What Affects Forecast Quality?

• Uncertainty in future weather
  – Precipitation (accuracy, distribution in space & time)
  – Spring temperatures affect melt/runoff pattern
  – Extreme weather events

Biggest unknown in forecast process!
What Affects Forecast Quality?

• Data
  – Data density limitations
  – Errors in observed data; both historical and current
    • Bad or missing data
    • Quality and frequency of streamflow measurements
  – Ungaged/unknown diversions
    • Unmeasured depletion estimate
      – May or may not be what is occurring
What Affects Forecast Quality?

• Hydrologic Model
  – Bad initial conditions (snow, soil moisture, flows)
    • Tied to data quality
  – Calibration errors/bias
    • Usually tied to quality of historical data
Calibration: Colorado River-Cameo

1983

Red = Observed Streamflow
Blue = Model Simulation
Calibration: Colorado River-Cameo

1995

Red = Observed Streamflow
Blue = Model Simulation
Calibration: Colorado River-Cameo

1997

Red = Observed Streamflow
Blue = Model Simulation
Calibration: Colorado River-Cameo

2006

Red = Observed Streamflow
Blue = Model Simulation
Why the model does well at Cameo

- Downstream location in the Upper Colorado
  - Model errors will be higher at headwater basins

- Snowmelt basin
  - Model errors are higher in basins that are lower in elevation and receive a rain/snow mix

- High quality data set (precipitation, temperature, streamflow, diversions)
  - Representative of all areas/elevations in the basin
  - Long period of record
  - Sufficient amount of stations
January 1st 2017 Forecast: April-July Volume

• Many unknowns in the future weather
• Many future hydrologic scenarios
• Large range of possibilities in forecast volumes
  
  Minimum: 50% of average
  Most Likely: 95%
  Maximum: 173%
Forecasts: Colorado River -Cameo

April 1\textsuperscript{st} 2017 Forecast: April-July Volume

- Fewer unknowns in the future weather
- Still many future hydrologic scenarios
- Smaller range of possibilities in forecast volumes

Minimum: 76\% of average
Most Likely: 105\%
Maximum: 165\%
January 1st Forecast:
What we know:
• ~40% of snowpack accumulation
What we DON’T know:
• Jan-May weather (4 months)
• ~60% of snowpack accumulation

April 1st Forecast:
What we KNOW:
• ~96% of snowpack accumulation
• Dec-March weather
What we don’t know:
• April-May weather (2 months)
• Snowmelt pattern
Summary

• Uncertainty in the future weather is the largest source of error
  – Forecasts are most accurate when the weather does not deviate from normal
• Model performs well with high quality data inputs
• As data quality decreases; forecast error increases
Verification Tools

- Seasonal Water Supply Forecasts
  - Evolution plots
  - Maps (model and annual forecast performance)
  - Site specific statistics

- Daily Forecasts
  - Working on updating and improving current daily forecast verification tools

- Temperature and Precipitation
  - Current project; stay tuned
Questions?