



Colorado Springs Utilities
It's how we're all connected

Use of Climate Data to Support Planning

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Colorado Springs Utilities



Colorado Springs Water Supply

- Serve 412,800 people with about 81,000 acre-feet/year or 26.4 Billion Gallons/year
- Infrastructure extends over 3 rivers basins and 9 counties.

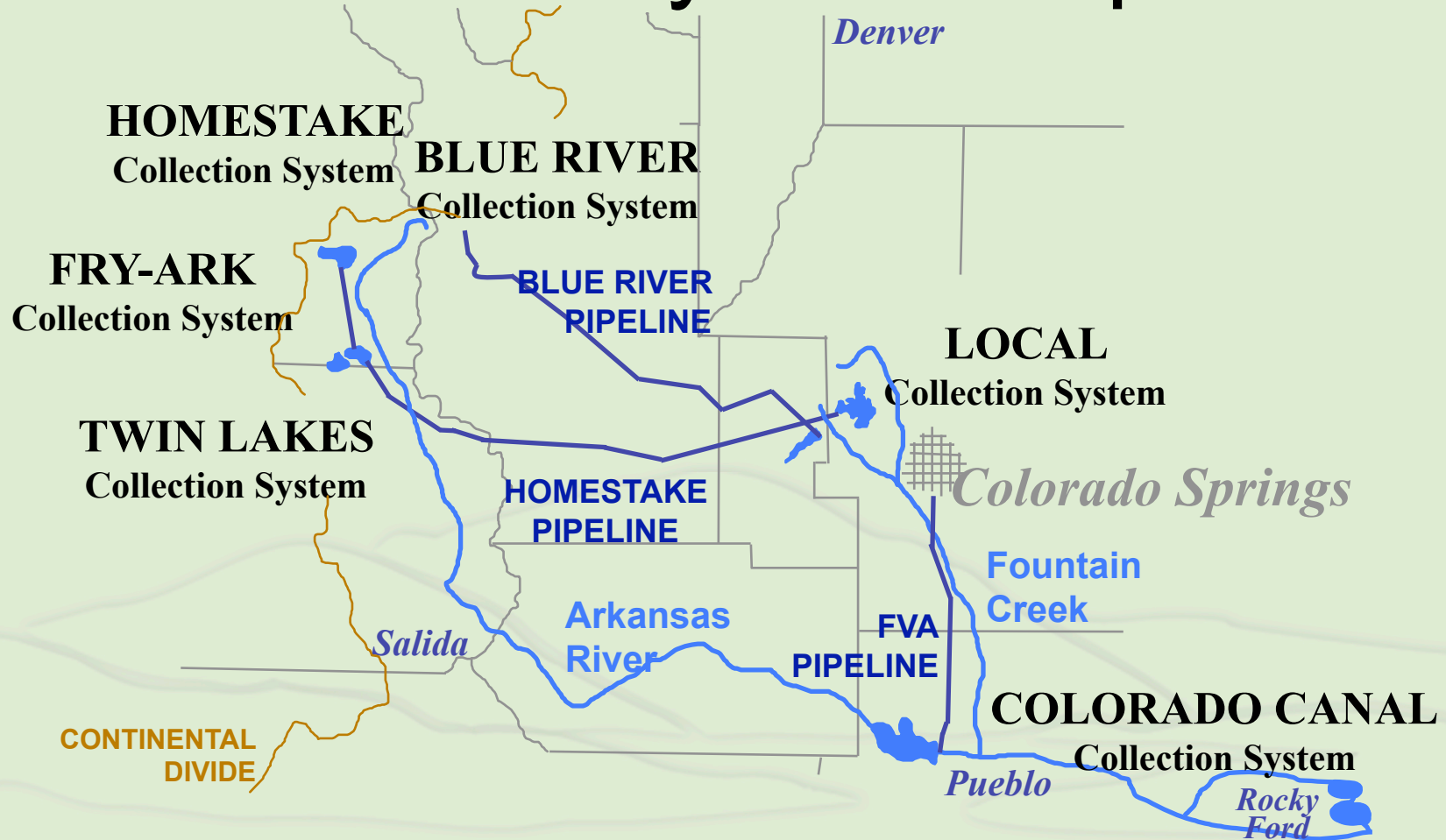


Colorado Springs Water Supply

- On average 65% of water is derived from Colorado River Basin (50% directly, 15% by exchange)
 - Homestake
 - Twin Lakes
 - Blue River
 - Fry-Ark Project
- Via 3 delivery pipelines
 - Otero
 - Blue River
 - Fountain Valley Authority
- It is reused to extinction via exchanges & in the non-potable system



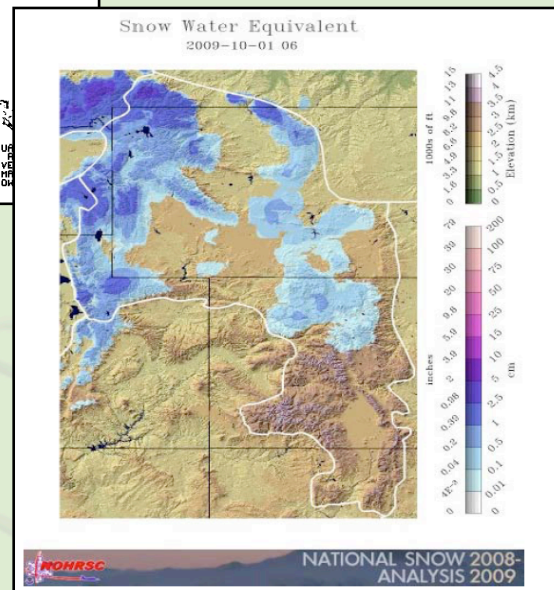
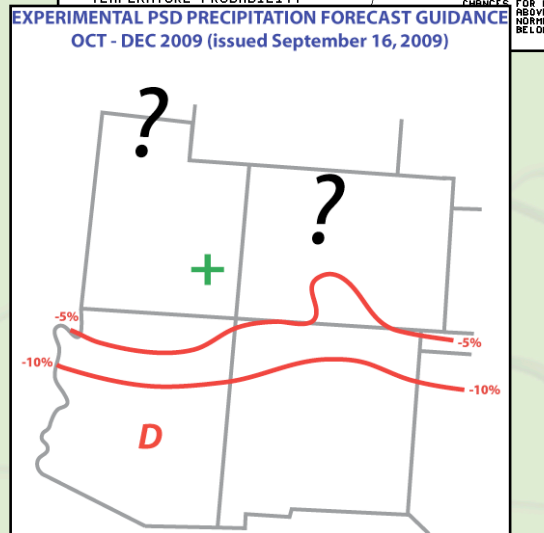
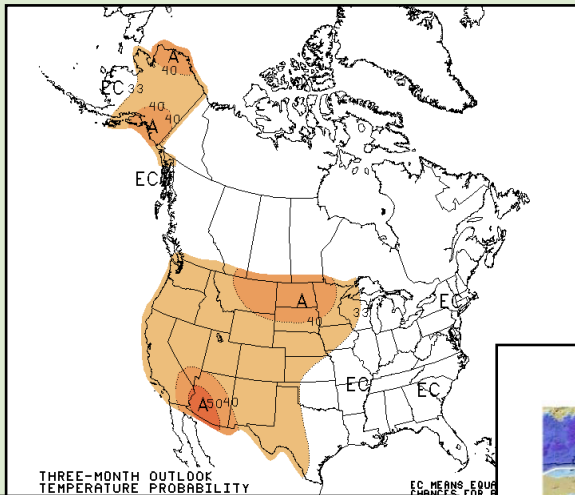
Water System Map





Short Term Forecasts

A variety of tools are used to help estimate system yields



- NWS Climate Prediction Center forecasts (3 month)
- Klaus Wolter's experimental forecast
- NOAA SWE Maps and projected precipitation
 - 2 weeks forecast
 - 1 month probability (above or below average)
- Other Available tools (NRCS, Intermountain West Climate Summary)

http://www.nohrsc.noaa.gov/nsa/index.html?year=2009&month=10&day=1&units=e®ion=Central_Rockies
<http://www.cdc.noaa.gov/people/klaus.wolter/SWcasts/index.html>

Intermountain West Climate Summary

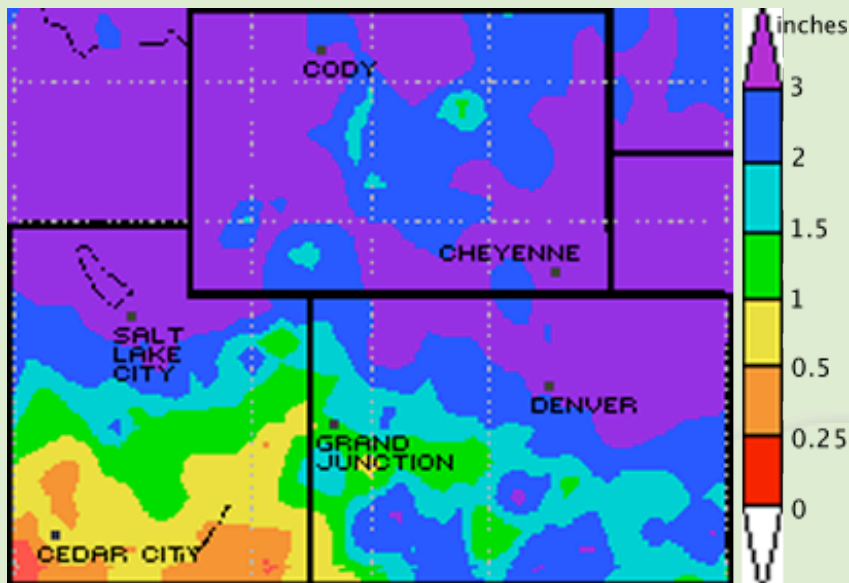


Figure 1. Precipitation for the month of June 2009 (inches). (Source: NOAA ESRL Physical Science Division)

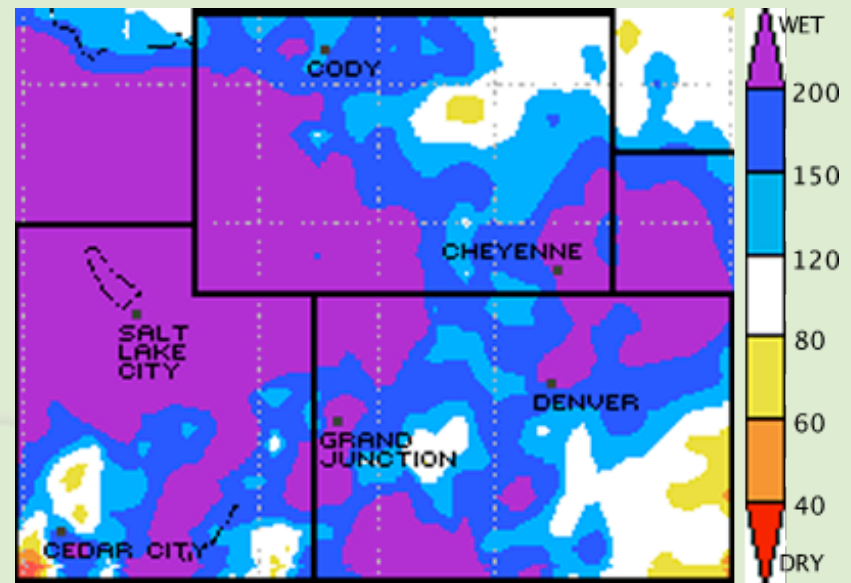


Figure 2. Precipitation for the month of June 2009 as percent of average precipitation for June. (Source: NOAA ESRL Physical Science Division)

http://wwa.colorado.edu/IWCS/2009_July.html

Use of Short Term Forecasts

- Forecast system yields using NRCS Water Outlook and measured SWE
 - Climate prediction tools are used as guidance.
 - Determine if forecast is adjusted higher or lower than statistics/historical records.
 - More of a subjective experience based adjustment for forecast.

Joint Front Range Climate Change Vulnerability Study

- Goal - To determine streamflow sensitivities to increases in temperature and change in precipitation.
- Intended to provide the education, tools, and methodology necessary to examine the effects of climate change scenarios on several common watersheds
- Regional unified approach is intended to give Colorado water providers the opportunity to work from the same historical and projected hydrometeorological data, historical undepleted streamflow, and methodology
- Each participant then uses results as needed for their respective models and planning studies.

<http://cwcb.state.co.us/Home/ClimateChange/JointFRCCVulnerabilityStudy/>



Participants

Water Providers	Water Agencies	Additional Interest
Aurora Water	Colorado Water Conservation Board	Cheyenne Board of Public Utilities, WY
City of Boulder	Water Research Foundation (WRF)	City of Longmont
Colorado Springs Utilities	Western Water Assessment	City of Westminster
Denver Water	Riverside*	
City of Fort Collins	NCAR*	
Northern Water		
*Denote Project Investigator Agency		

Educational Sessions

- **2007**
 - WEAP 101, Sac/SMA 101 – David Yates, Riverside
- **2008**
 - WWA Climate, Water, and Modeling Workshop – Brad Udall, Balaji Rajagopalan, Levi Brekke, Chris Anderson, Joe Barsugli, Jess Lowrey
 - Methodology logistics at NCAR and Kick-off meeting – Laurna Kaatz
 - Global Climate Modeling 101 – Joe Barsugli
 - Long Term Precipitation Trends – Nolan Doesken
 - Temperature Trends and Water Management – Klaus Wolter
 - Riverside's C2D2S2 climate interface with NOAA - Riverside
- **2009**
 - The complexity of the Climate System and Human Roles – Roger Pielke Sr.
 - The impacts of climate change on snowpack in the Colorado headwaters – David Yates
 - The Colorado River Water Availability Study – Ben Harding
 - Statistical Downscaling 101 – Levi Brekke
 - Adapting to Climate Change – Jess Lowrey
 - Incorporating Climate Uncertainty into Planning – Jennifer Daw

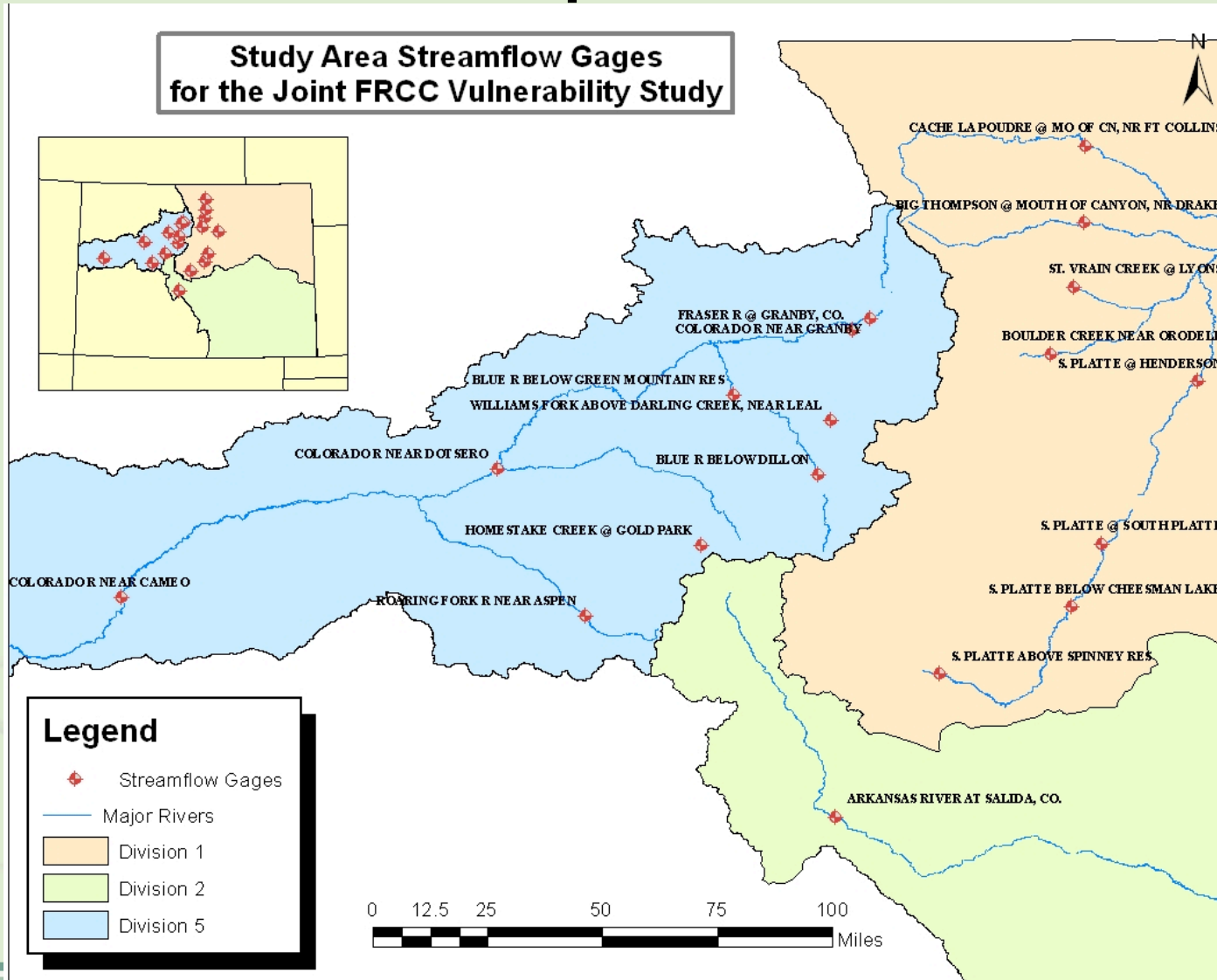
Climate Offset Scenarios

- ***Simple Assessment***
 - Constant Temperature or Precipitation offsets
 - Increase of 1.8°F
 - Increase of 7.2°F
 - Increase of 7.5%
 - Decrease of 3%
- ***Sophisticated Approach***
 - Temperature and Precipitation Scenarios (2040, 2070)
 - warm and wet
 - warm and dry
 - median
 - very warm and wet
 - very warm and dry

Two Models

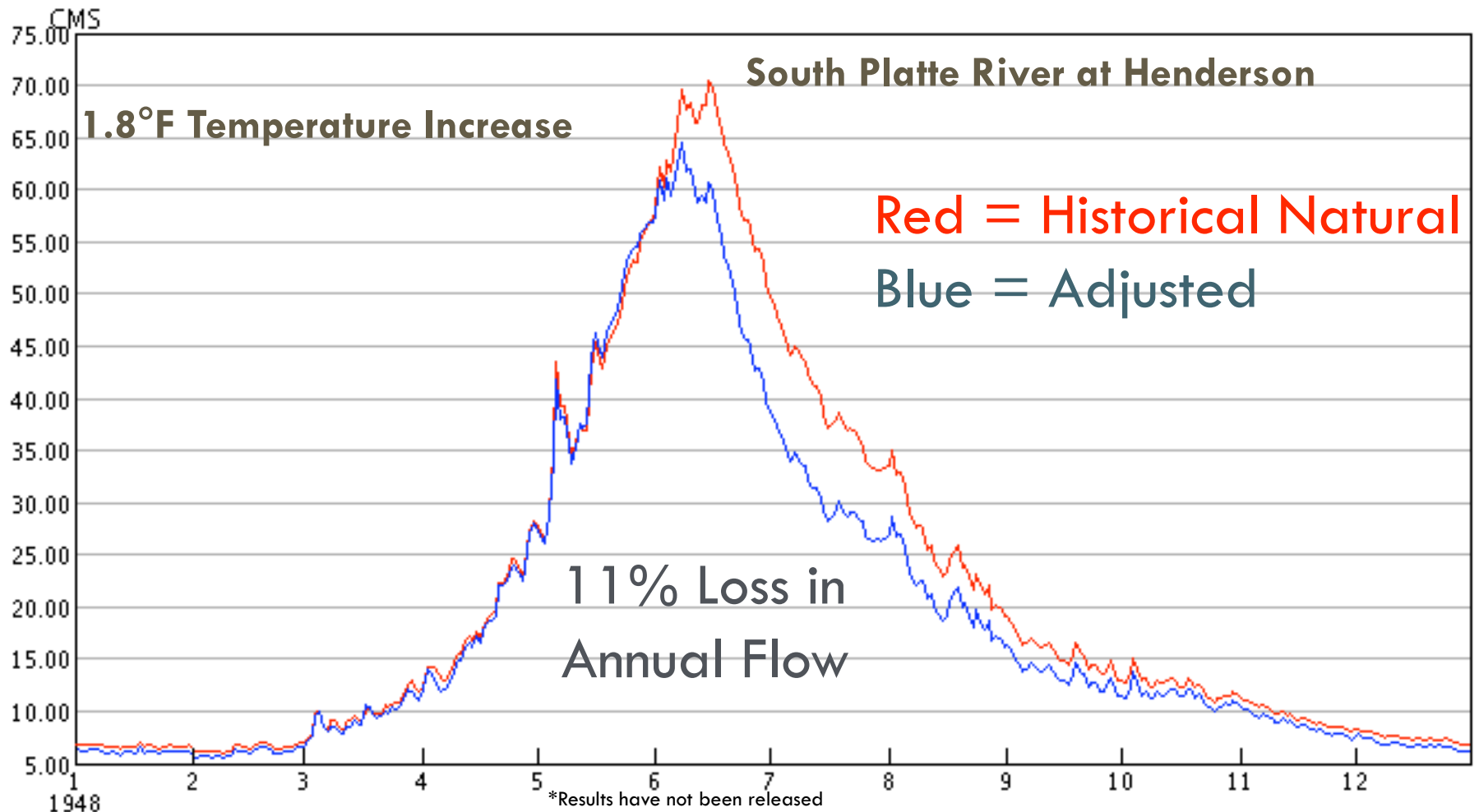
- Water Evaluation and Planning (WEAP) Model
 - Dr. David Yates and Team
- Sacramento Soil Moisture and Snow-17 Model
 - Riverside Team

Model Development: 18 Gauges





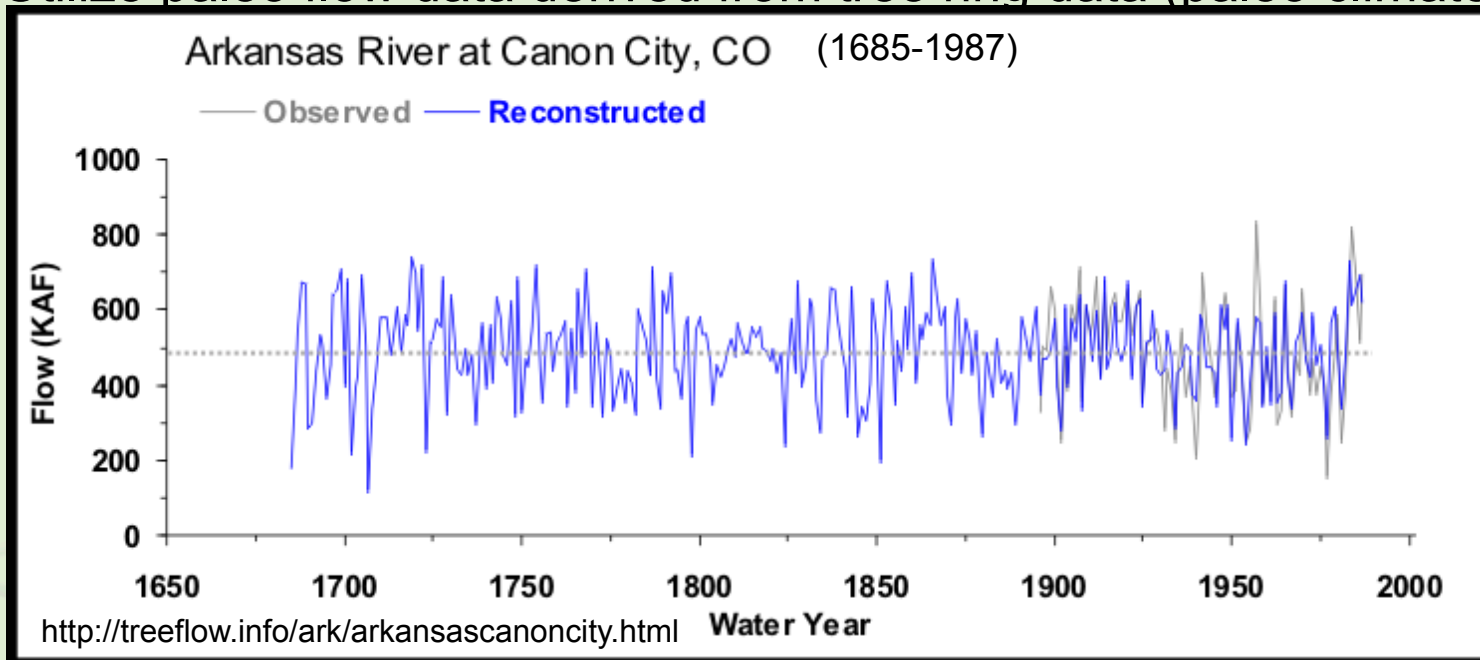
Preliminary Results*: Sacramento Model





Water Supply Planning

- Develop short and long-term integrated water resources plan (supply and demand side)
- Utilize paleo flow data derived from tree ring data (paleo climate)



- Connie Woodhouse extending upper Arkansas Basin chronologies
- Utilize paleo flow for drought/wet cycle information

Water Supply Planning

- Integrate paleo flow in similar fashion to Colorado River water availability study generate multiple ensembles of stream flow sequences
- May use statistically derived stream flow rather than deterministic rainfall runoff model
- Use Front Range Study information as bounding flows rather than integrated in sequencing