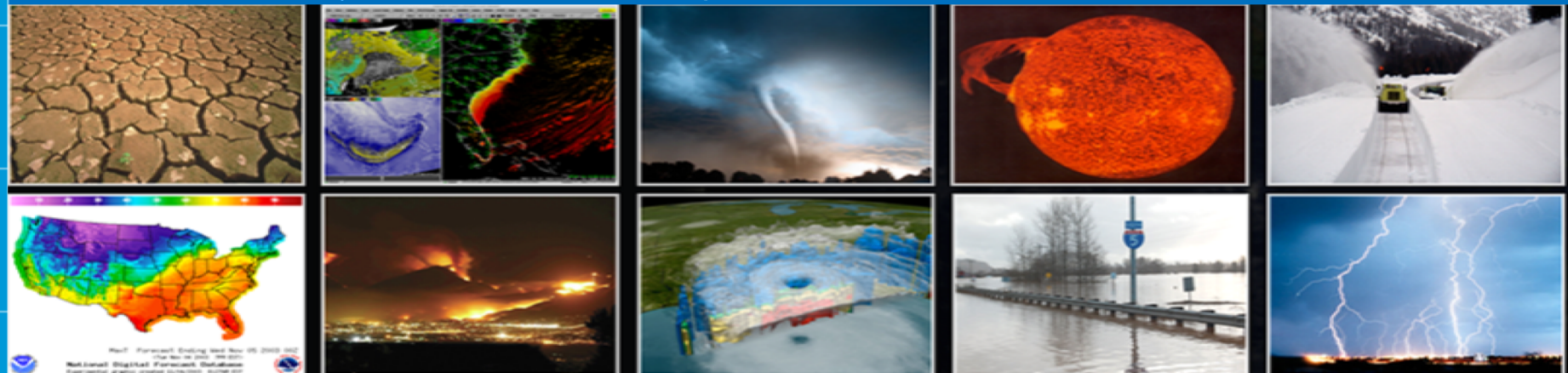
NOAA

National Weather Service

Road to the Forecast
November 15, 2018

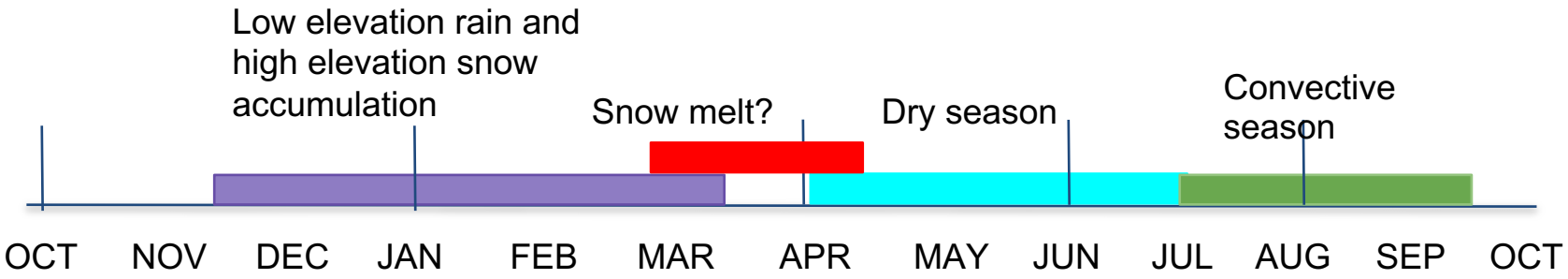
Lower Basin Stakeholder Engagement Forum

Salt River Project Offices, Phoenix, Arizona



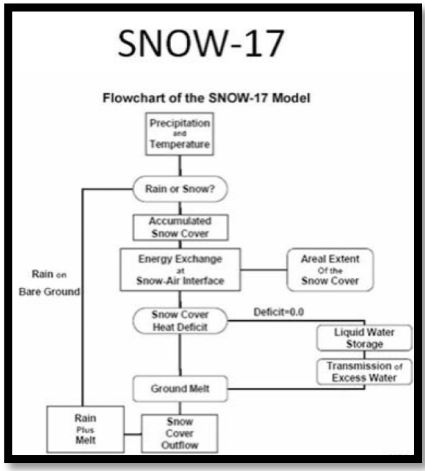
Overview

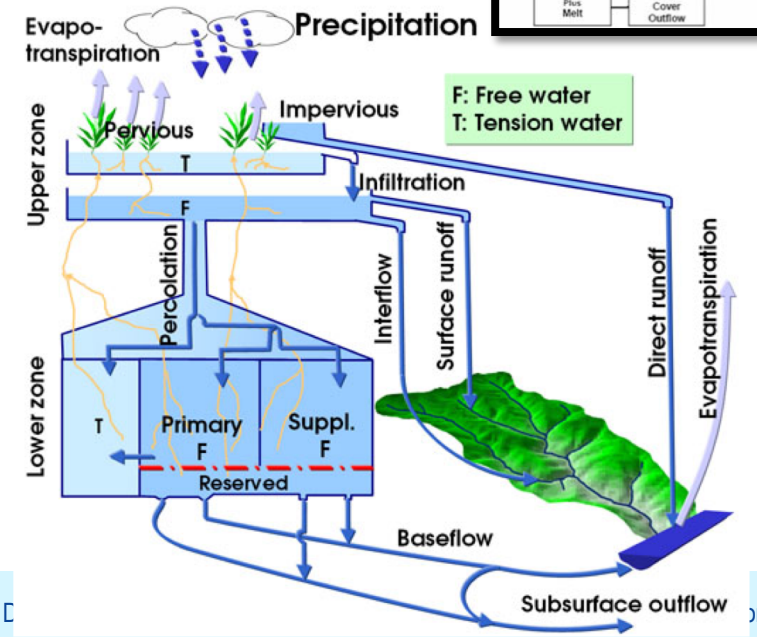
- Operational Timeline of the Lower Basin



CBRFC Model Description

- Continuous
- Conceptual
- Lumped
- Main components are the Sac-SMA and SNOW-17 models
- Calibrated using 1981-2015 data
- Quality of precipitation data is the most important part of the model





Calibrations

- Done for each basin where historical/real-time data exists
- The crux of the forecast process
  - Calibrations are done offline
  - Run the same in forecast mode as in calibration mode
- Forecasts are objective
- Process is evolutionary
  - Always seeking ways to improve calibrations
  - Always incorporating new data

Calibrations

Little Colorado

Virgin

Muddy - Las Vegas

Bill Williams River

Lake Havasu

Verde

Salt

Agua Fria

Hassayampa - Centennial

Upper Gila

San Pedro

Santa Cruz

Lower Gila

Whitewater - Vamori

Calibration System

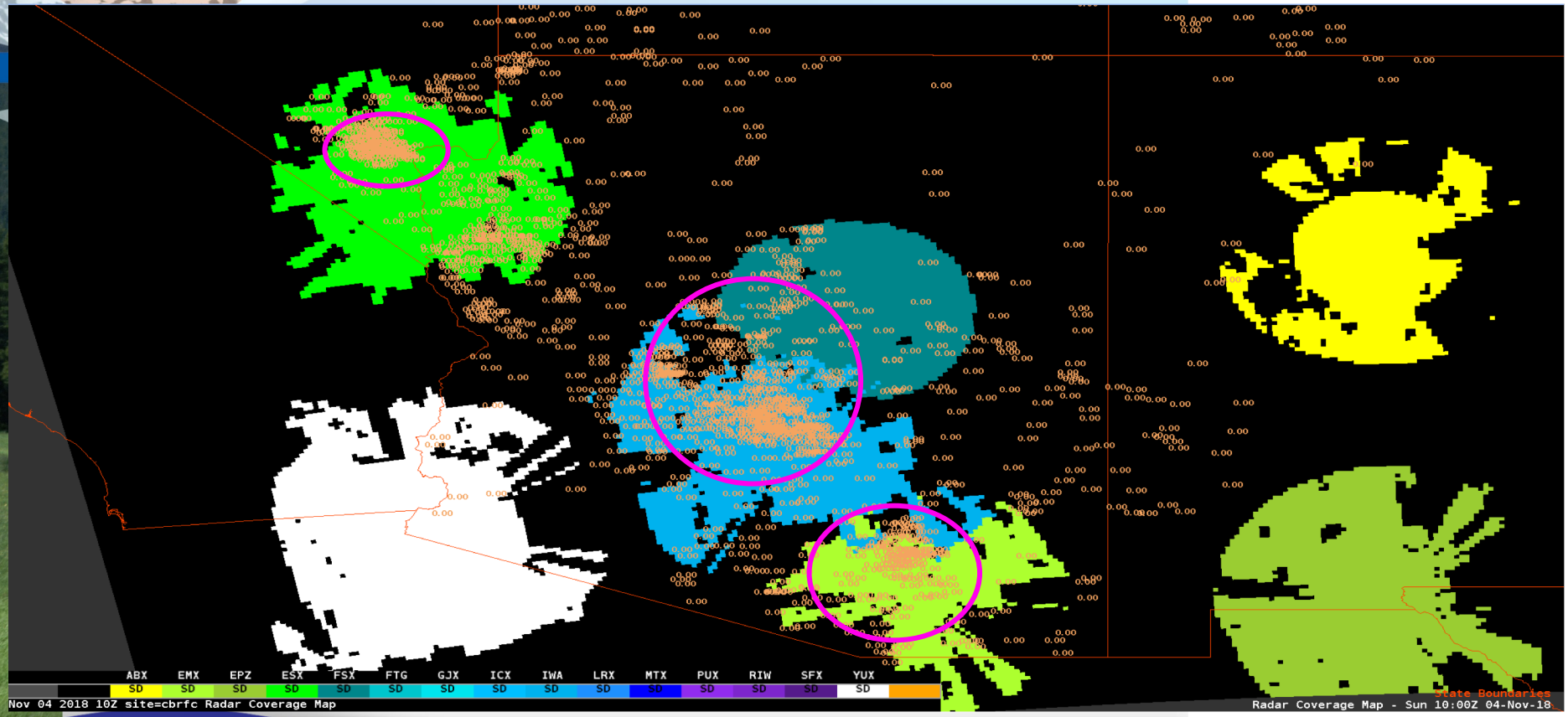
- Store historical precipitation, temperature, and flow time series for the basin (1981 - 2015)
- Choose from a variety of sub-models and processes
  - Snow model
  - Soil Moisture model
  - Unit Hydrograph
  - Channel routing
  - Reservoir operations
- Determine the optimal set of parameters for each model, for each sub-area to best simulate *unregulated* flow

Important gage networks

More gage density in Lower Basin than Upper Basin

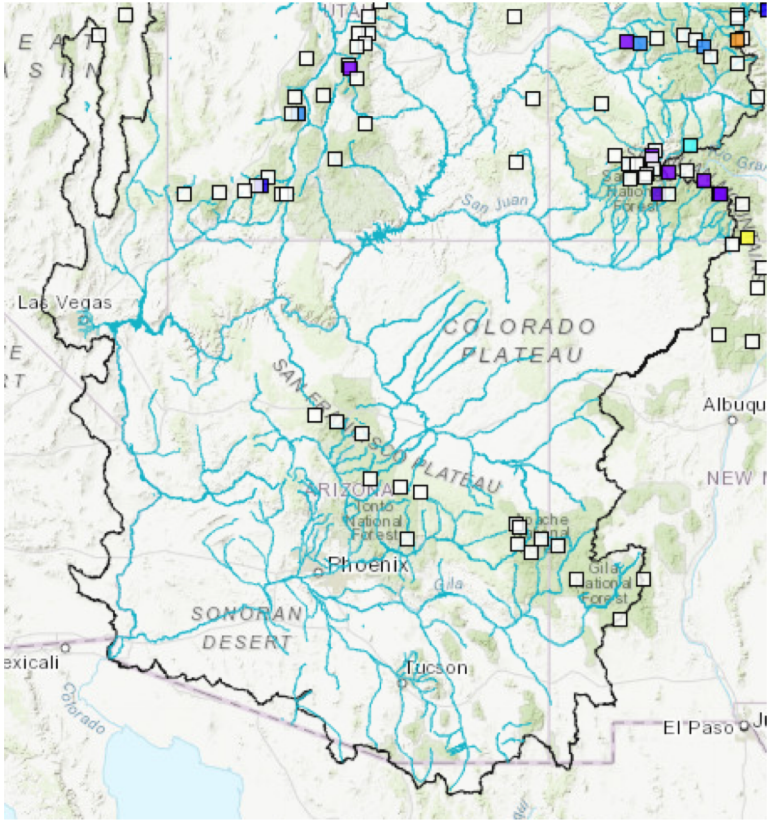
- RAWRs
- CoCoRahs
- USGS precipitation gages
- ALERT network
- SNOTEL
- Radar

Good Radar/Gage Coverage



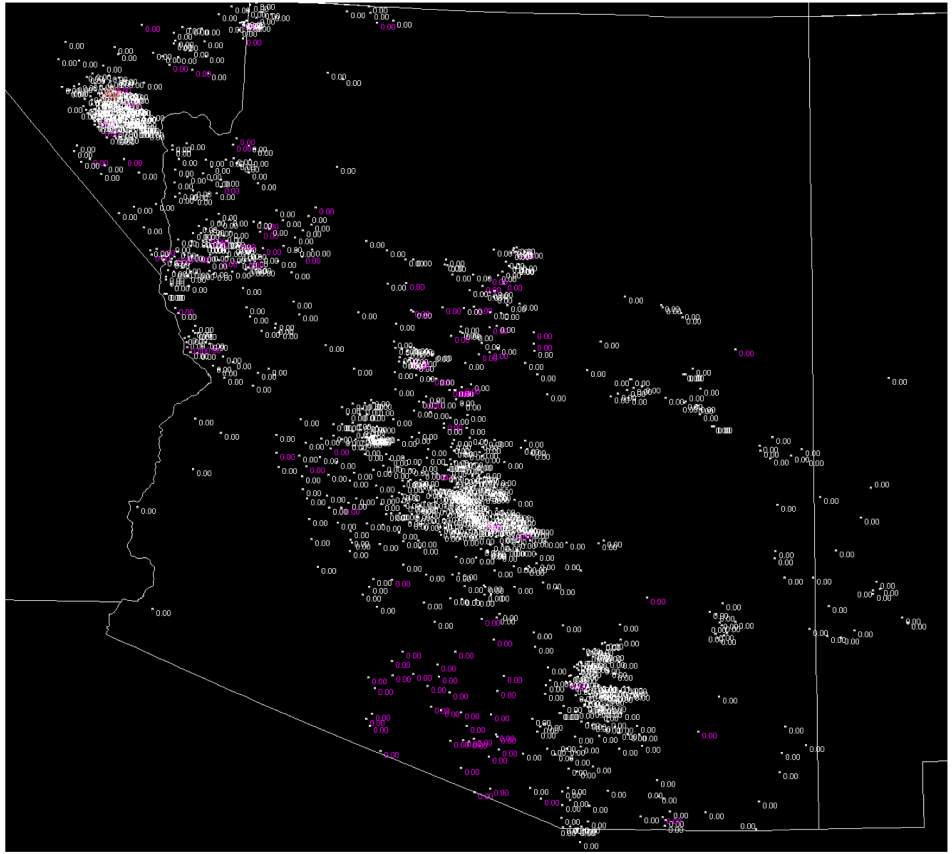
SNOTEL Stations

- Use SNOTEL stations with long, uniform records
  - 10 to 15 years minimum
  - Critical for UC water supply - Lake Powell forecasts
  - Rainfall events can dominate LC hydrology



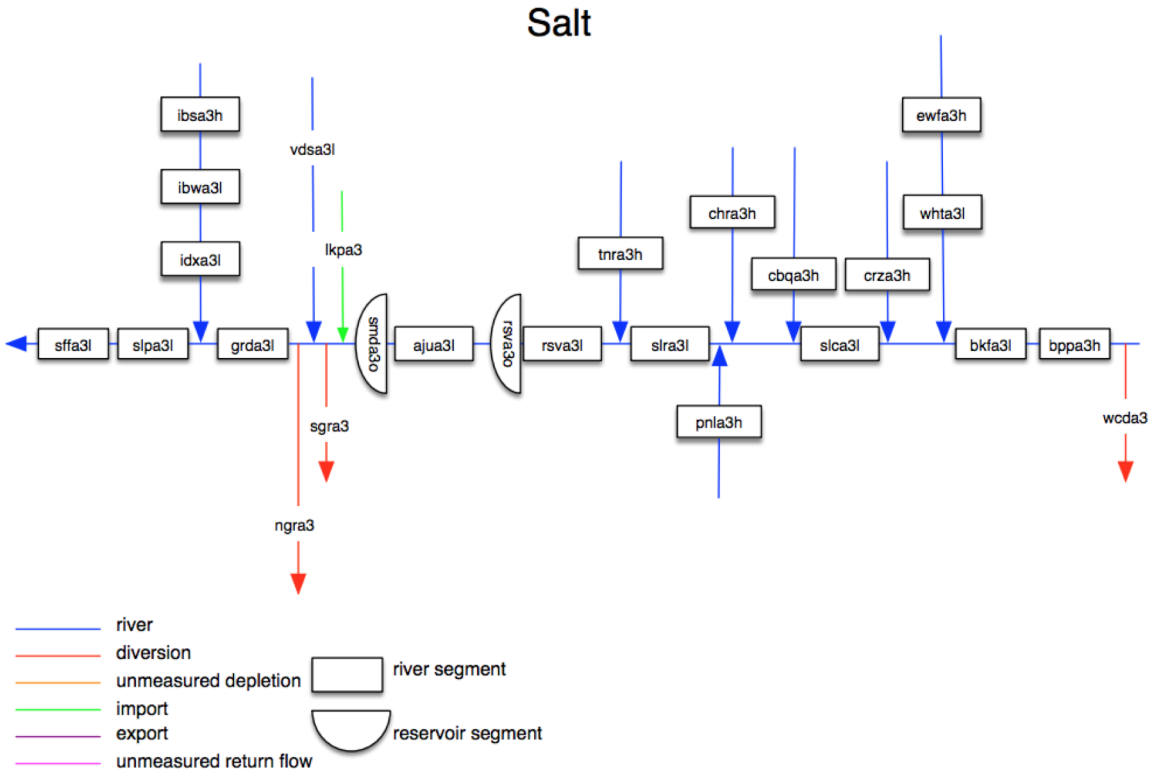
ALERT Network

- Critical for capturing event information in the Lower Colorado River Basin
- We receive data about every 5-10 minutes directly from the counties, JE Fuller
- We relay that information to area Weather Forecast Offices (some WFOs pass the information to us)



CBRFC Model Setup

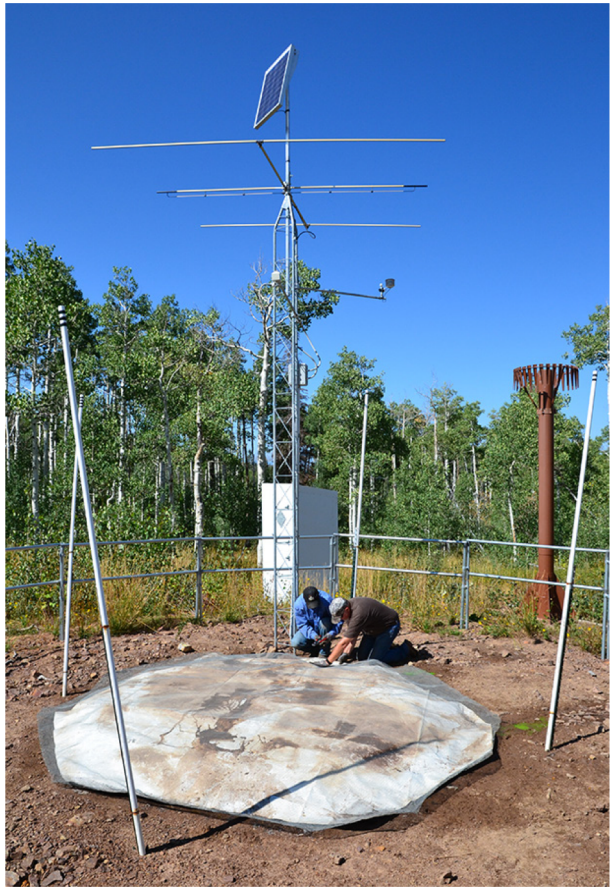
Each river point in the model is called a segment; there are 486 segments in the CBRFC area.



January 1st - First Water Supply Forecasts Issued

- Snow accumulation underway, but rainfall events can dominate
  - Uncertainty can increase
  - QC observed precipitation daily

- Synoptic rainfall events can be the primary driver for water supply, different from snowpack driven Upper Basin

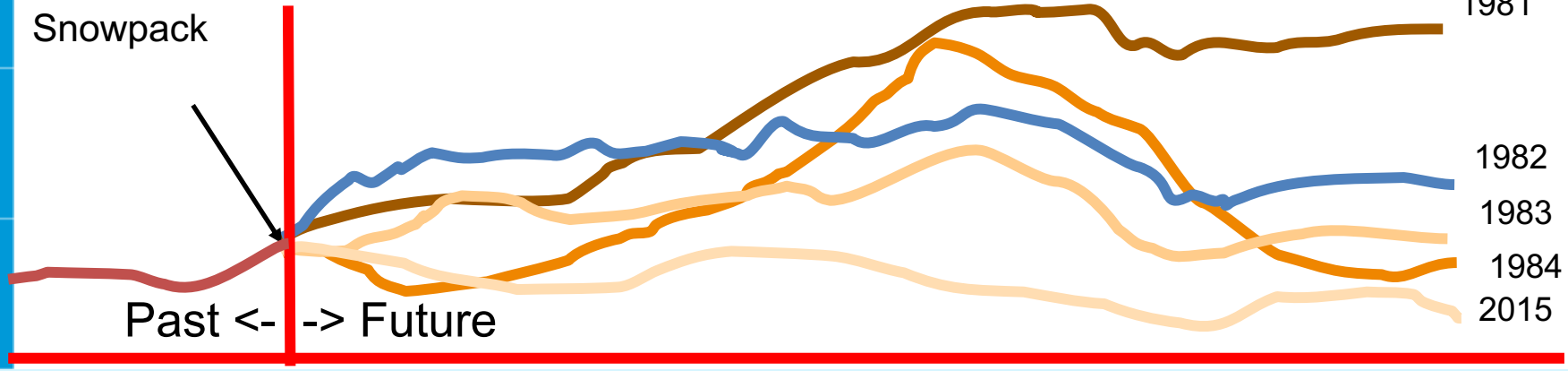


CBRFC Water Supply Forecasting ESP Overview

- Start with the current conditions of streamflow, soil moisture, snowpack
- Apply precipitation and temperature from each historical year used in model calibration (1981-2015)
- A forecast is generated for each of the years (1981-2015)
  - This creates 35 possible future streamflow patterns
  - Each year is given a 1/35 chance of occuring

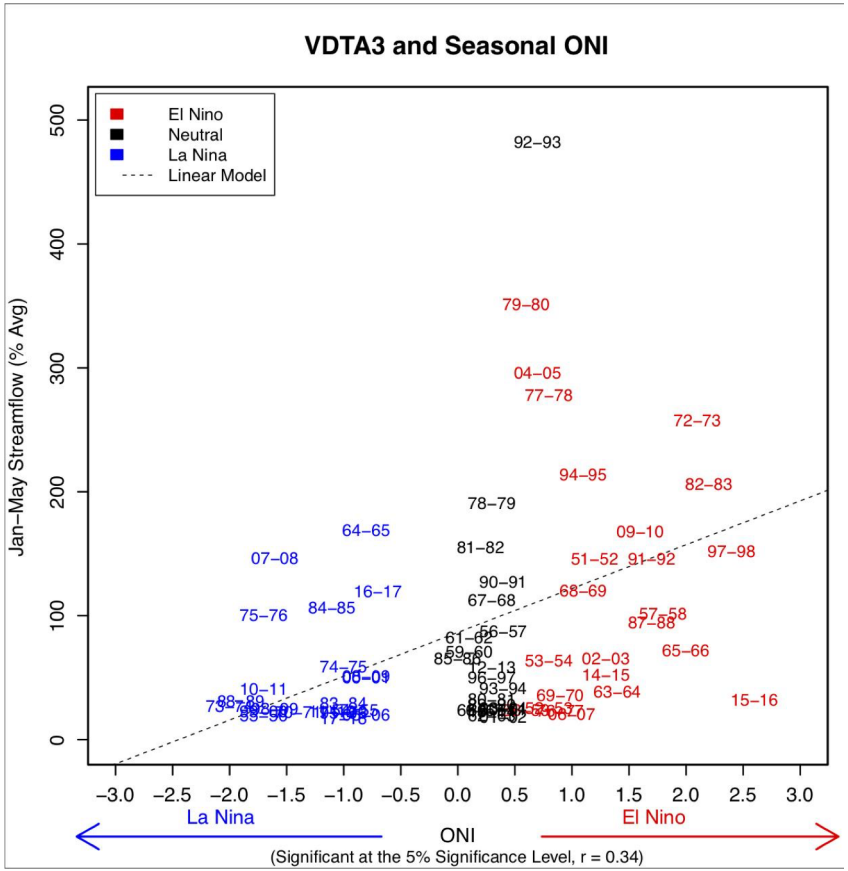
Current hydrologic model states:

River / Res. Levels
Soil Moisture
Snowpack



Incorporating ENSO

- During an ESNO event
  - La Niña years are weighted less during El Niño years, and vice versa
  - Changes distribution of events
- This is not done in the Upper Basin where there is no statistical significance

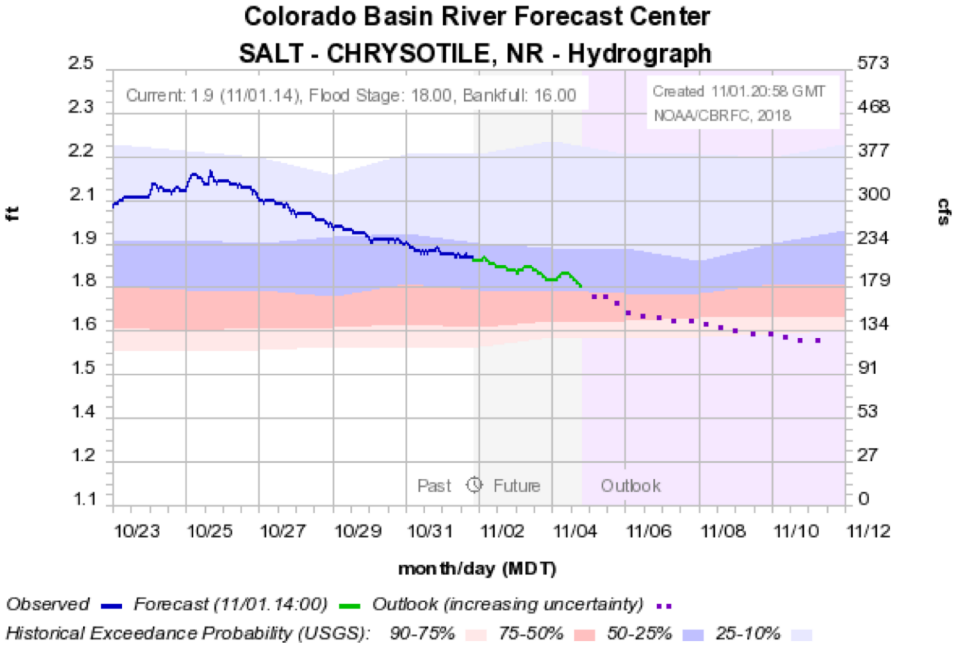


July to September - Active Weather?

- Potential for active monsoon weather
  - Difficult to accurately capture timing and position of events, particularly localized convective ones
  - Data QC becomes very important during and after large events
- Tropical storm remnants
  - Uncertainty associated with storm tracks

Forecasts and Changing Weather

We use 5-6 days of forecast precipitation and 10 days of forecast temperature in our daily streamflow forecasts



QC of these forcings becomes critical as well and can become challenging if meteorological models are inconsistent.

Reservoir Releases

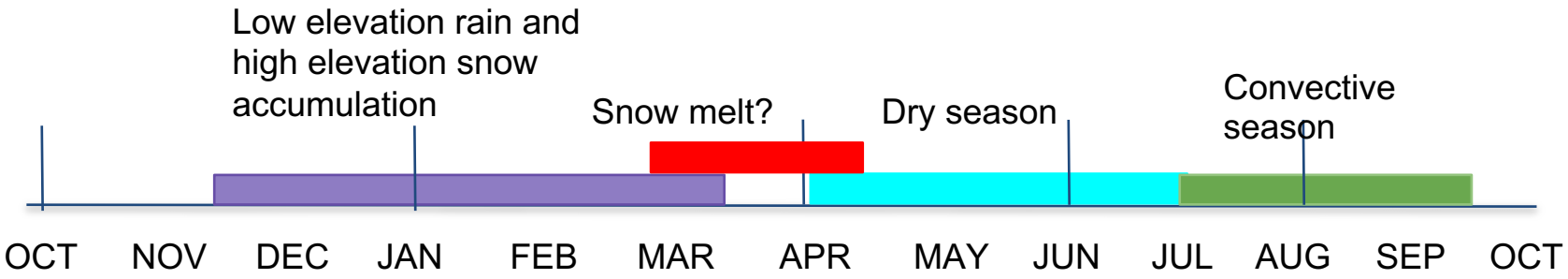
- Reservoir releases are critical to accurate short term forecasts
  - If we know what planned operations are, we will incorporate those
  - We typically assume persistence if we don’t know
  - Will adjust operations on our own to avoid hitting critical levels

Going Forward

- How does our operations timeline align with the timing of your decision making process?
- What are the gaps you face when making decisions? How can we help fill those gaps?
- Where do you look for information when making a decision?

Timeline

- Operational Timeline of the Lower Basin

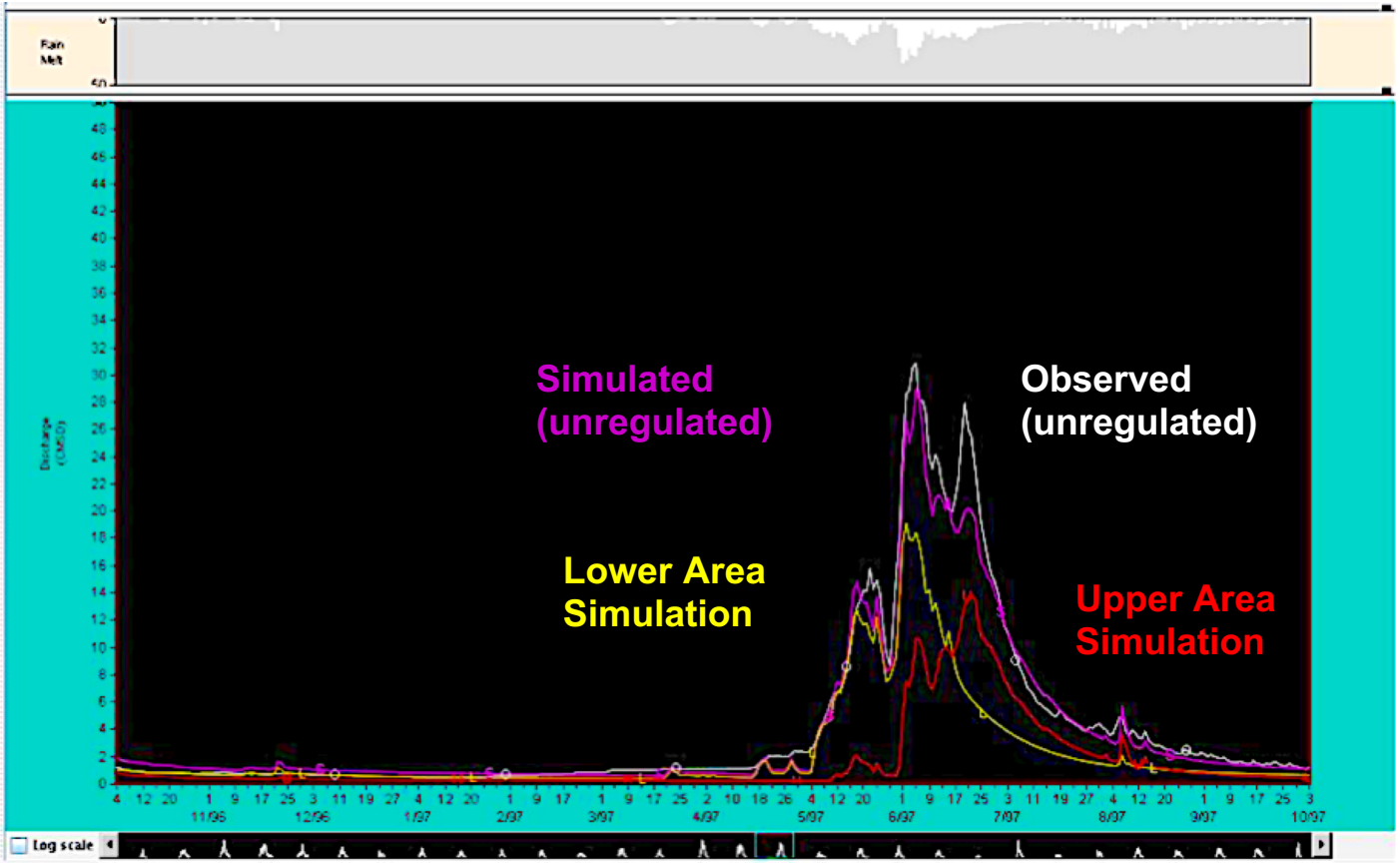


Extra Slides

Calibration Basics

- Water balance is calculated using the PRISM dataset
- Evaporation is determined through a water balance and is regionalized
- Forced by 35 years (1981-2015) of hourly precipitation and temperature
  - Mean Areal Precipitation (MAP) for each subarea (elevation zone) is calculated using predetermined station weights
    - Use precipitation stations that ideally have similar characteristics to that area
    - Weights are chosen to guarantee water balance in each area
  - Mean Areal Temperature (MAT) for each subarea (elevation zone) represents the mid-point elevation
    - Nearby stations are used to calculate the temperature of the MAT
  - Operationally MAPs and MATs are calculated in a similar way to ensure our forecasts will have similar quality/characteristics to 35 years of calibration
  - Mostly use SNOTELs
  - **Extensive analysis and quality control of the data is performed**

Calibration Results



Calibration Errors

Data

- Errors in data used in model calibration
- Density and availability of data over an area

Model

- Model is conceptual so many hard-to-measure parameters are estimated
- Basin scale model may not capture characteristics at smaller spatial scales