom: 6

Leaflet | Powered by Esri | USGS, NOAA



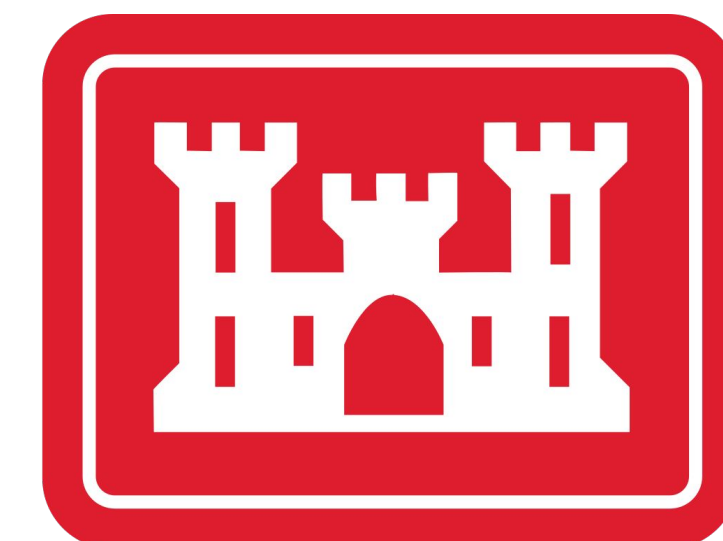
Colorado Basin River Forecast Center (CBRFC)

- Work with a broad and diverse set of stakeholders
 - NWS Weather Forecast Offices
 - Bureau of Reclamation
 - Municipal and agricultural water users
 - USGS, NRCS and many other federal agencies
 - State agencies, academics, NGOs, tribes

- Data consumers-we rely and depend on data provided by our stakeholders
 - Hydro data
 - Streamflow
 - Reservoir
 - Diversions
 - Meteorological Data
 - Weather models
 - Precipitation
 - Temperature
 - Snow



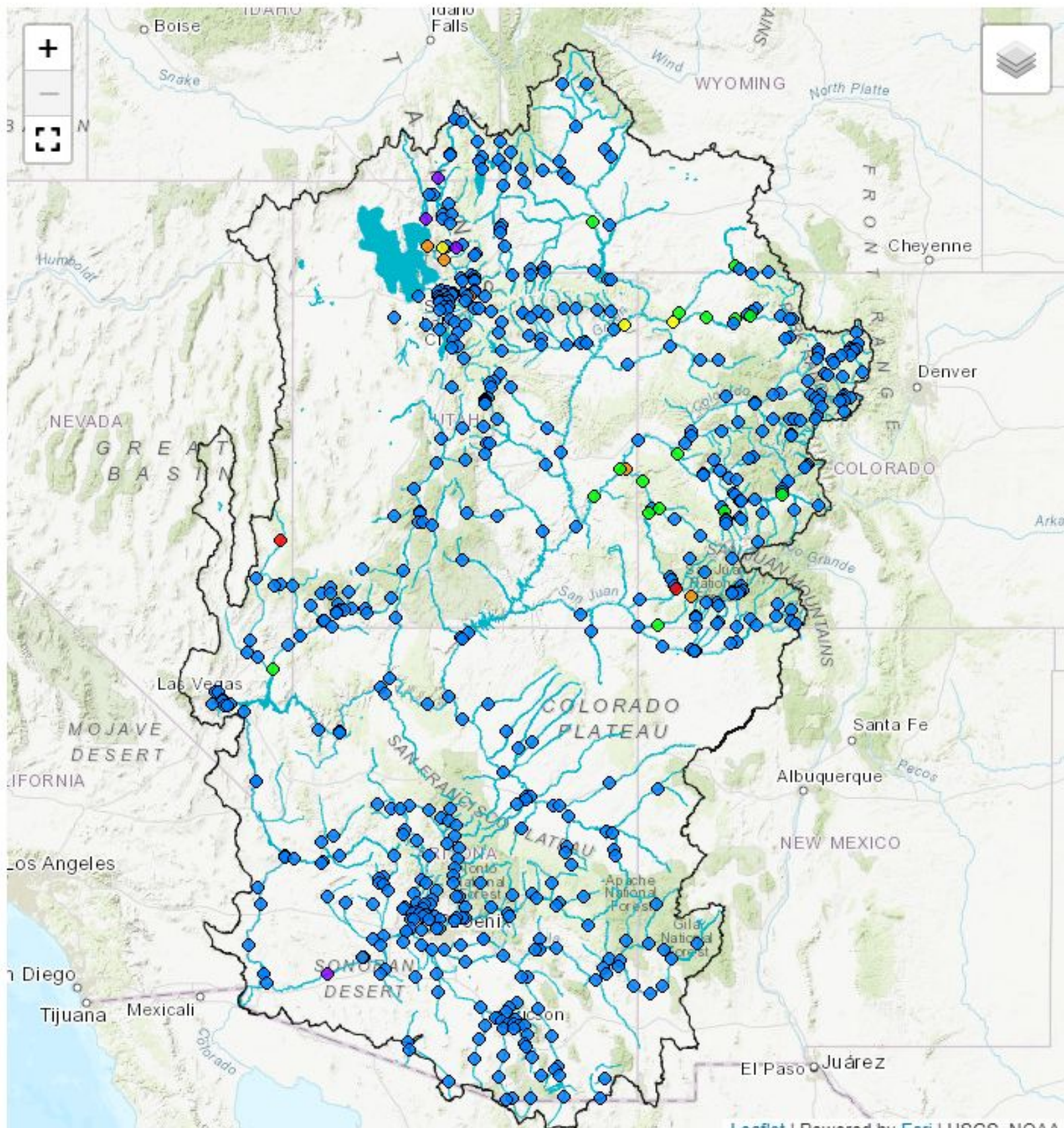
— BUREAU OF —
RECLAMATION





Providing Decision Support

Wednesday, November 8



River Conditions

Data Updated: 04/13/18Z

Show

Data

Forecast

Reservoir Inflow

Reservoir Outflow

Official Flood

Active

Not Available
 Normal
 Significant Rise
 Near Action
 Above Action
 Above Flood Stage
 Outlook (> 3 days)

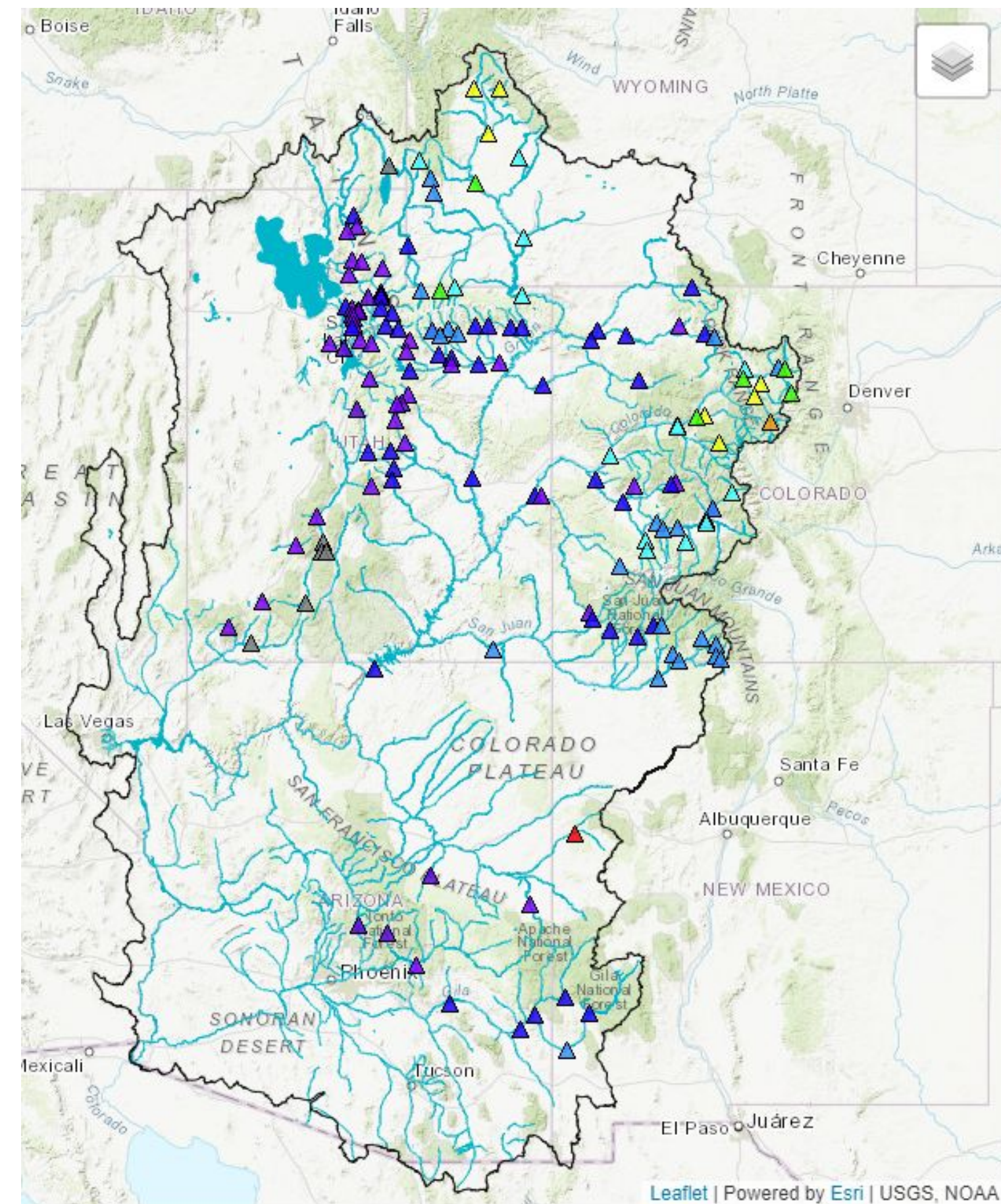
Linear Flow
 Legacy Hydrographs
 Future Significant Rise

- **Developing a forecast**
- **Extensive QA/QC every day**
- **478 points, at least once a day**
- **10-day deterministic forecasts**
- **Constant development**



Providing Decision Support

Wednesday, November 8



River Conditions
 Snow Conditions
 Water Supply Forecasts

Show

First of Month Forecast: 2023-04-01
 Percent Average
 Percent Median
 Percentile

Latest Model Guidance:
 Percent Average
 Percent Median
 Percentile

▲ < 30%
 ▲ 30-50%
 ▲ 50-70%
 ▲ 70-90%
 ▲ 90-100%
 ▲ 100-110%
 ▲ 110-130%
 ▲ 130-150%
 ▲ 150-200%
 ▲ 200-300%
 ▲ 300-500%
 ▲ >500%
 ▲ Regulated
 △ No Forecast

Peak Flow Forecasts

- The CBRFC (and other western RFCs) emphasizes water supply forecasts
- Seasonal (usually April through July), volumetric forecasts at 174 locations
- Unregulated forecast
- Probabilistic



CBRFC Daily Forecast Operations

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LEAD FORECASTER

6:30 am - 8:00 am - Data QC and preparation of hydrologic model input (new rating curves, reservoir releases, etc.)

BASIN FOCAL POINTS

8:00 am - 10:00 am - Operational streamflow forecasting and coordination

LEAD FORECASTER

10:00 am - 12:00 pm - ESP model run

10:30 am - 11:00 am - CBRFC hydromet briefing

CBRFC Staff

11:00 am - 4:00 pm - Water supply

- Model development

- Stakeholder engagement

- Media inquiries

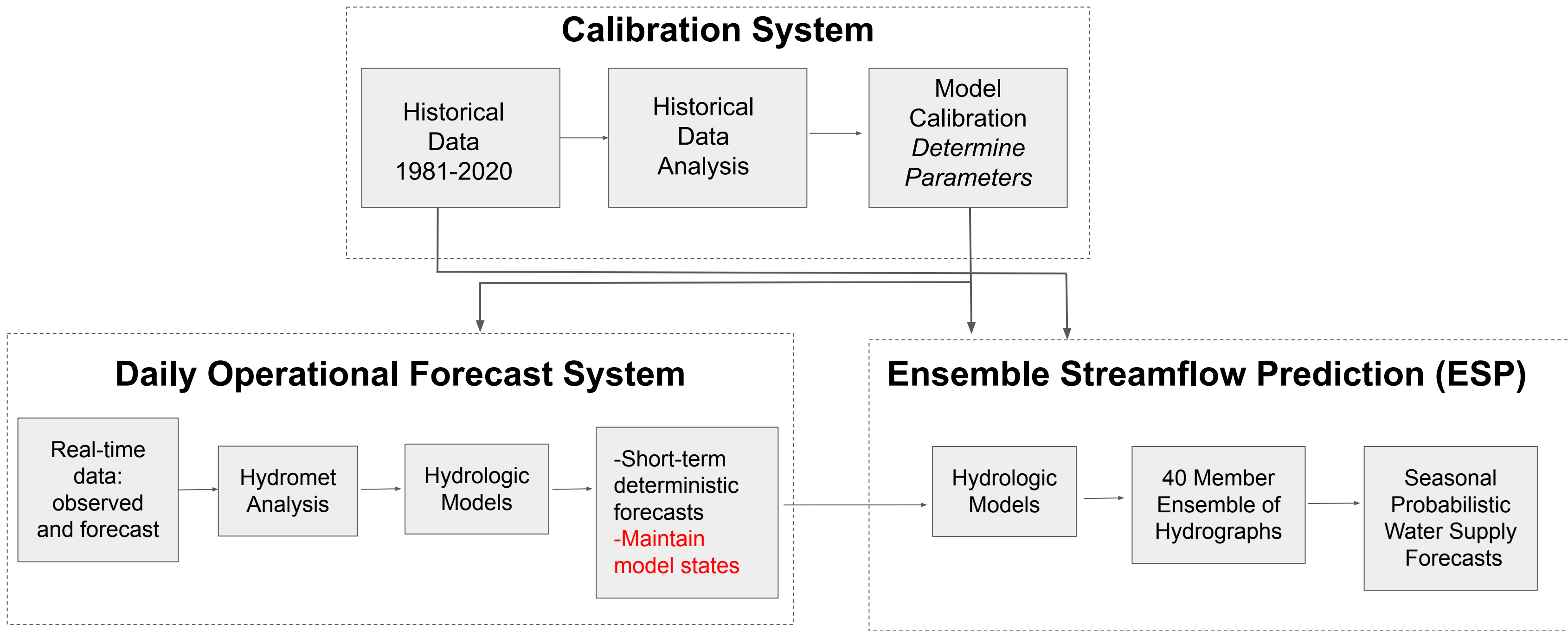
- Internal/external meetings

4:00 pm - 6:00 am - Extended hours (if necessary)

- Additional model runs / decision support



NWS River Forecast System - 3 Interconnected Components



Another component - **Stand Alone (SA) System**
 -allows for offline model development work



Modeling Framework: NWSRFS & CHPS

Wednesday, November 8

- **NWSRFS = National Weather Service River Forecast System**

- A comprehensive set of hydrologic models
- Everything from processing historical data to model calibration and real-time operational forecasting



Configuration of NWSRFS Hydrologic Models/Workflow

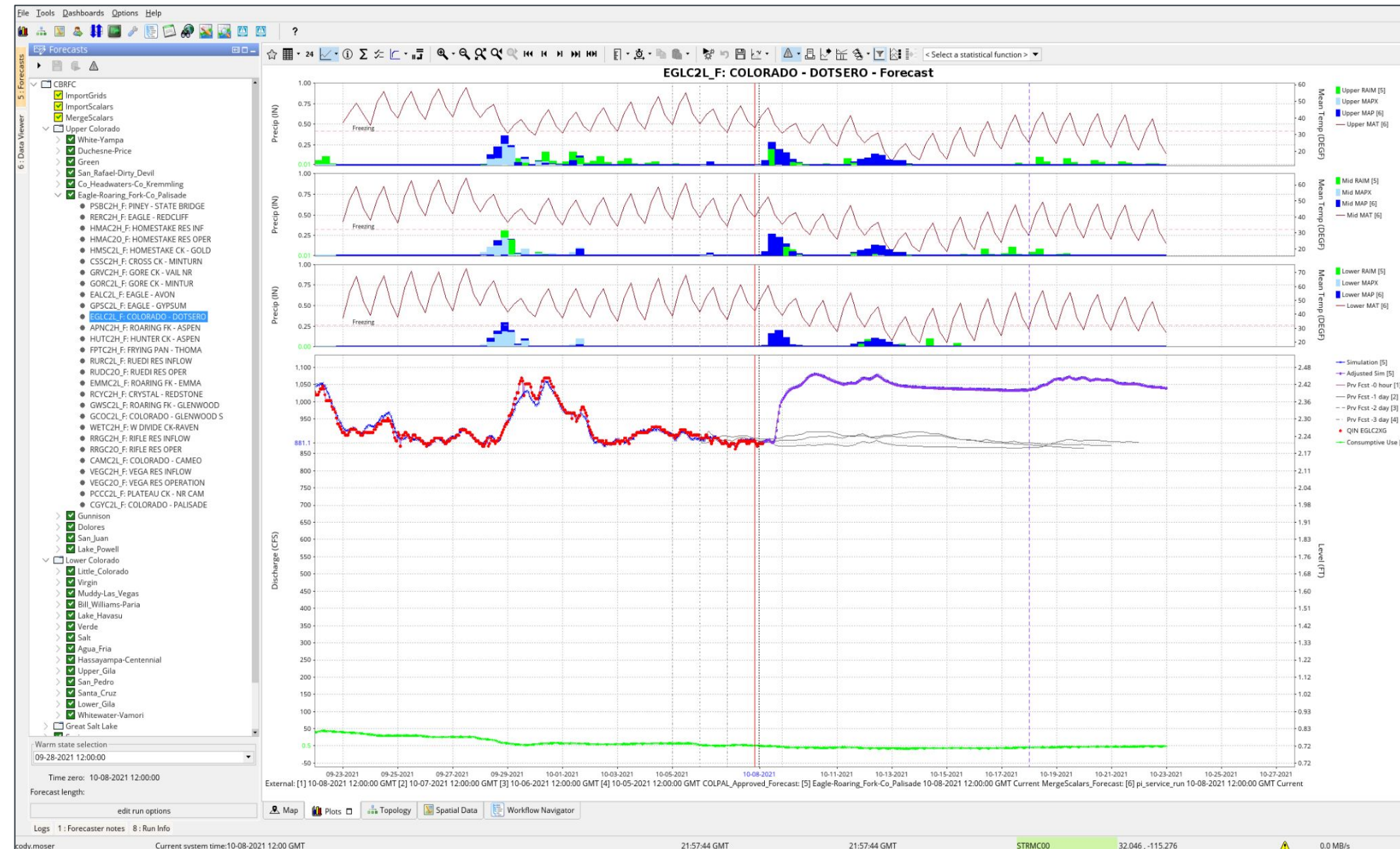


- **CHPS = Community Hydrologic Prediction System**

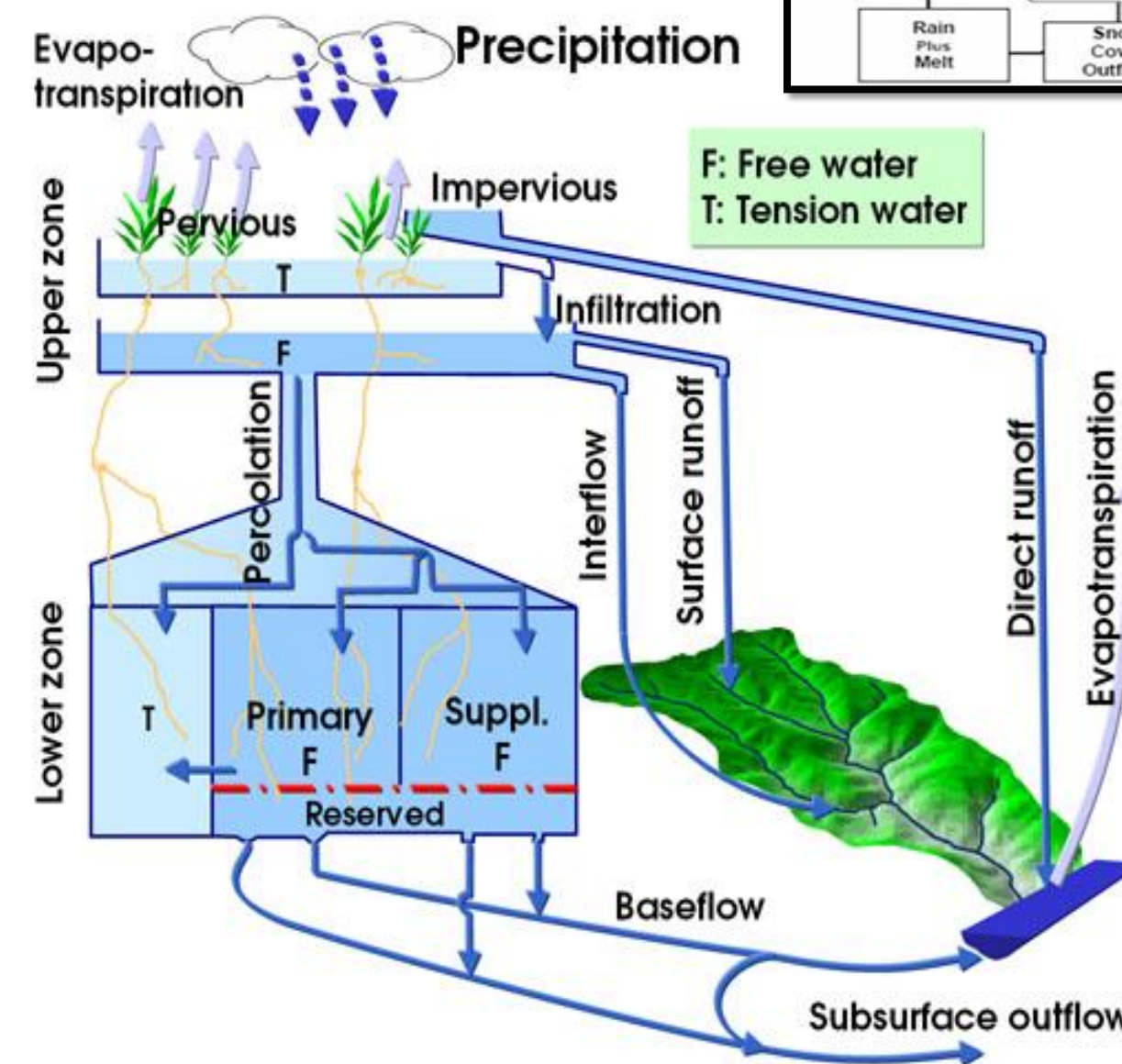
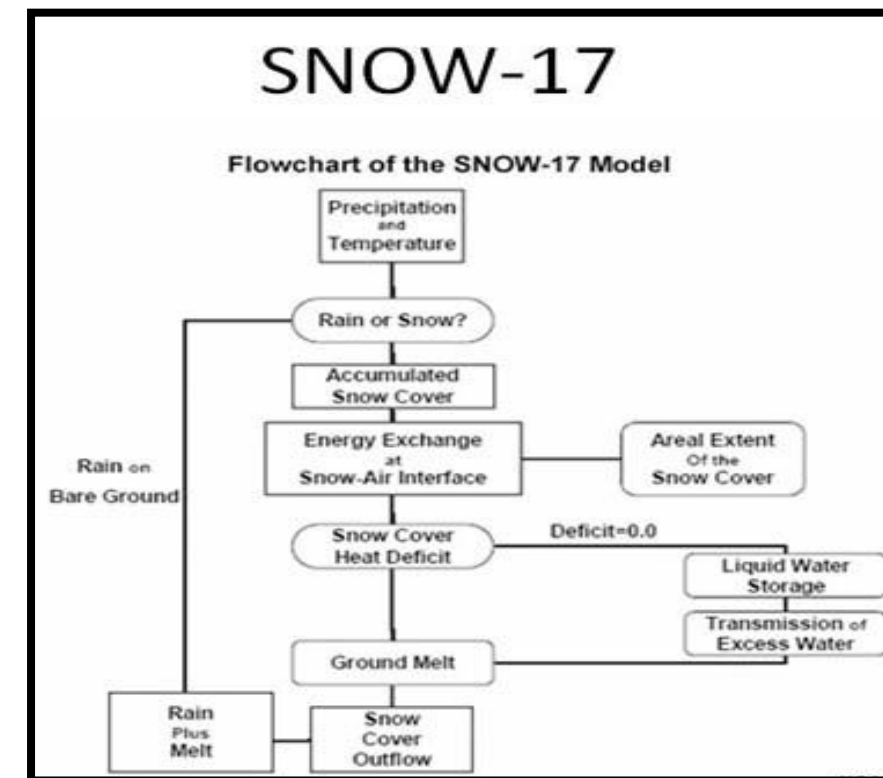
- Viewing and interacting with forecast data
- Highly configurable
- Has the capability to run (plug in) any hydrologic model



CHPS Operational Forecast System Screenshot

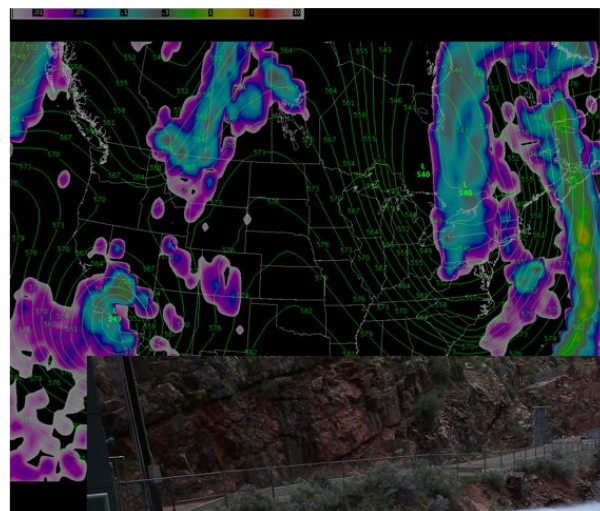


- Use a continuous, conceptual, lumped model where the main components are SAC-SMA coupled with SNOW-17
- Quality of data is the most important part of the model, especially when it comes to precipitation





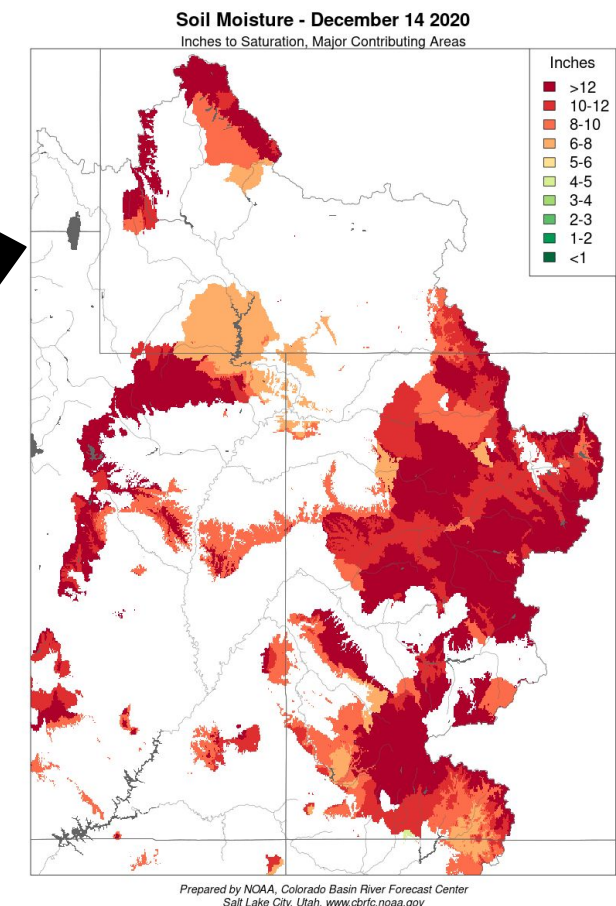
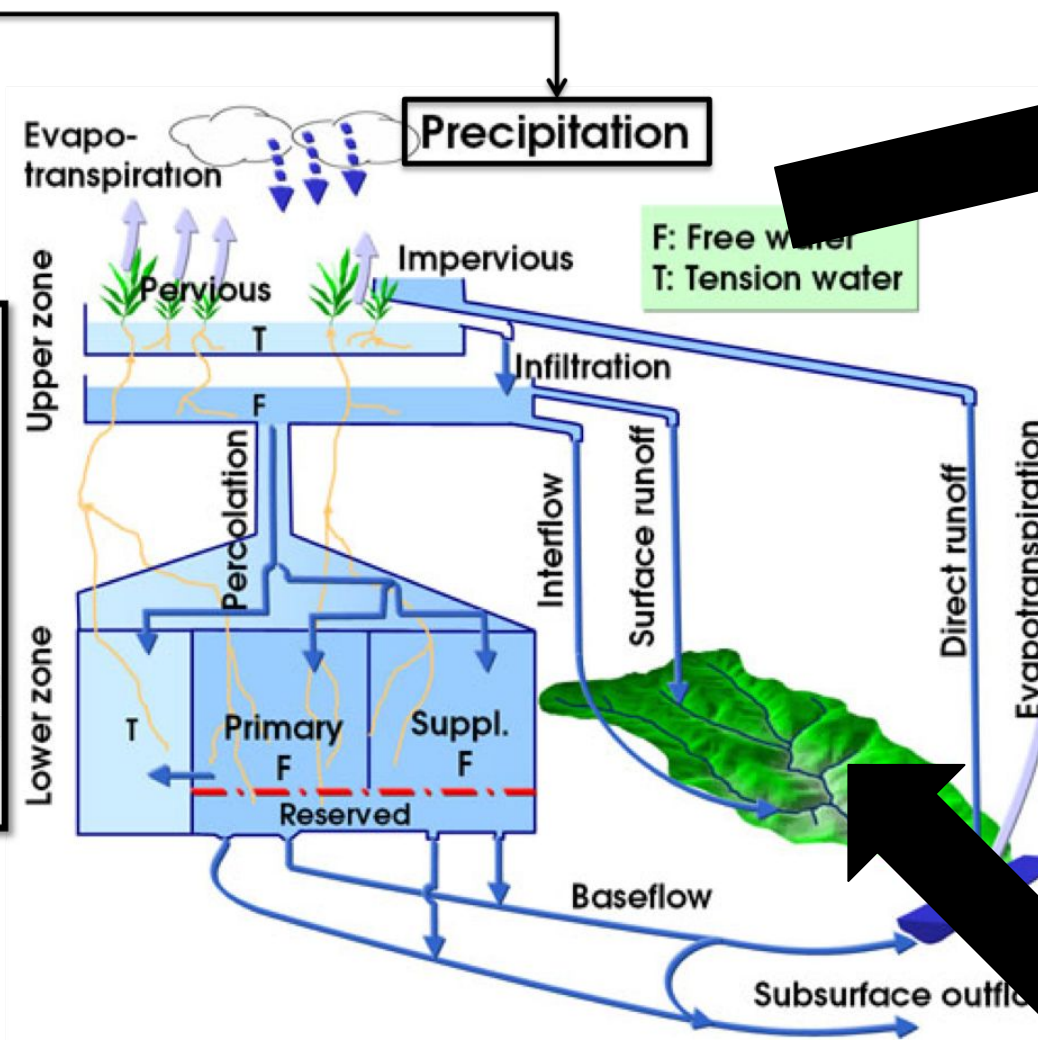
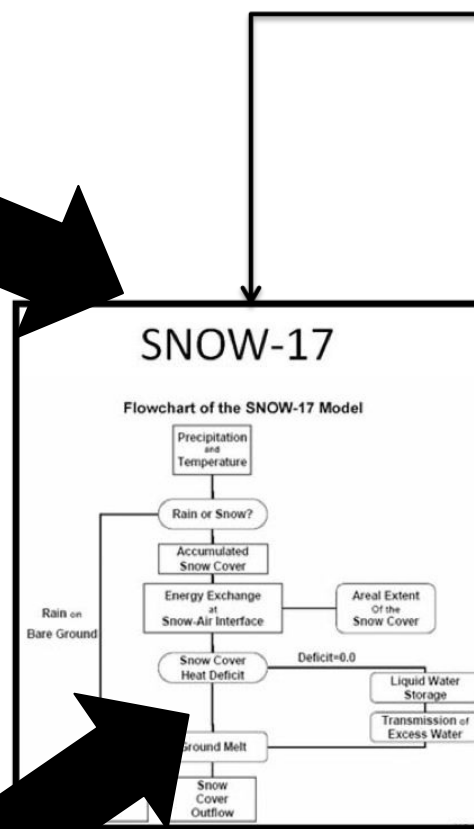
Observed data



Forecasted weather and operations



Evaluating model states



Objective, physically based interaction by forecasters



Each river point in the model is called a segment.

There are 478 river points/segments and 97 reservoirs in the CBRFC model.

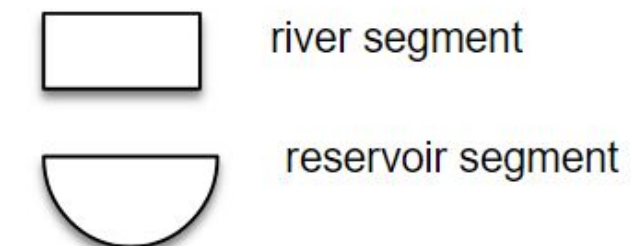
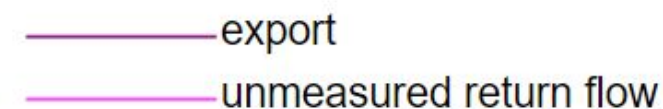
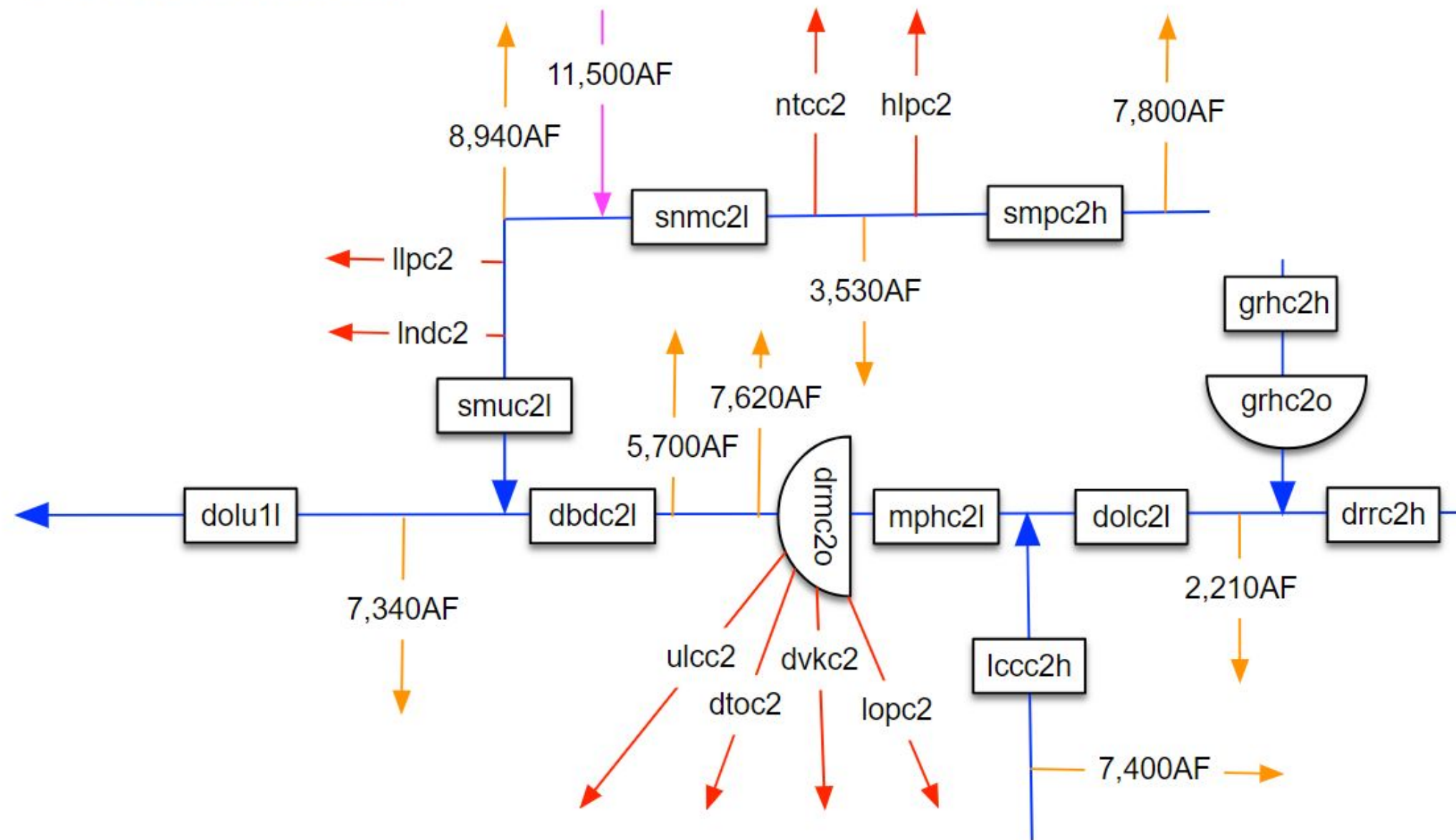
Stick Diagrams for each basin are available on our webpage.

These show segment connections as well as measured and unmeasured loss/gains that are included in our model.

Segment naming convention:

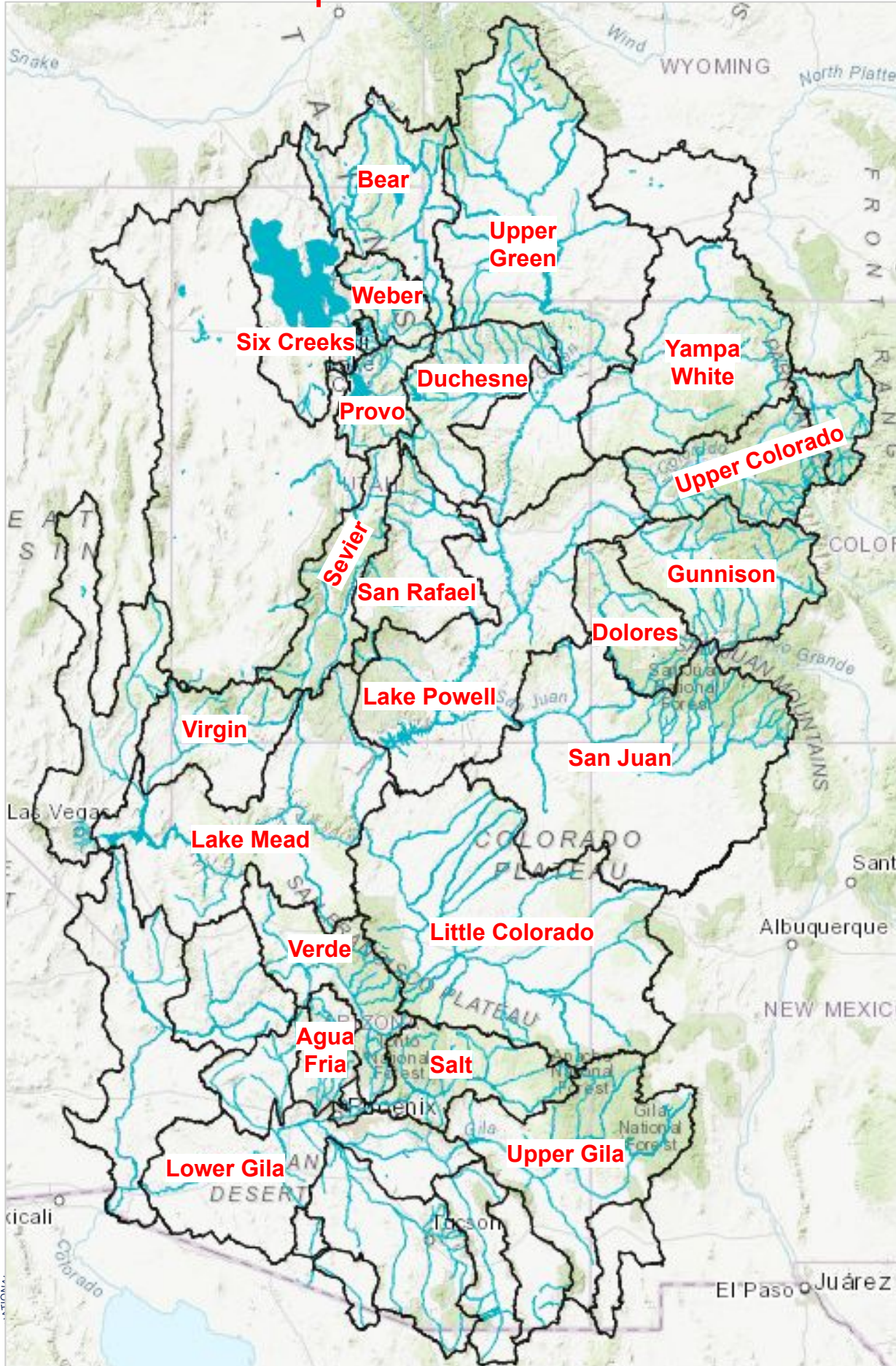
- ends with 'H' = headwater
- no upstream segment
- ends with 'L' = local
- upstream segment passes water
- ends with 'O' = reservoir operation

Dolores River

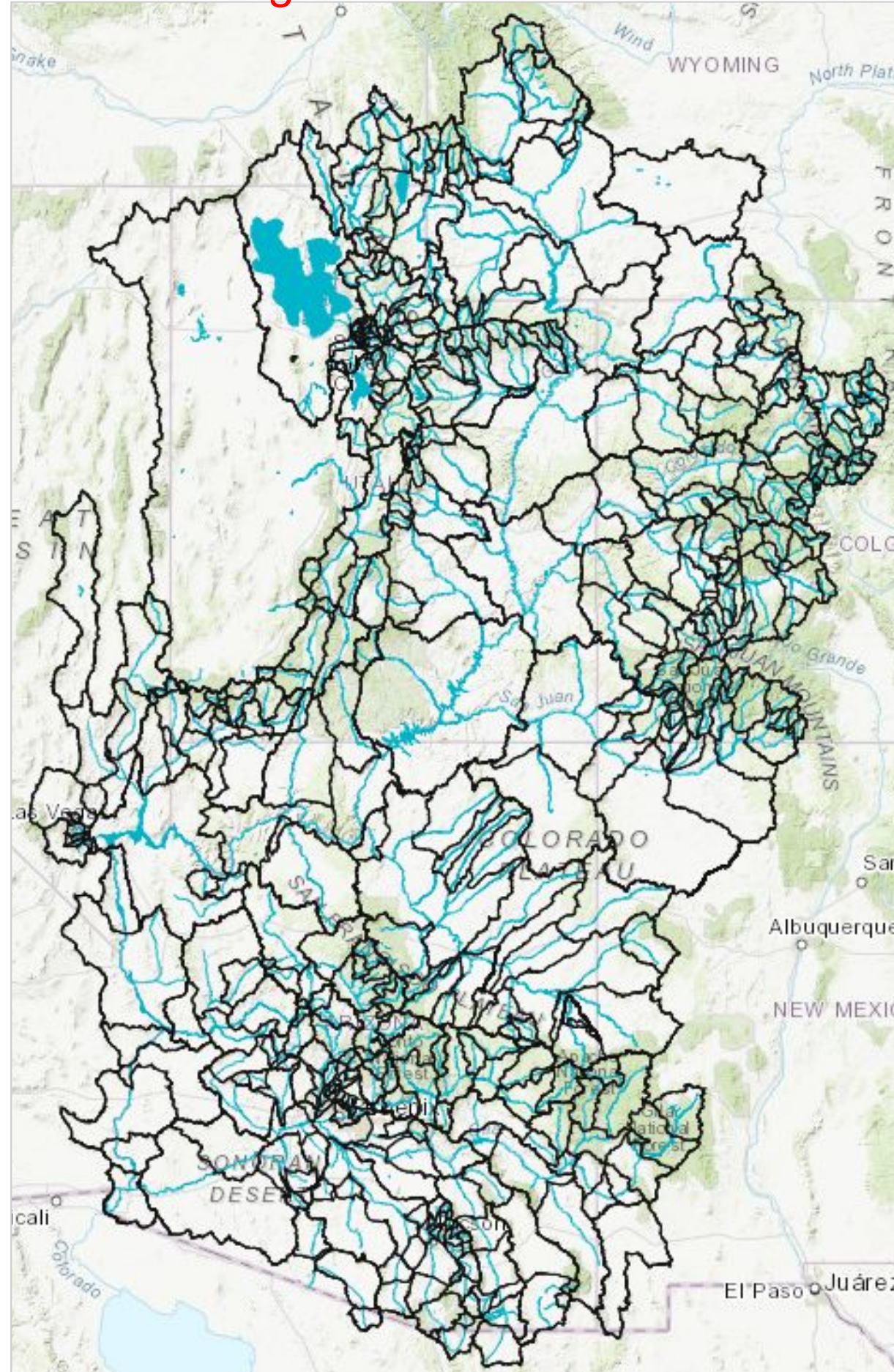


CBRFC Hydrologic Model Setup

Forecast Groups



Forecast Segments



Upper Colorado

- 175 River
- 44 Reservoirs

Great Basin

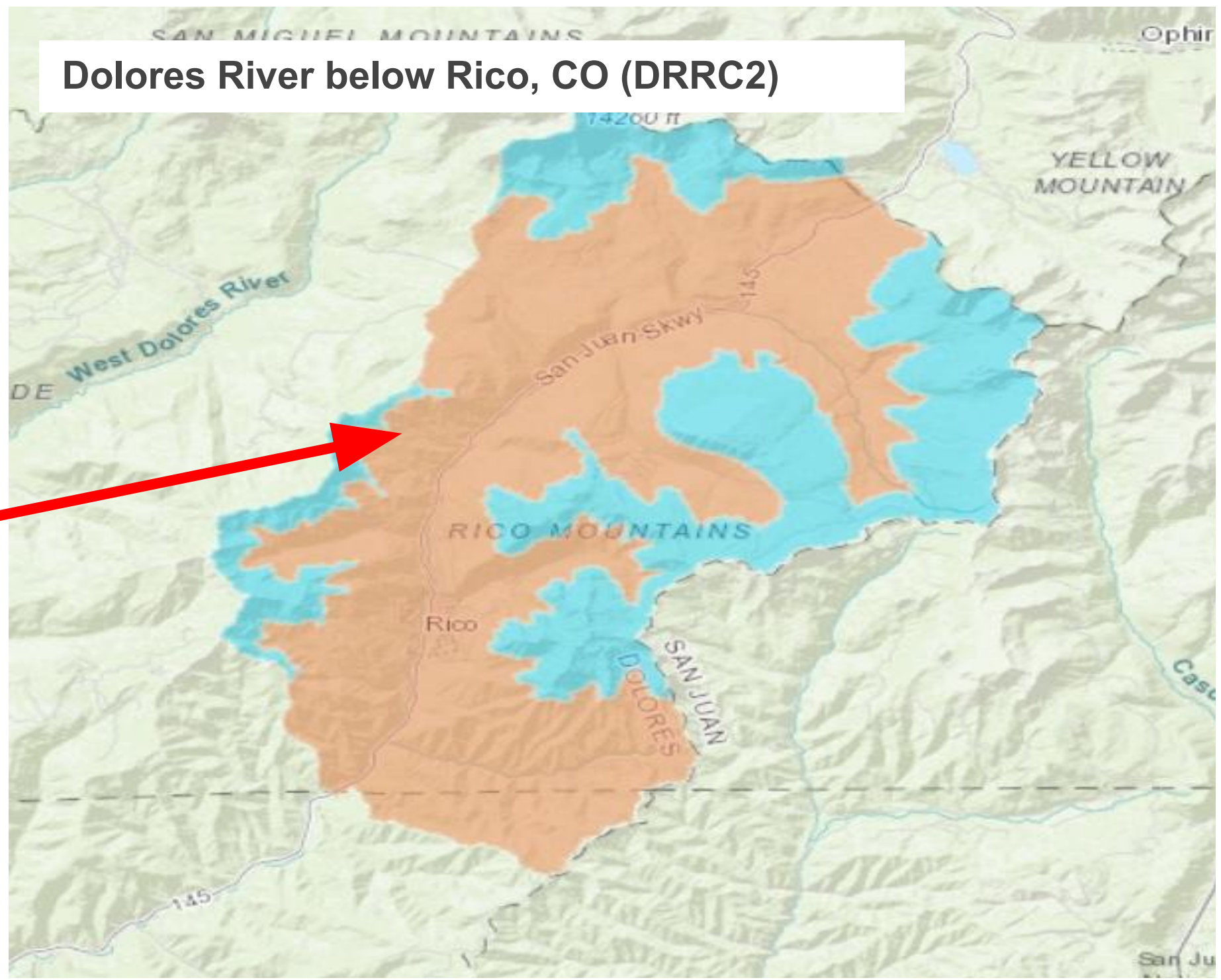
- 83 River
- 22 Reservoirs

Lower Colorado

- 220 River
- 31 Reservoirs

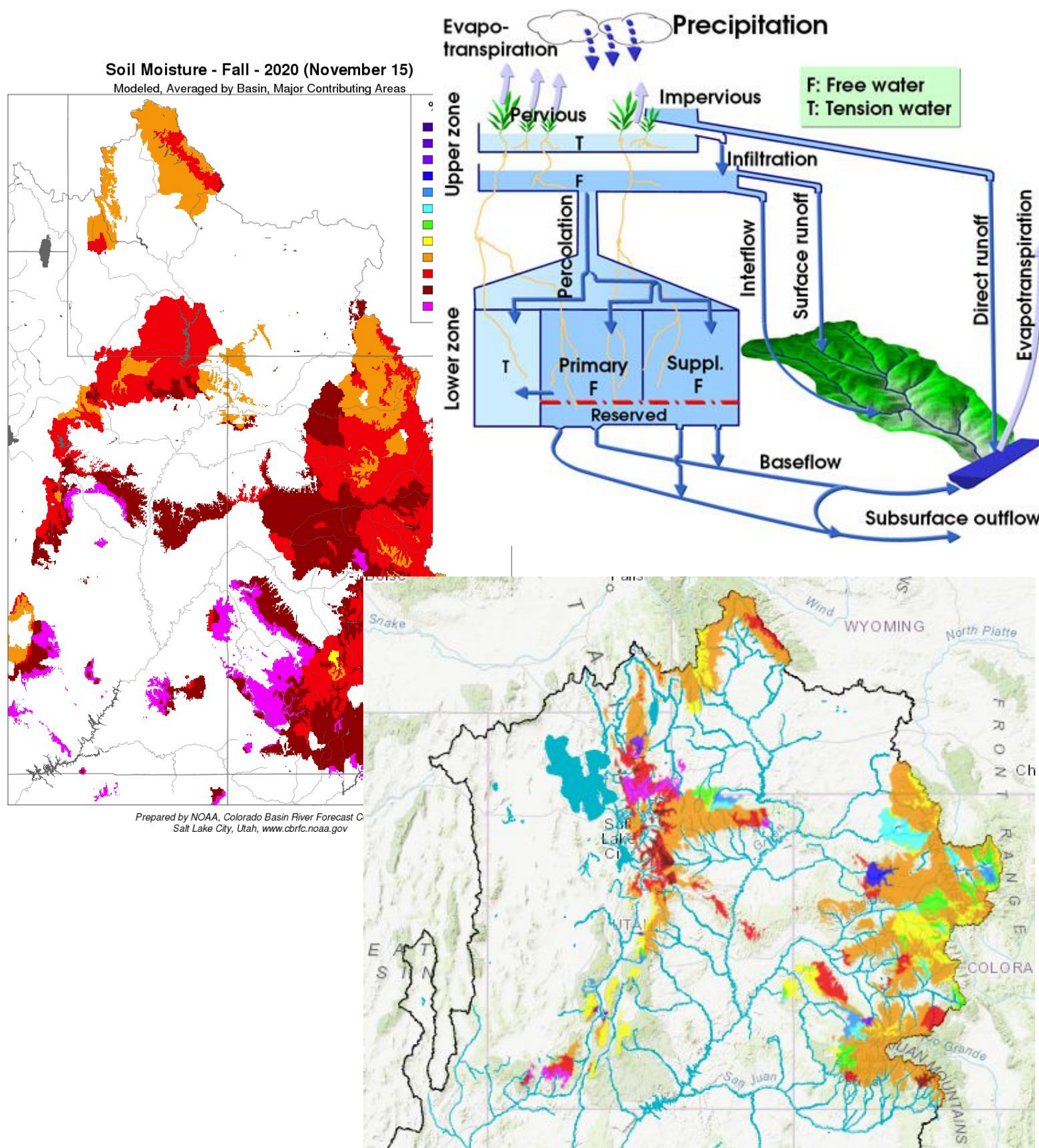
Each segment is broken into 2-3 elevation zones based on similar hydrologic characteristics.

Each zone is represented by a single, mean areal point for precipitation and temperature.



Lower Elevation Zone: 8,320 ft - 11,000 ft (69 mi²)

Upper Elevation Zone: 11,000 ft - 14,172 ft (36 mi²)



- Spend a lot of time making sure our model “states” are accurate and representative of current conditions
 - Soil moisture
 - Snowpack
- Work closely with our partners
 - Reservoir schedules
 - Streamflow and other data (e.g., temp, precip, SWE)



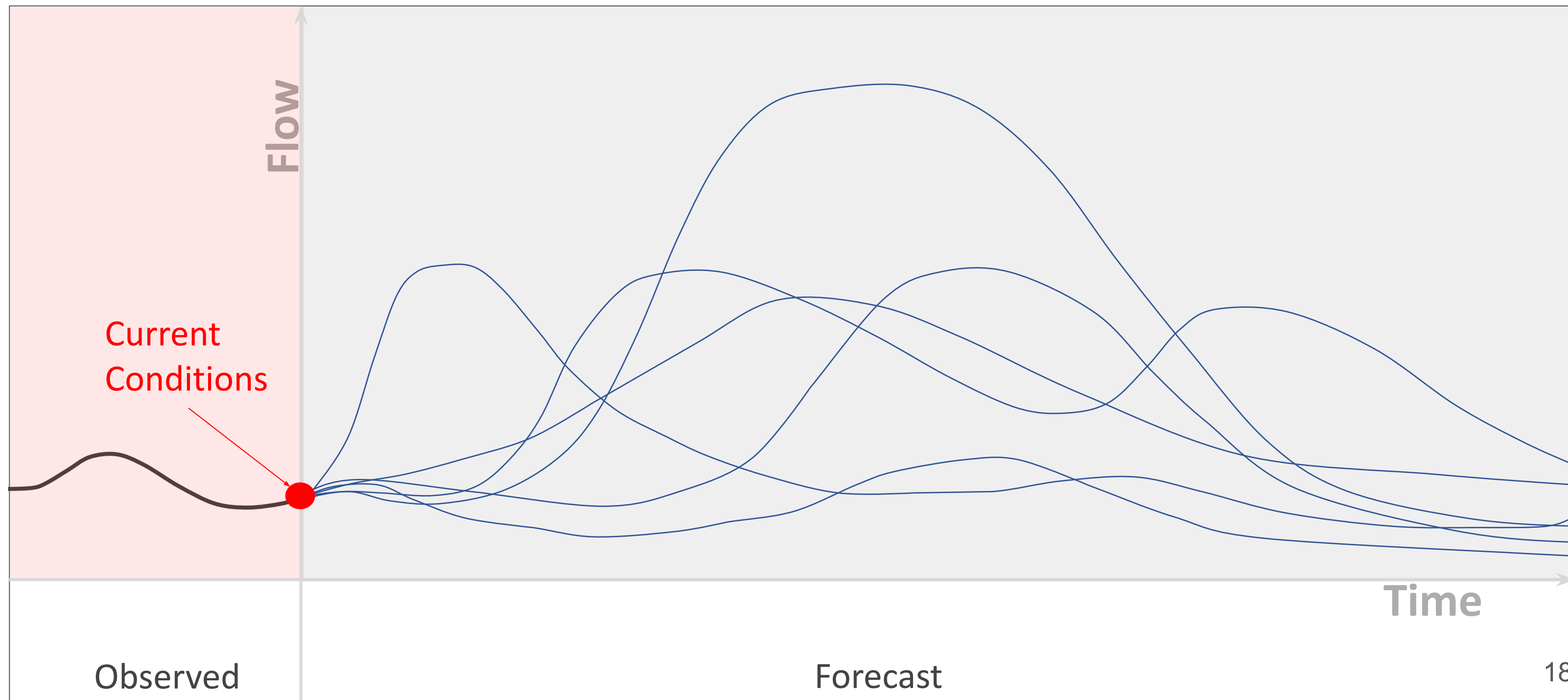
Ensemble Streamflow Prediction (ESP)

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- Start with current model conditions of snowpack, soil moisture and simulated flow
 - ***These are the saved model states from the daily operational run***
- Apply precipitation and temperature from each historical year from 1991-2020
 - A forecast hydrograph, or trace, is generated for each of the 30 years
- Results are used to produce probabilistic forecasts

Current conditions from daily model run

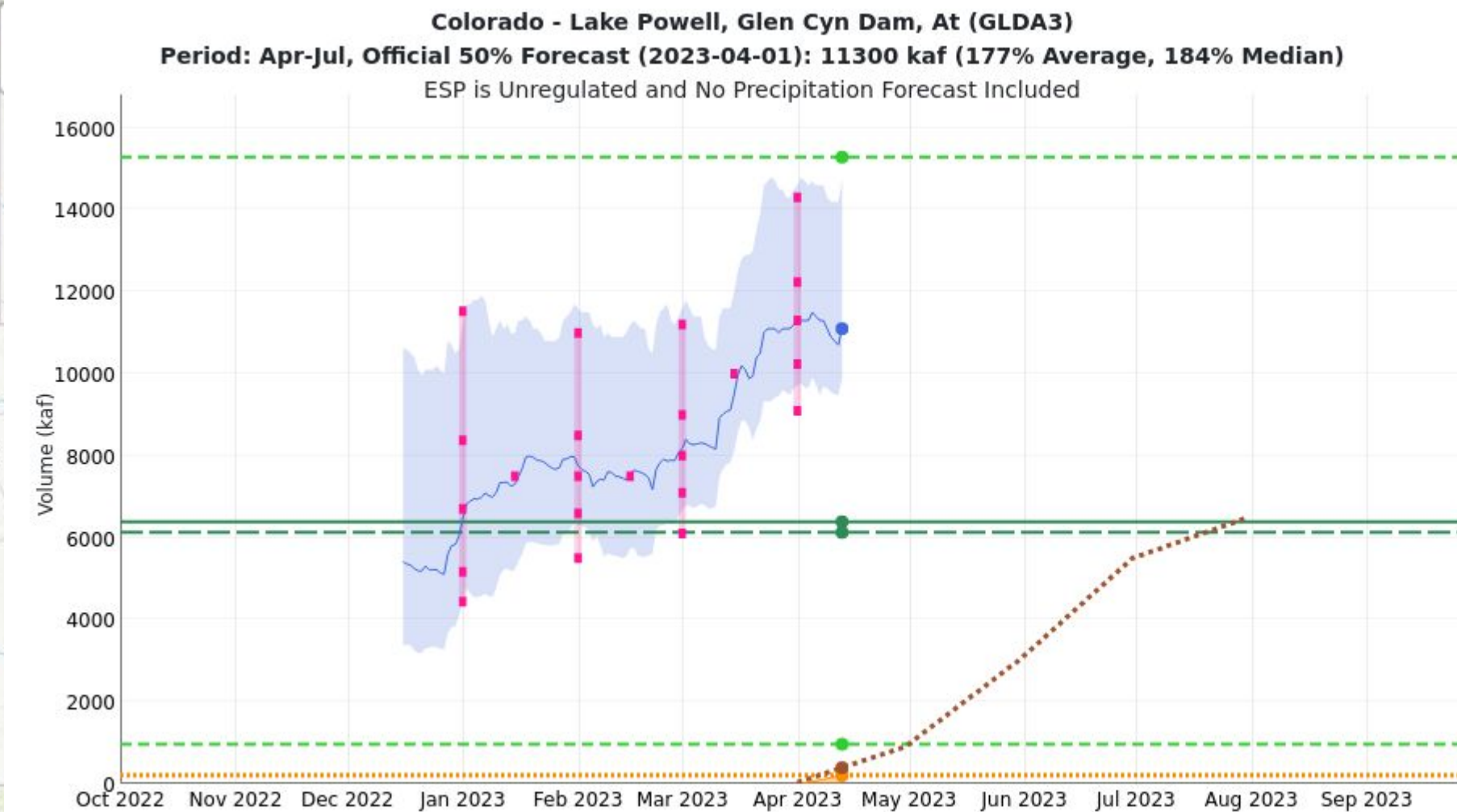
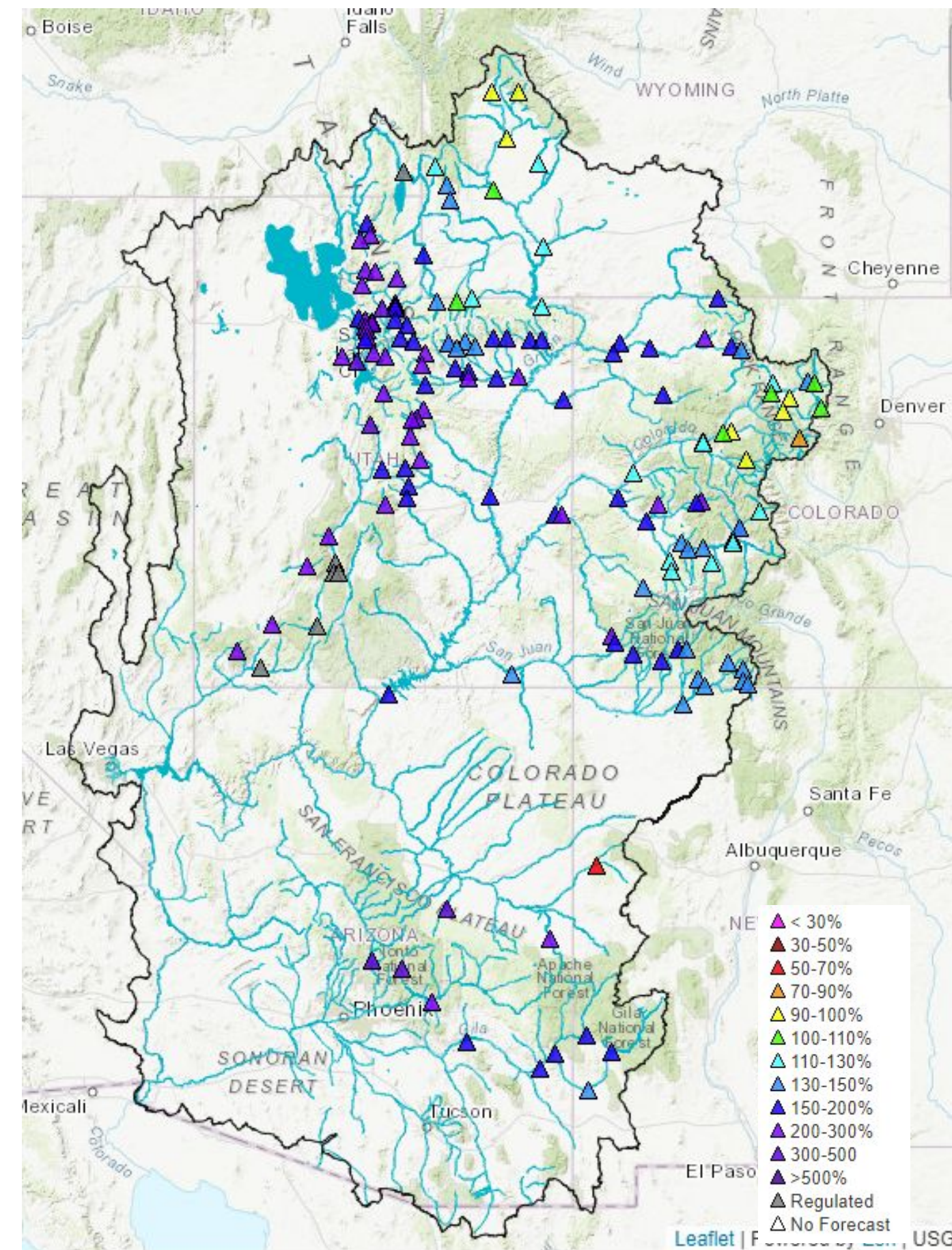
- Simulated Flow
- Soil Moisture
- Snowpack





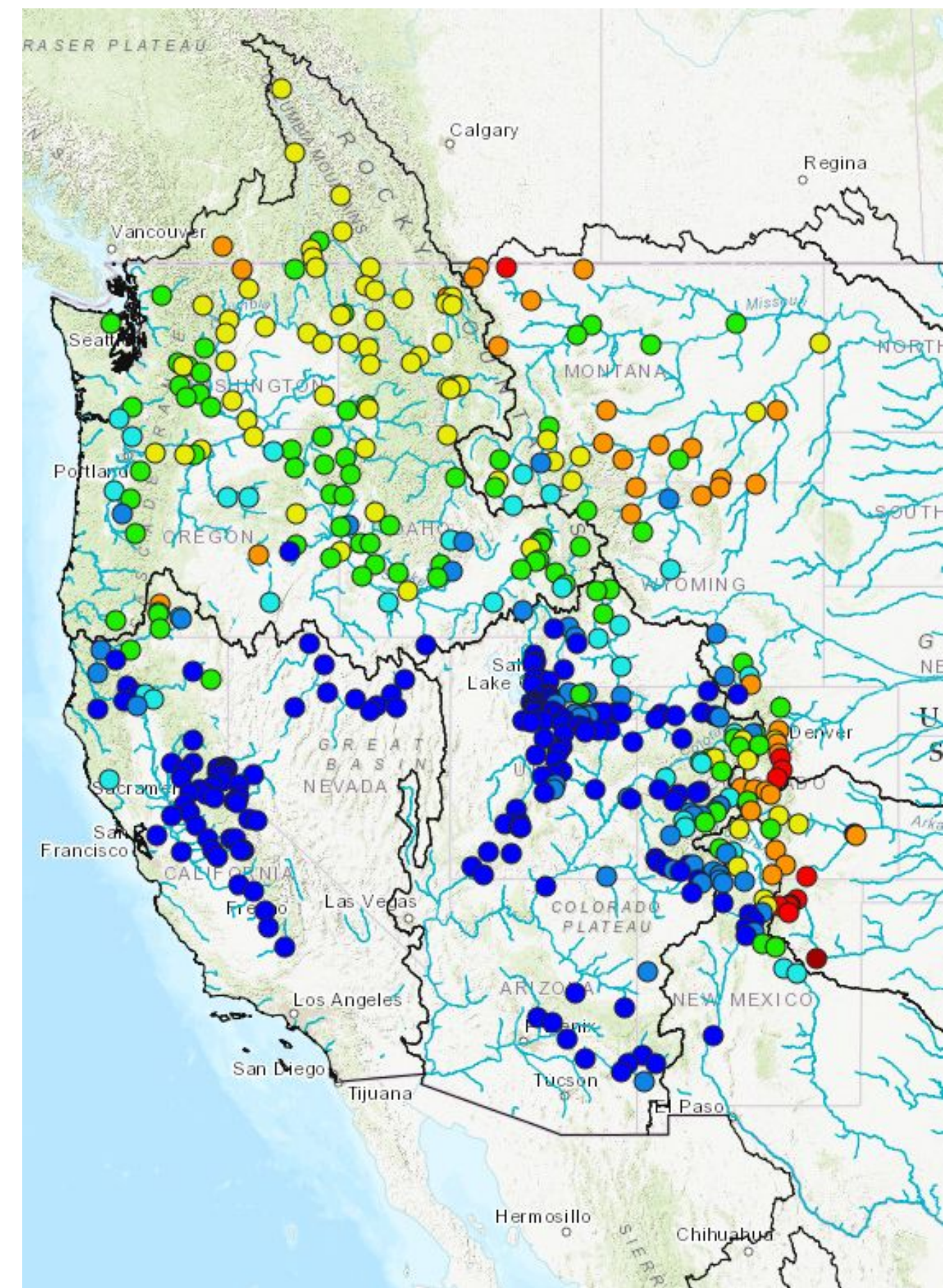
Water Supply Forecasts

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2023/04/13:
Max 1984: 15285.64
Min 2002: 963.96
Average: 6390
Median: 6130
Observed Accumulation: 208
Observed Total: 208
Normal Accumulation: 391
ESP: 11100

- Probabilistic volumetric forecasts
- Updated daily, with monthly “official” forecasts
- Monthly and seasonal timesteps
- Used in reservoir operations models



- Other River Forecast Centers also produce water supply forecasts
- Page brings together all water supply forecasts onto one page
- CN and NW RFCs link to their pages
- Other RFC forecasts are formatted to look like CBRFC forecasts



NRCS Forecasts

Wednesday, November 8



NOAA & NRCS FORECAST COMPARISON TOOL

! FORECASTING PARADIGMS

AREA MONTH YEAR PROBABILITY

- GREEN COLORADO SAN JUAN GREAT SEVIER VIRGIN LOWER COLORADO
- JAN FEB MAR APR 2023 2022 2021 2020
- MIN 90 P 70 MOST PROB P 30 MAX 10

||| COLUMNS 1 FILTERS ≡ DENSITY ↓ EXPORT AVERAGE MEDIAN

Area	Stator ID	USGS Station ID	River	Location	Fcst Period	CBRFC Fcst (KAF)	CBRFC Avg (KAF)	RFC % of Avg	NRCS Fcst (KAF)	NRCS Avg (KAF)	NRCS % of Avg	Difference (NRCS-CBRFC)	Difference % (NRCS-CBRFC)
UT	SL	AFFU1	10164500	AMERICAN FORK	AMERICAN FORK; NR; UP PWRPLNT; ABV	4-7	64	25	256	64	26	246	0
UT	GN	ASHU1	09266500	ASHLEY CK	VERNAL; NR	4-7	75	46	163	75	46	163	0
UT	SL	BCTU1	10168500	BIG COTTONWOOD CK	SALT LAKE CITY; NR	4-7	69	34	203	70	33	212	1
UT	SL	BERU1	10011500	BEAR	UTAH	4-7	146	109	134	162	109	149	16
UT	SV	BEVU1	10234500	BEAVER	BEAVER; NR	4-7	54	23	235	60	23	261	6
UT	SJ	BFFU1	09379500	SAN JUAN	BLUFF; NR	4-7	1600	1110	144	1700	915	186	? N/A
UT	GN	BNRU1	09217900	BLACKS FORK	ROBERTSON; NR	4-7	95	88	108	110	87	126	15
UT	GN	BRUU1	09261700	BIG BRUSH CK	VERNAL; NR; RED FLEET RES; ABV	4-7	32	20	163	34	20	173	2
UT	SL	CASU1	10150500	SPANISH FORK	CASTILLA; NR	4-7	146	54	270	165	53	311	? N/A
UT	SV	CCDU1	10194200	CLEAR CK	SEVIER; NR; DIVERSIONS; ABV	4-7	45	19	243	48	19	259	3
UT	SL	CCSU1	10172500	CITY CK	SALT LAKE CITY; NR	4-7	12	7	185	16.3	7	251	? N/A
UT	SL	CIVU1	10131000	CHALK CK	COALVILLE	4-7	79	35	226	76	35	217	-3
UT	SL	CLLU1	10130500	WEBER	COALVILLE; NR	4-7	215	119	181	220	115	191	5
UT	UC	CLRU1	09180500	COLORADO	CISCO; NR	4-7	6200	4080	152	5740	3890	148	-460
UT	SV	COAU1	10242000	COAL CK	CEDAR CITY; NR	4-7	50	18	276	48	18	265	-2
UT	SL	CRAU1	10132490	LOST CK	LOST CK RESERVOIR; CROYDEN; NR	4-7	27	13	211	29	13	227	2
UT	GN	CRUU1	09286700	CURRANT CK	CURRANT CK RESERVOIR	4-7	43	18	243	46	18	260	3
UT	GN	DADU1	09279150	DUCHESNE	DUCHESNE; NR; KNIGHT DIV; ABV	4-7	290	188	154	320	188	170	30
UT	SL	DCRU1	10159500	PROVO	DEER CK RESERVOIR	4-7	270	119	227	240	122	197	-30
UT	SL	DELU1	10171000	DELL FK	LITTLE DELL RESERVOIR	4-7	12.6	4	286	14.1	4	320	1.5
UT	UC	DOLU1		DOLORES	CISCO; NR	4-7	1050	505	208				
UT	GN	DURU1	09302000	DUCHESNE	RANDLETT; NR	4-7	720	350	206	780	345	226	60
UT	SL	ECBU1	10131500	WEBER	ECHO RESERVOIR; ECHO; AT	4-7	295	152	194	285	148	193	-10
UT	SL	ECRU1	10134500	EAST CANYON CK	EAST CANYON RESERVOIR; MORGAN; NR	4-7	71	23	309	65	23	283	-6
UT	GN	ELLU1	09317801	HUNTINGTON CK	ELECTRIC LAKE	4-7	30	11	265	30	11	263	0
UT		EMIU1		Emigr	Emigration Ck nr SLC	4-7				10.6	3	342	
UT	GN	FCNU1	09310500	FISH CK	SCOFIELD; NR; RESERVOIR; ABV	4-7	67	26	258	67	26	258	0
UT	GN	FRRU1	09326500	FERRON CK	FERRON; NR	4-7	53	35	151	57	35	163	4
UT	SL	GATU1	10136500	WEBER	GATEWAY	4-7	685	275	249	625	270	231	-60



Water Supply Verification

Wednesday, November 8

Water Supply Verification

Select Type

Historical

Select Month

April

Filter points...

Filter

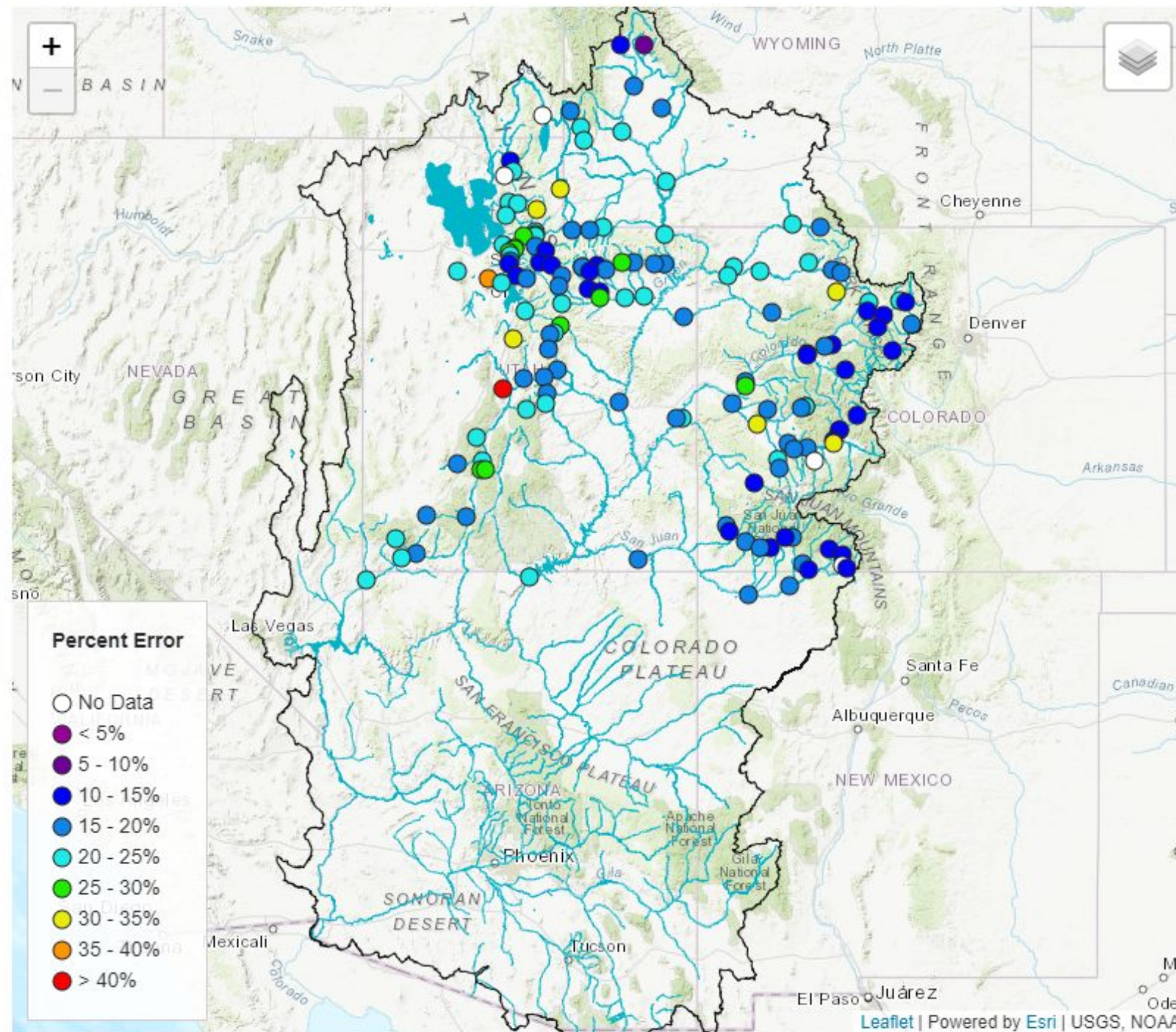
Select Point

- American Fork - Amer
- Animas - Durango
- Ashley Ck - Vernal-
- Bear - Montpelier- N
- Bear - Utah-wyoming
- Bear - Woodruff Narr
- Beaver - Beaver- Nr
- Big Brush Ck - Verna
- Big Cottonwood Ck -
- Big Sandy - Farson-

Point Info

[Historical Help](#)

[Yearly Help](#)

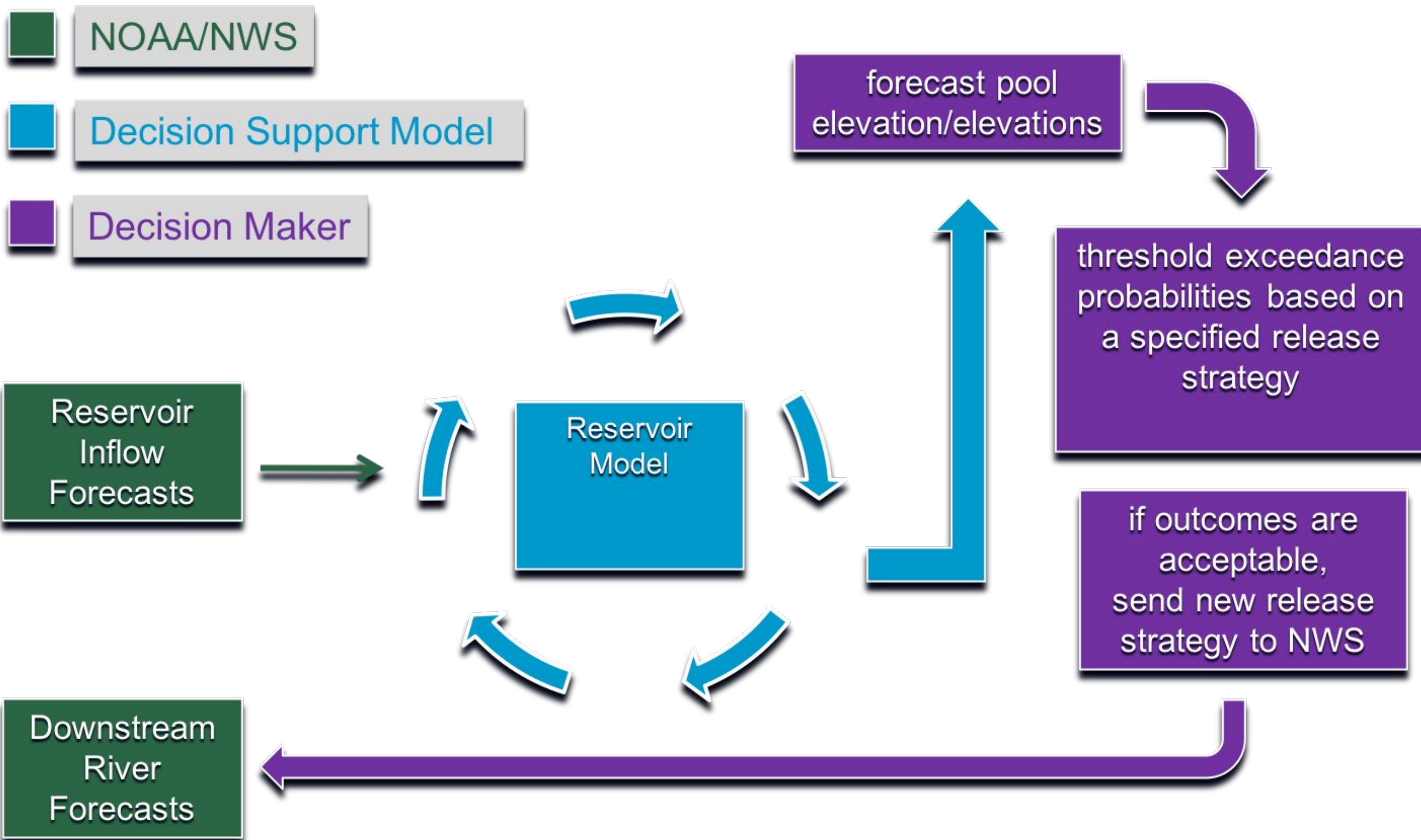


Water supply verification statistics are available on our website



Role of Forecasts in Decision Support for Reservoir Operations

Wednesday, November 8





- **Water Resource and Reservoir Management**
 - Major decisions made by Reclamation and others
 - Increased focus on forecasts by the CBRFC
- **Environmental impacts**
- **Recreational impacts**
- **Economic impacts**

Decisions are made every day based on our forecasts



CBRFC Contacts & Basin Focal Points

Wednesday, November 8

Basin Focal Points (Forecasters)

Brenda Alcorn - Green, Duchesne, White/Yampa
brenda.alcorn@noaa.gov

Ashley Nielson – Gunnison, San Juan, Dolores, Lake Powell
ashley.nielson@noaa.gov

Cody Moser – Upper Colorado Mainstem/Sevier
cody.moser@noaa.gov

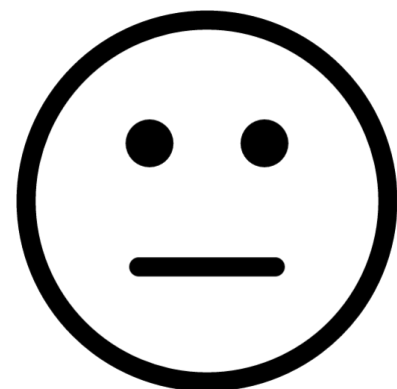
Trevor Grout – Great Basin
trevor.grout@noaa.gov

Nanette Hosenfeld/Wolfgang Hanft - Virgin, Lower Colorado
nanette.hosenfeld@noaa.gov
wolfgang.hanft@noaa.gov

Tracy Cox - Hydrometeorologist
tracy.cox@noaa.gov

Patrick Kormos - Senior Hydrologist
patrick.kormos@noaa.gov

Current Hydrologist Vacancy



Michelle Stokes – Hydrologist In Charge
michelle.stokes@noaa.gov

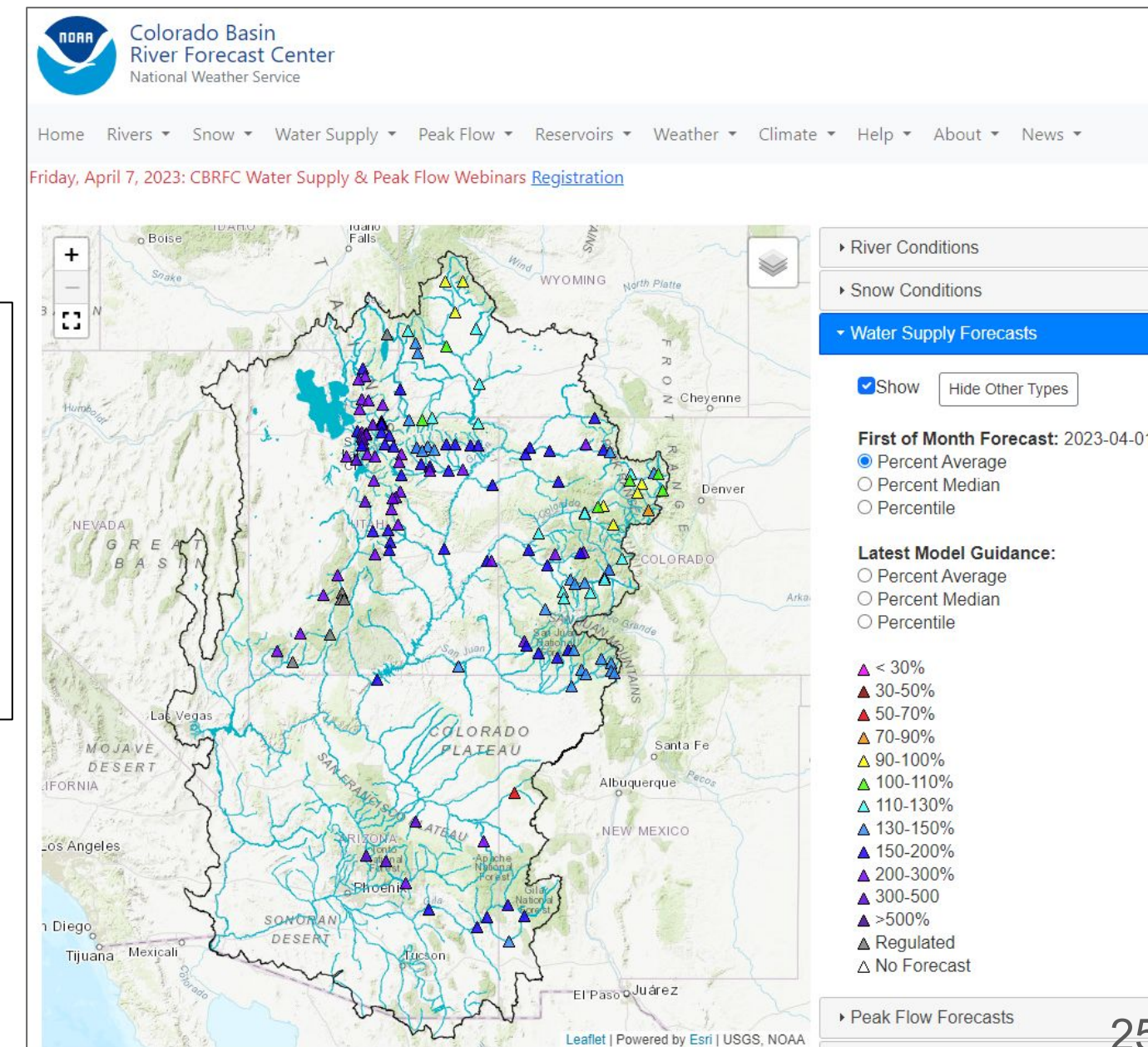
Paul Miller– Service Coordination Hydrologist
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John Lhotak – Development and Operations Hydrologist
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CBRFC Webpage
<https://www.cbrfc.noaa.gov/>

CBRFC Water Supply Presentations
<https://www.cbrfc.noaa.gov/present/present.php>





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Cody Moser – Upper Colorado Mainstem/Sevier
cody.moser@noaa.gov

Trevor Grout – Great Basin
trevor.grout@noaa.gov

Nanette Hosenfeld/Wolfgang Hanft - Virgin, Lower Colorado
nanette.hosenfeld@noaa.gov
wolfgang.hanft@noaa.gov

Vacancies as of January 2024
Senior Hydrologist
Hydrometeorologist
Hydrologist



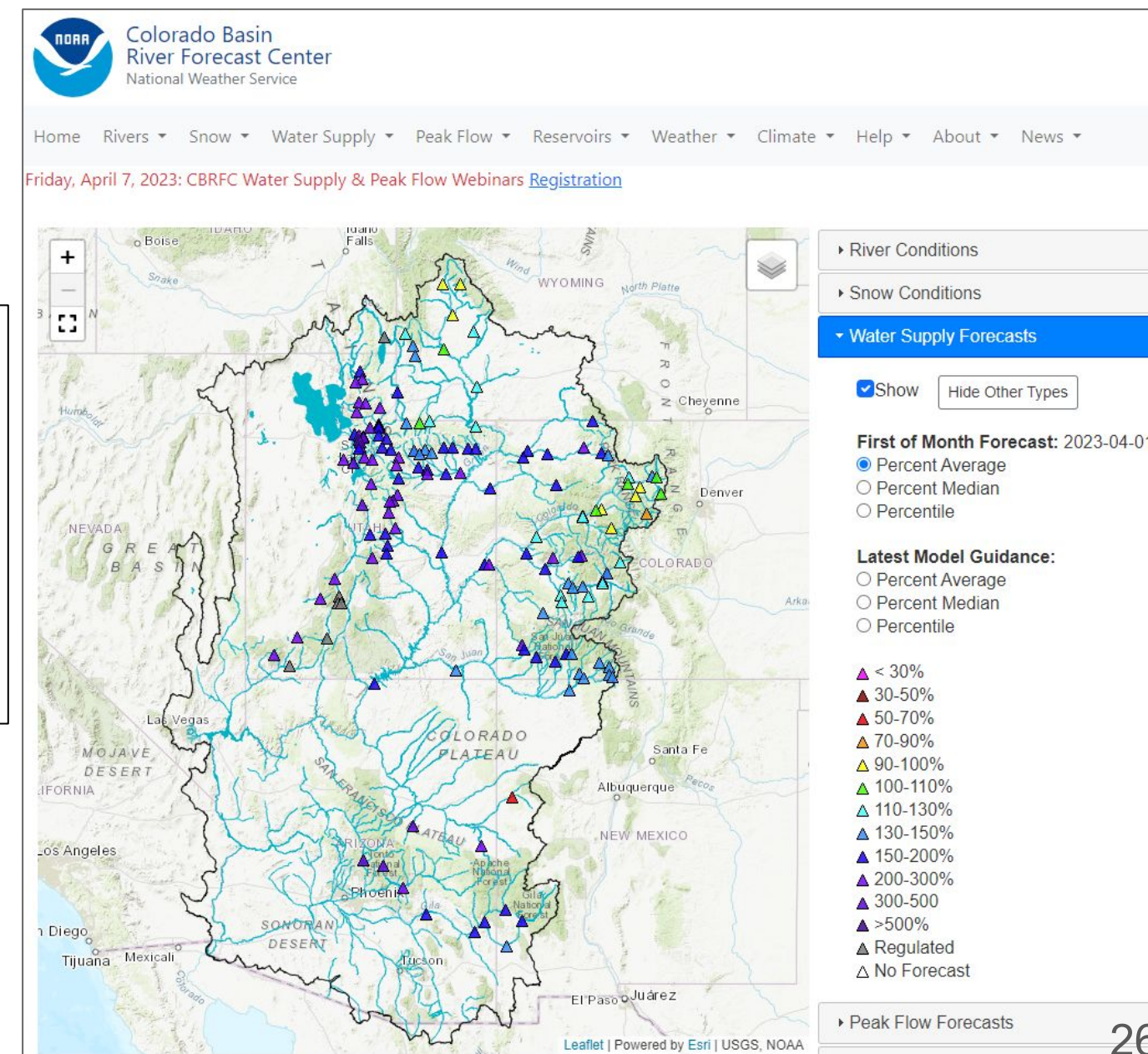
Michelle Stokes – Hydrologist In Charge
michelle.stokes@noaa.gov

Paul Miller– Service Coordination Hydrologist
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John Lhotak – Development and Operations Hydrologist
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CBRFC Water Supply Presentations
<https://www.cbrfc.noaa.gov/present/present.php>





Summary of Registration Info

Wednesday, November 8

How do you currently use CBRFC forecasts and products? Feel free to include information regarding particularly important decisions or time frames when CBRFC information is or could be impactful.

29 responses

Reclamation operational forecasts for Lake Powell, CU Modeling project with CBRFC & RTI

Planning for the season and trip to trip, day to day

Daily use of forecast information to guide the administration of water rights on the mainstem of the Colorado River. My staff then use the information I provide to further administer water rights on tributaries to the Colorado River.

Reclamation Forecasts

coordination of spring, summer and fall flow augmentation (reservoir releases) to benefit endangered fish, other reservoir operations forecasting

I use them for my research and teaching on climate and water issues

We use the Colorado River unregulated inflow forecasts and ESP forecast in our models

operational decision making

What would you ideally like to get out of attendance at the Forum? Please include any specific questions you might have.

29 responses

How to best utilize the CBRFC tools to meet our goals.

I would like to meet CBRFC staff in person since we use their products so often. I would like to hear more

- We developed the stations to try and answer the questions and comments you all had during registration.
- If we aren't answering something, make sure to ask us!



Station Overview

Wednesday, November 8

- **Station A - Interacting with the Model (Ops Area)**
- **Station B - Current Snow and Soil Model Practices (John's Office)**
- **Station C - Water Supply (Michelle's Office)**
- **Station D - Research Projects (David's Office)**

