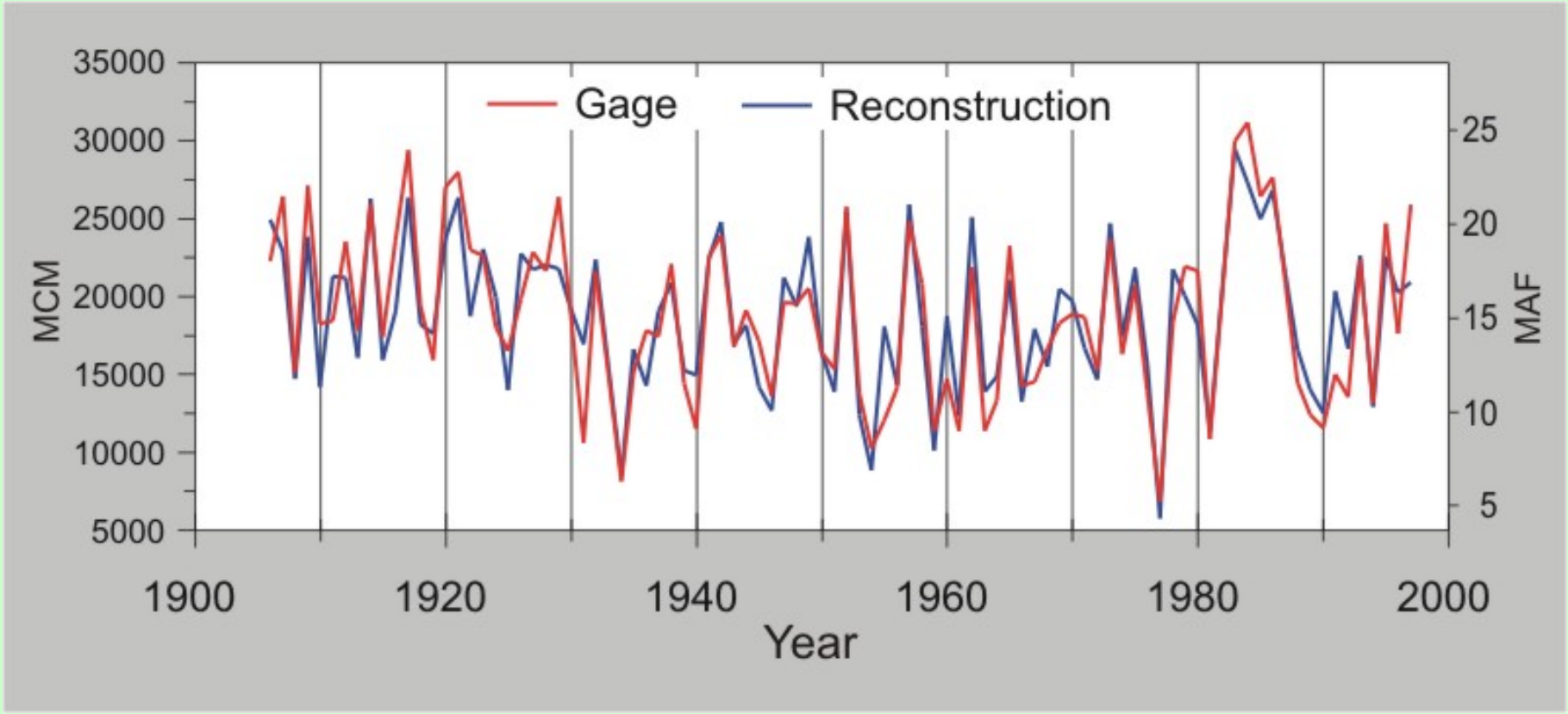
Summary of Issues and Challenges in Applying Tree-Ring Reconstructions to Water Resources Management

- Tree-ring data Issues
- Modeling issues
- Use of this information in planning and decision making
- Application of paleodata in the face of a changing climate

TREE-RING DATA ISSUES

1) Trees are not streamflow gages



Here, a linear combination of 7 chronologies explains 80.6% of the variance in the Lees Ferry gage record. The 19.4% unexplained variance is most often in the extreme wet and dry values.

Possible remedies:

a) Scale variance to match gage record (Hydrosphere/City of Boulder, Cook et al. PDSI)

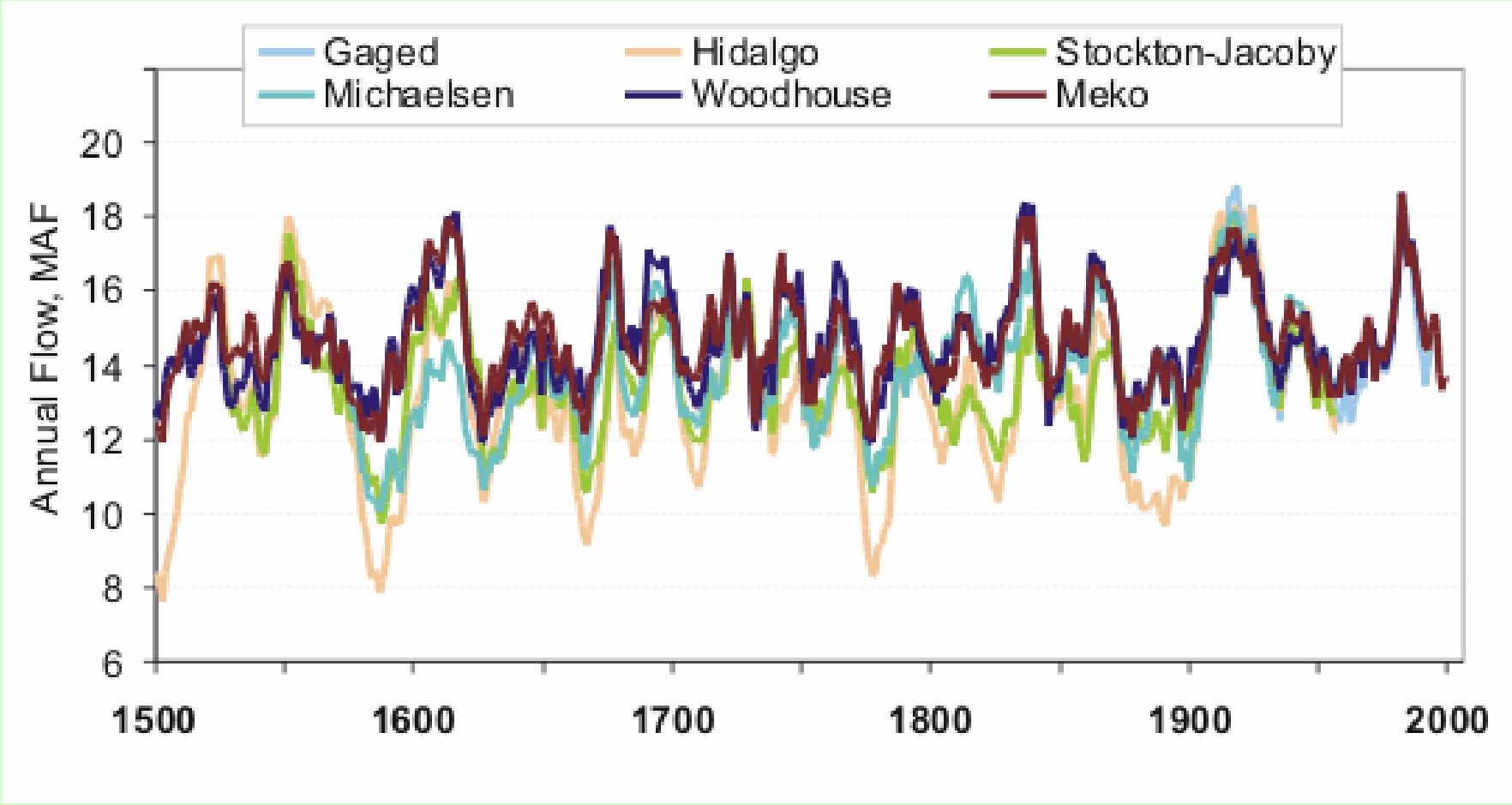
b) Tune reconstruction to better match extremes by calibrating separate models on wet and dry years then combining the two (Denver Water, City of Westminster)

c) Only use the information about flow sequences, not magnitudes of flows - "paleo conditioning" (USBR)

Drawbacks: a) inflates any errors; b) doesn't gain much?; c) loses broader range of extremes in longer record

TREE-RING DATA ISSUES

2) Uncertainty and sources of differences



Lees Ferry reconstructions through the years – which one is right?

Sources of differences

a. Gage data

b. Tree-ring data used

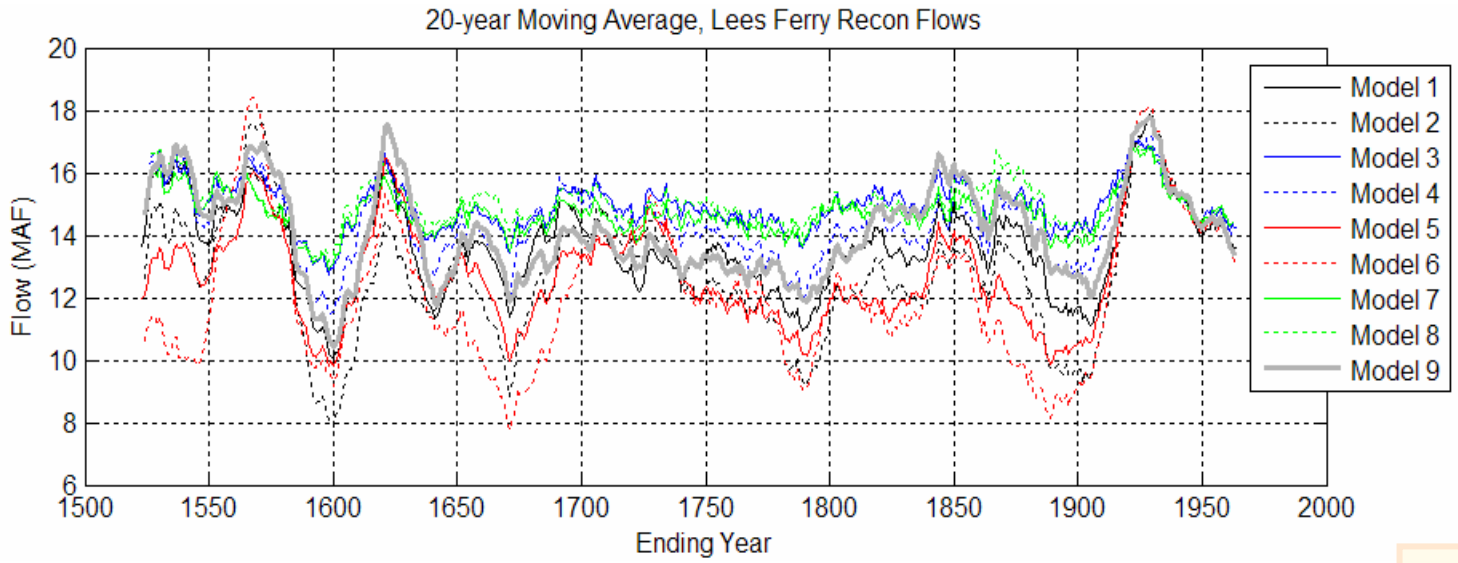
c. Calibration years

d. Tree-ring data treatment

e. Modeling approach

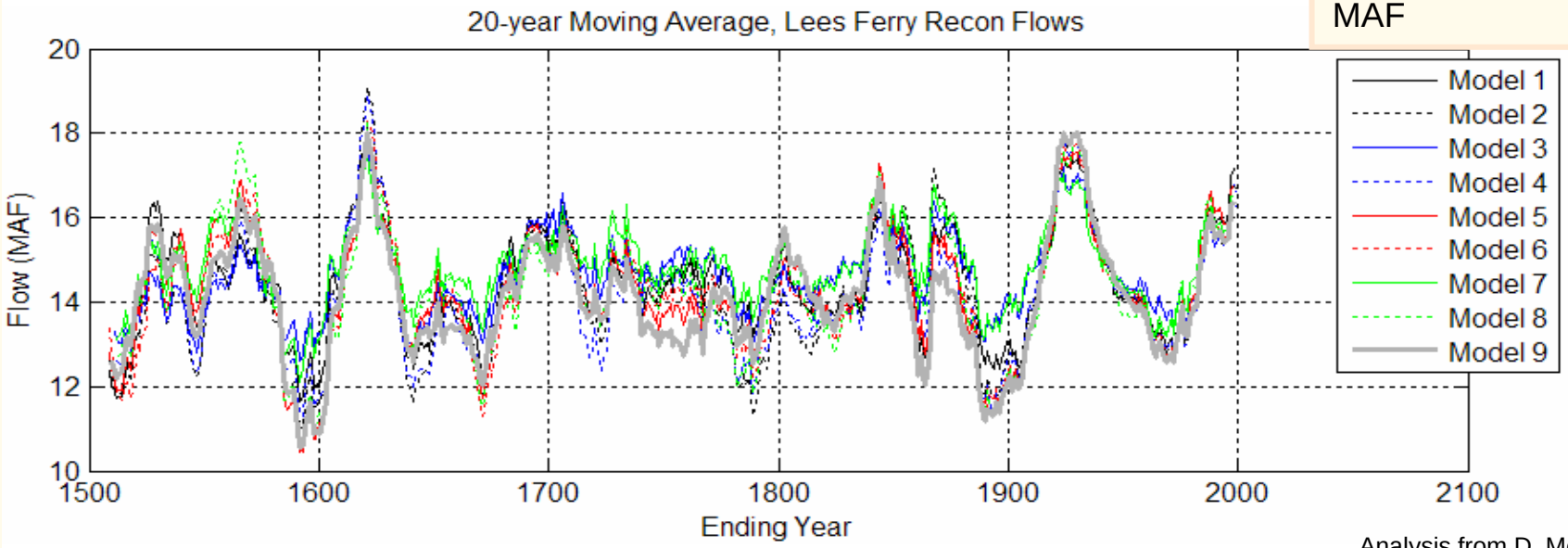
Different data, treatments, model choices - Lees Ferry

Stockton and Jacoby's tree-ring data and Hely gage record (1914-1961)



Means range from 12.2 to 15.0 MAF

New tree-ring data and latest USBR gage data (1906-1995)



Means range from 14.1 to 14.9 MAF

Analysis from D. Meko

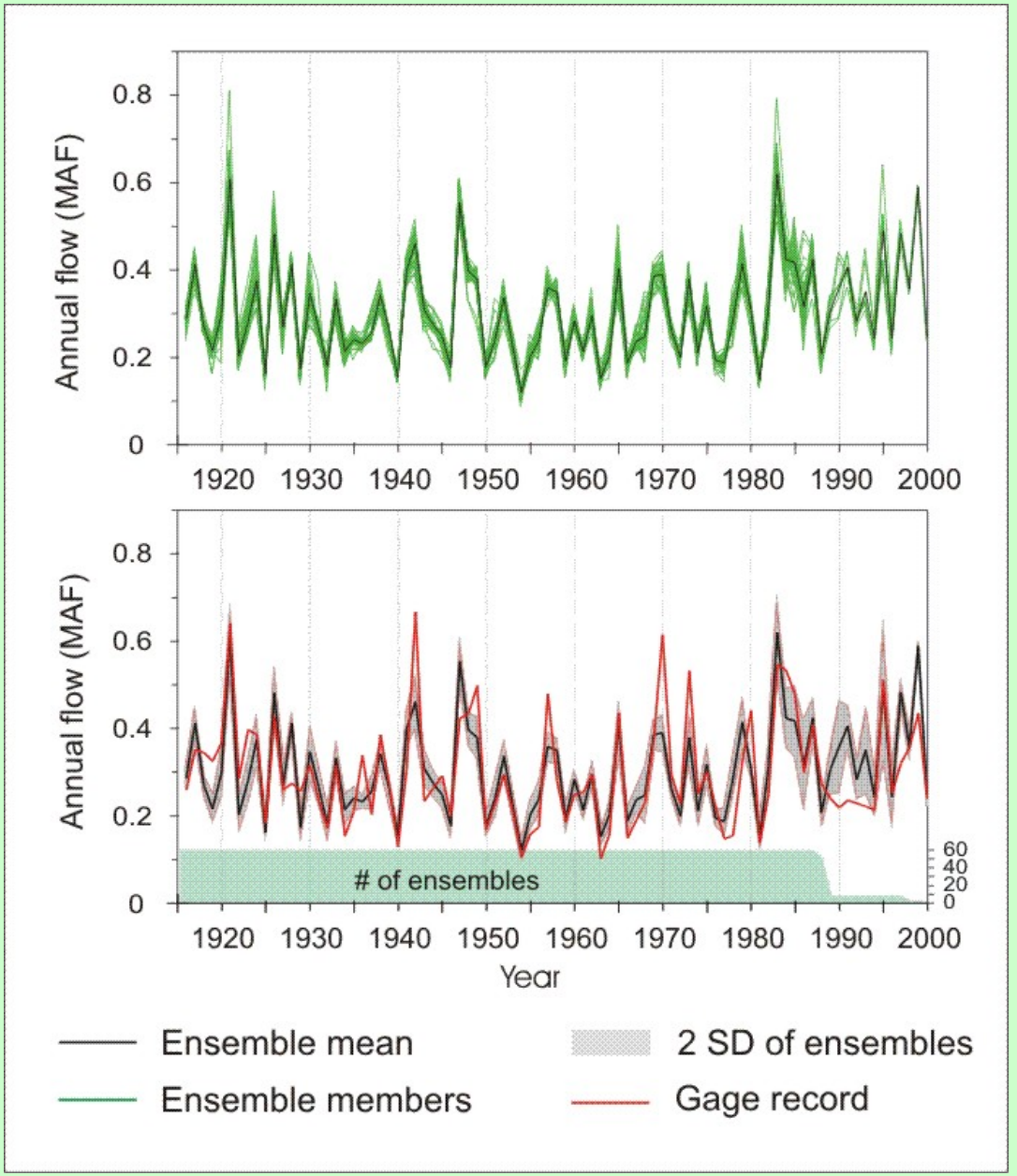
Possible remedies:

a. Ensemble reconstructions (Denver Water)

b. Resampling techniques (Stratus/Hydrosphere/ City of Boulder, USBR)

Drawbacks: how to make use of the quantified uncertainty?

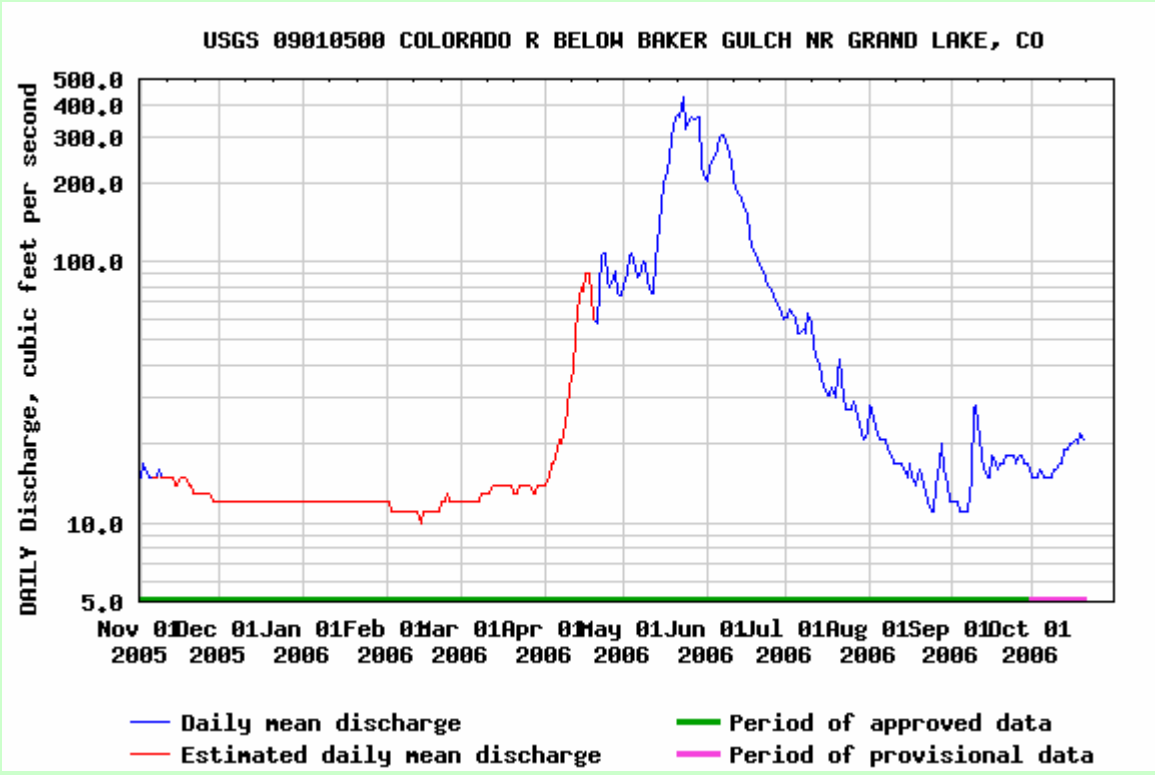
Also, even with these approaches, not all sources of uncertainty are considered



South Platte ensembles based of subsets of calibration years

MODELING ISSUES

1) Temporal disaggregation



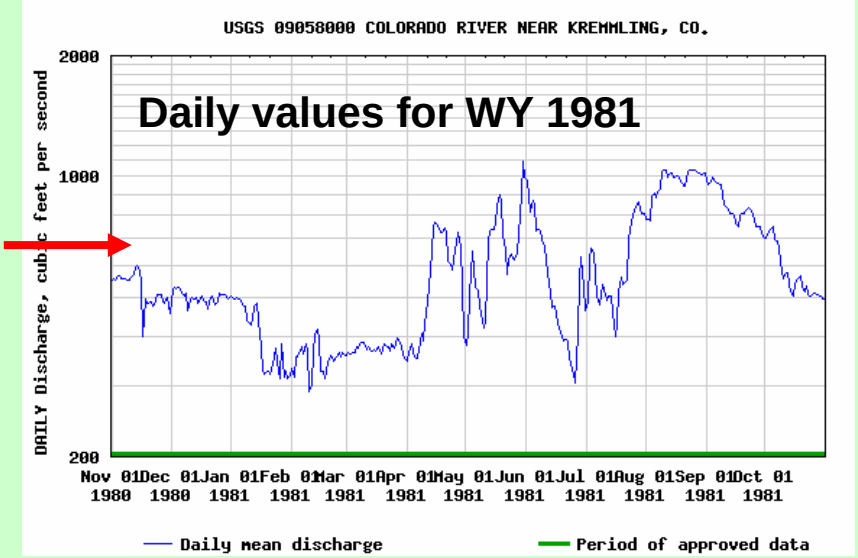
Annual rings → models with monthly or daily input requirements

Possible remedies:

a. Analogue method (Denver Water)

b. Nearest neighbor method (USBR, S/H/CoB)

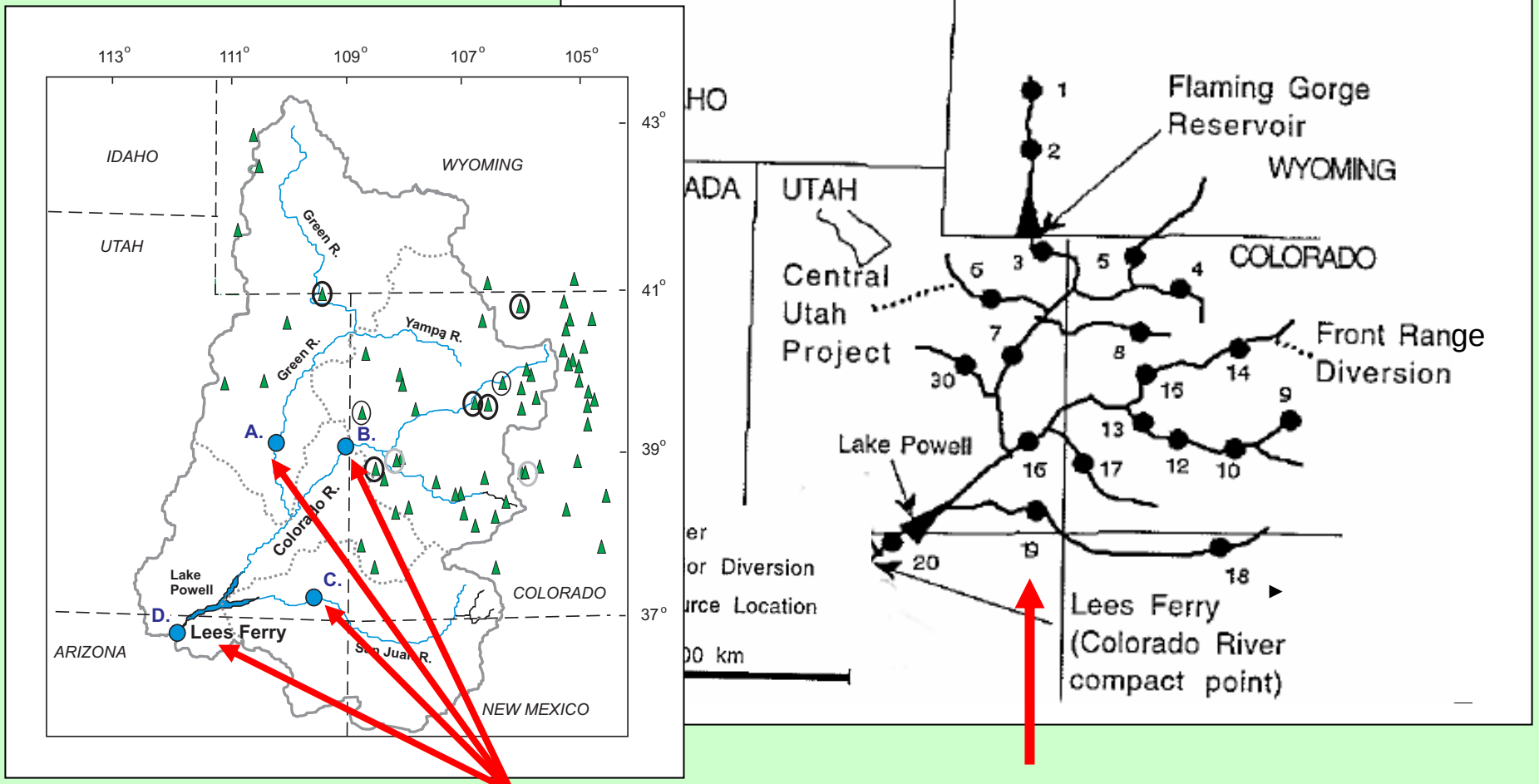
Reconstruction			Gage record analogue	
1585	778585	→	1981	768203
1586	1363031	→	1924	1364560
1587	975399	→	1976	975351
1588	1287478	→	1949	1287350



Drawback: assumptions are made about shape of hydrograph

MODELING ISSUES

2) Spatial disaggregation



4 Gage Reconstructions vs. 29 Model Inputs

Possible remedies:

a. Extension of Analogue method (Denver Water)

b. USBR approach (Jim Prairie)

Use of the information from reconstructions in planning and decision making

Challenge: treating and presenting the tree-ring data so that:

1) their positive attributes (record length, expanded range of variability) are used effectively

2) the data aren't misrepresented

An Example

City of Boulder Drought Plan

A computer model of Boulder's water supply system was used to test the effectiveness of various combinations of drought recognition triggers and drought response strategies against 300 years of historical and tree ring-based hydrology.

From Hydrosphere Resource Consultants, 2004

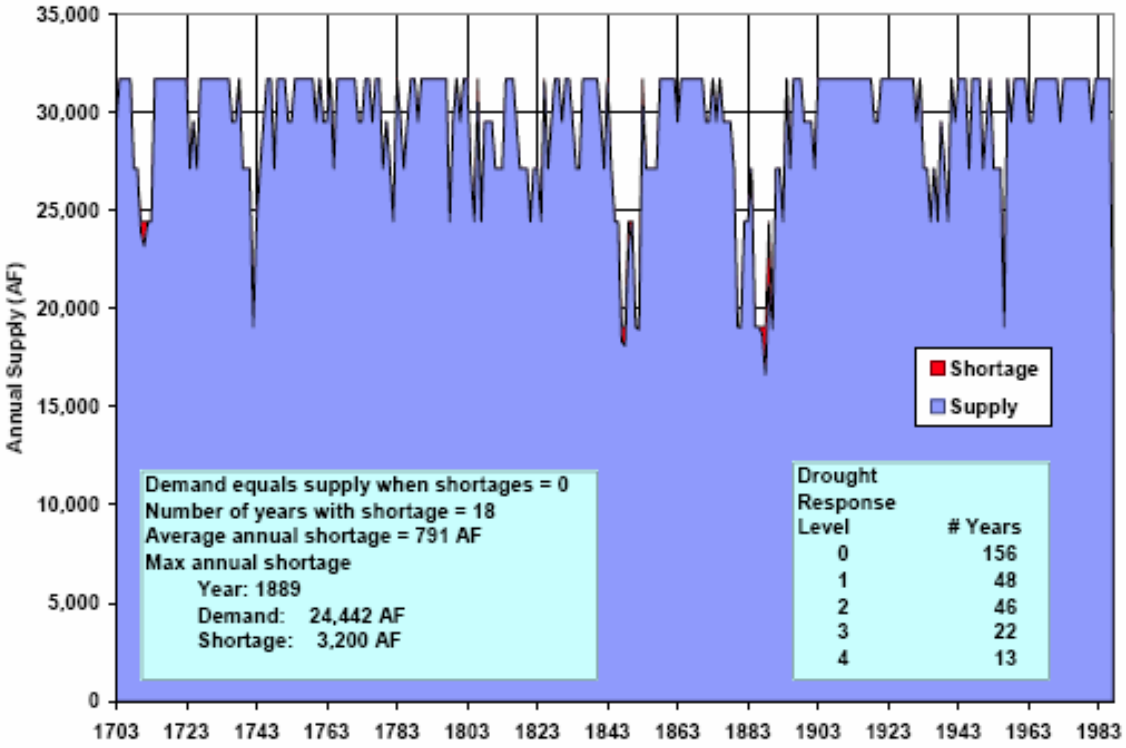


Figure 5. Demands & Supplies: 15% Reduced Flow Hydrology, Current Trends Scenario (demand = 31,700 AF/year).

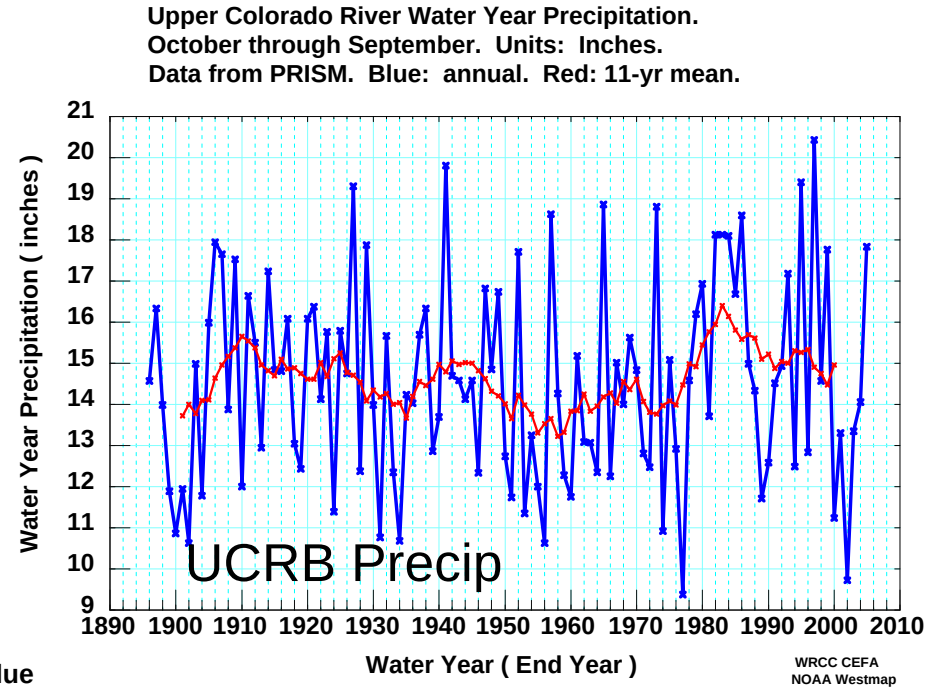
Applications of paleodata to water resource management in the face of a changing climate

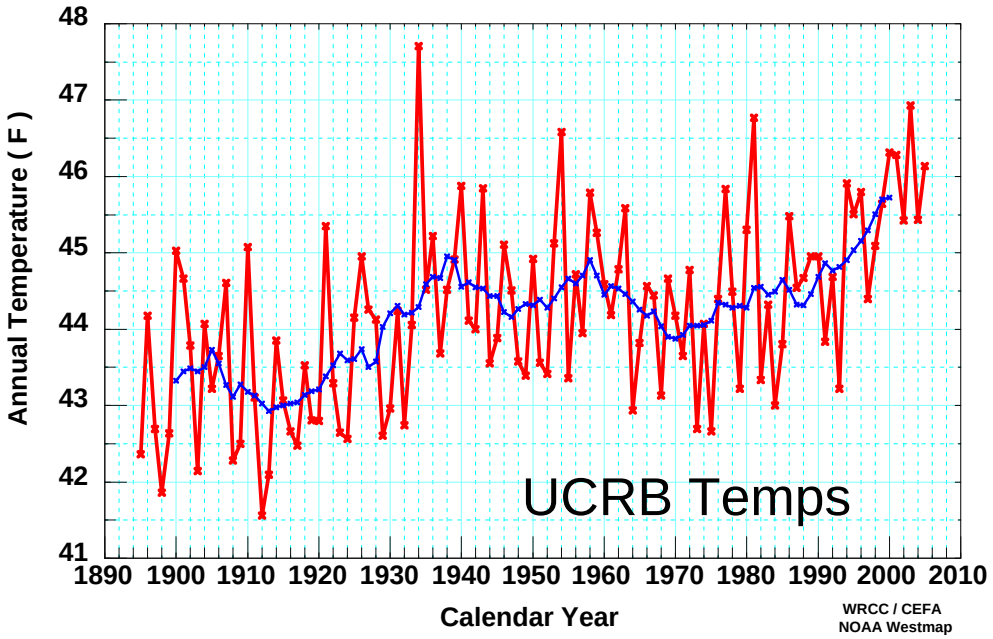
Challenges:

- integrating tree-ring data with climate change scenarios to provide enhanced guidance about future hydrology

- gleaning information about decadal/ multidecadal variabilibility that might allow some predcitive capacity

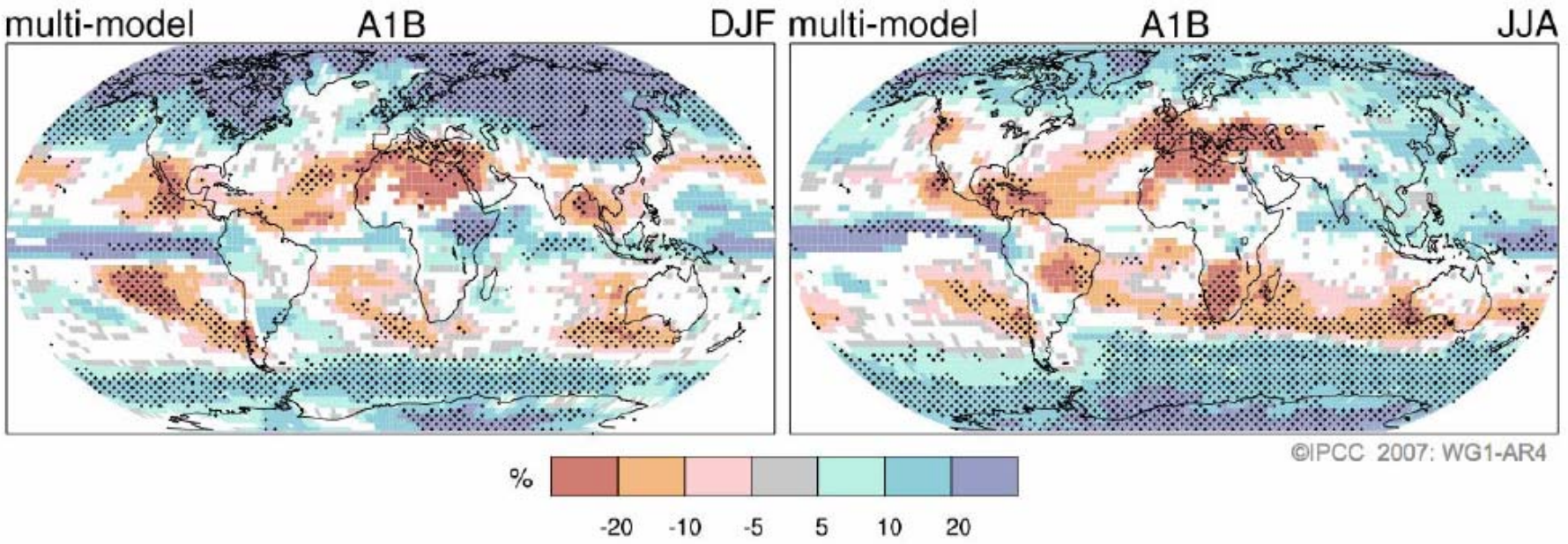
How relevant is the past to current and future conditions?

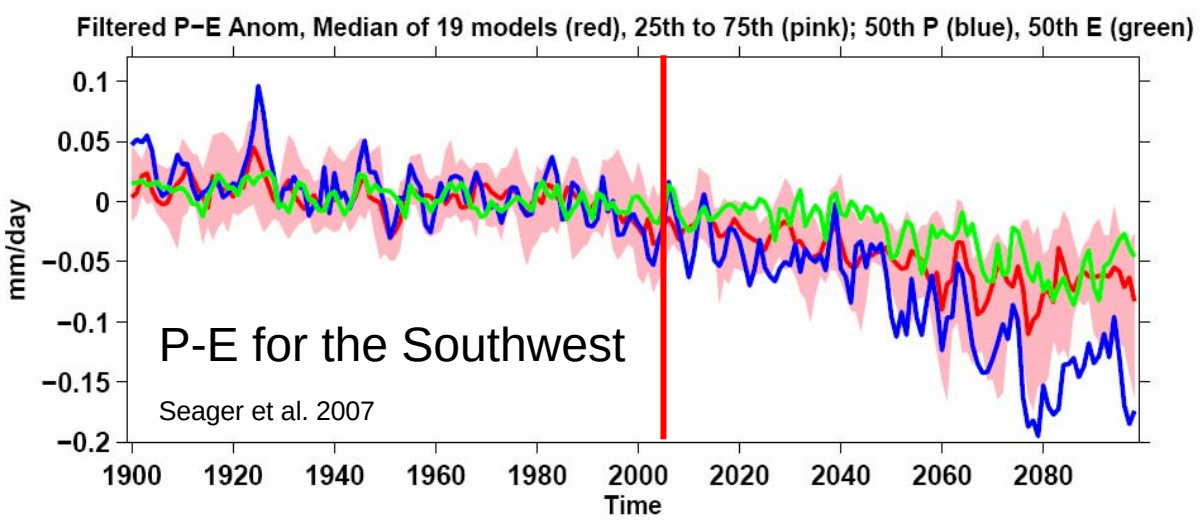


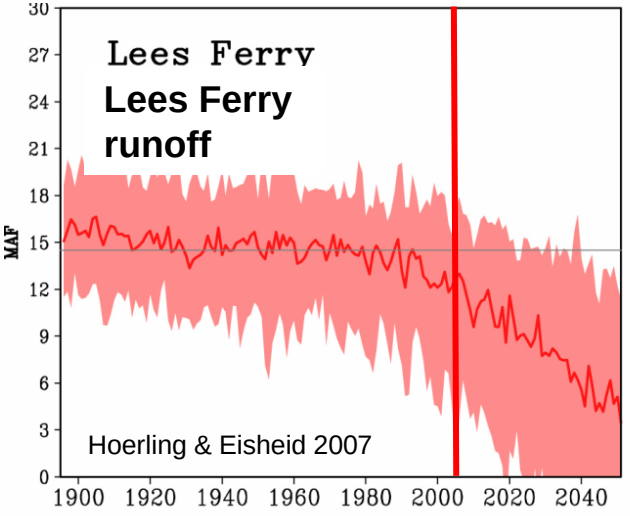


Annual temperatures have risen over the past 110 years, but clear trends in precipitation are not evident

Projected Patterns of Precipitation Changes







How relevant is the past to planning for climate in the future?

- The climate of the past is unlikely to be replicated in the future
- Although projections for temperatures appear to be robust, future scenarios of precipitation do not yet provide useful information for planning and water management
- Centuries-long paleoclimatic records provide a broader range of variability from which to assess the characteristics in the instrumental records
- The variability in the paleohydrologic records may be a useful analogue for future variability, used perhaps in combination with increased temperatures
- These long records are needed to assess and understand multidecadal scale variability and its causes

Next….. From the experts!

- KC Hallett, Stratus Consulting
- Lee Rozaklis, Hydrosphere Resource Consultants
- Steve Schmitzer, Denver Water
- Jim Prairie, USBR
- Charlie Ester, Salt River Project
- Doug Toy, City of Chandler
- Ben Harding, Hydrosphere
- Connie Woodhouse (presenting Manu Lall’s work)