Planning For Climate Change

The Joint Front Range Climate Change Vulnerability Study

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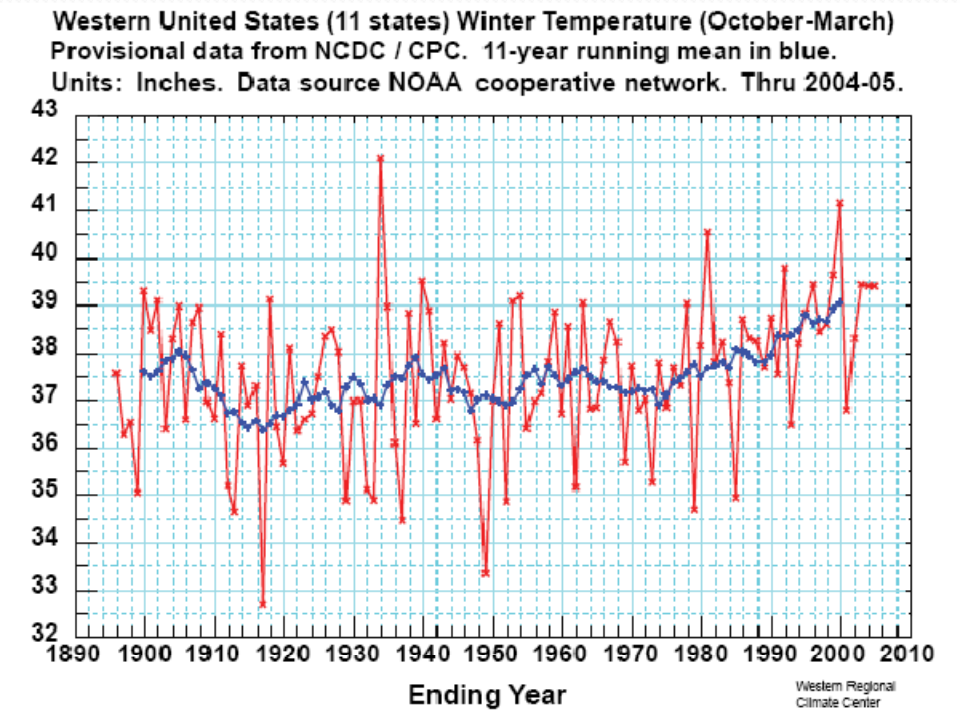
Why Consider this issue?

- Hydrologic System is Dynamic
  - Key Player in Climate
- 2002 Drought
  - Possibly enhanced by CC
  - Natural Variability
- Observations: Warming
- Projections: Warming
- Goal
  - Supply Water



Regional Projections

Temperature

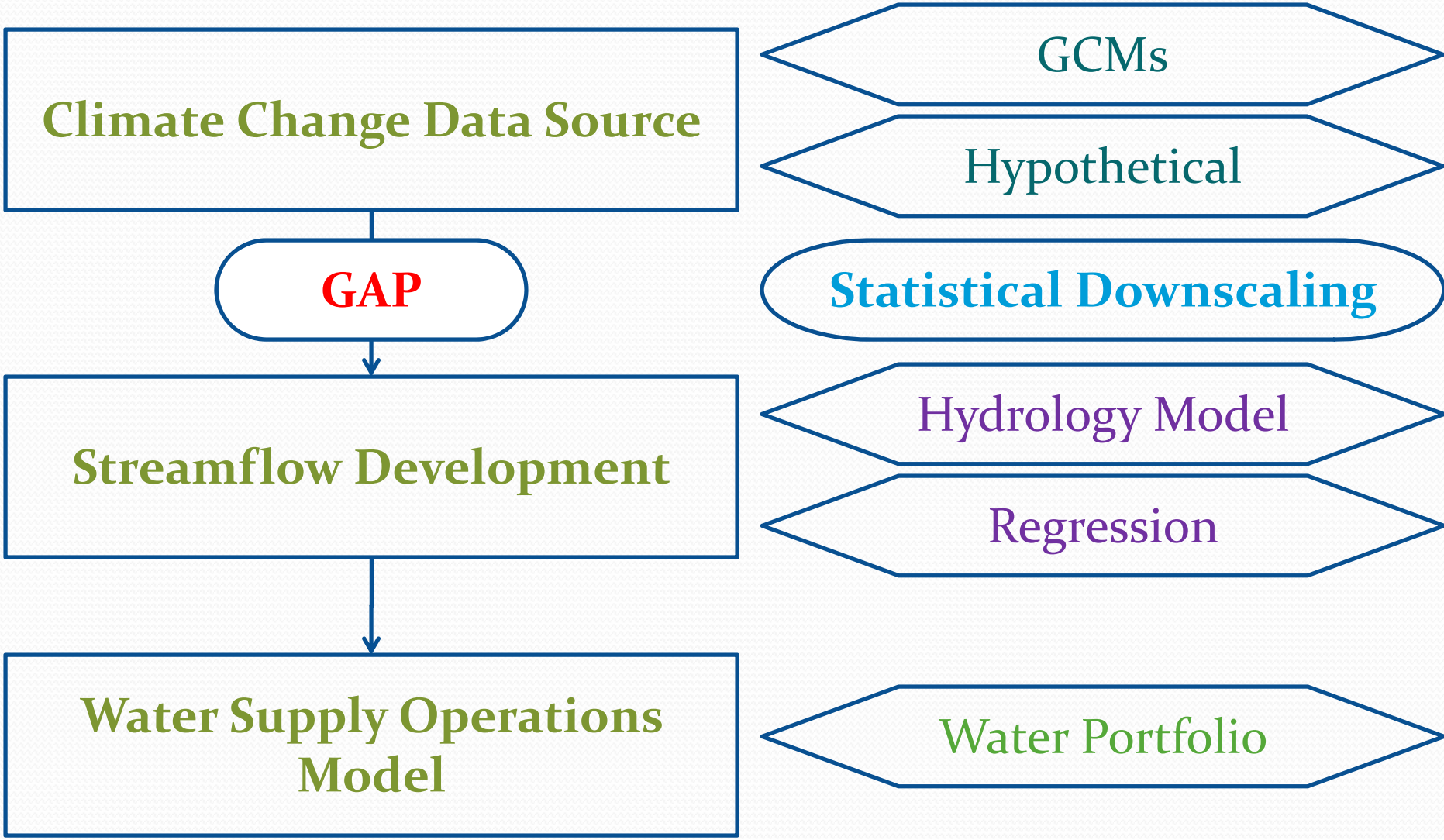
Precipitation

- Snowpack
- Run-Off
- Extreme Conditions
- Evaporation
- Soil Moisture
- Wildfire
- Erosion
- Sedimentation
- Water Quality

Dilemmas

- Which projection(s) should be used?
- Available data differs from most user needs.
- Data is not user friendly
- How do you incorporate uncertainties?
- How do you make a long range plan that will work for a variety of futures?

Common Approaches



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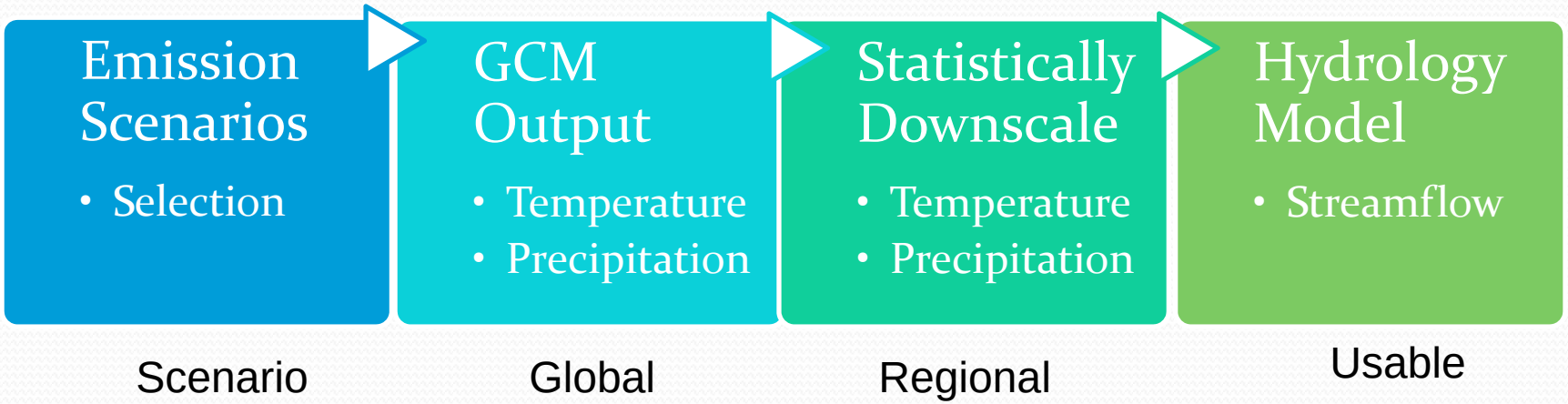
Determine streamflow sensitivity to projected changes in temperature and precipitation



Participants

6 Water Providers

- Aurora Water
- City of Boulder
- Colorado Springs Utilities
- Denver Water
- City of Fort Collins
- Northern Water

3 Water Agencies

- Colorado Water Conservation Board
- Water Research Foundation (formerly AwwaRF)
- Western Water Assessment

Regional Approach

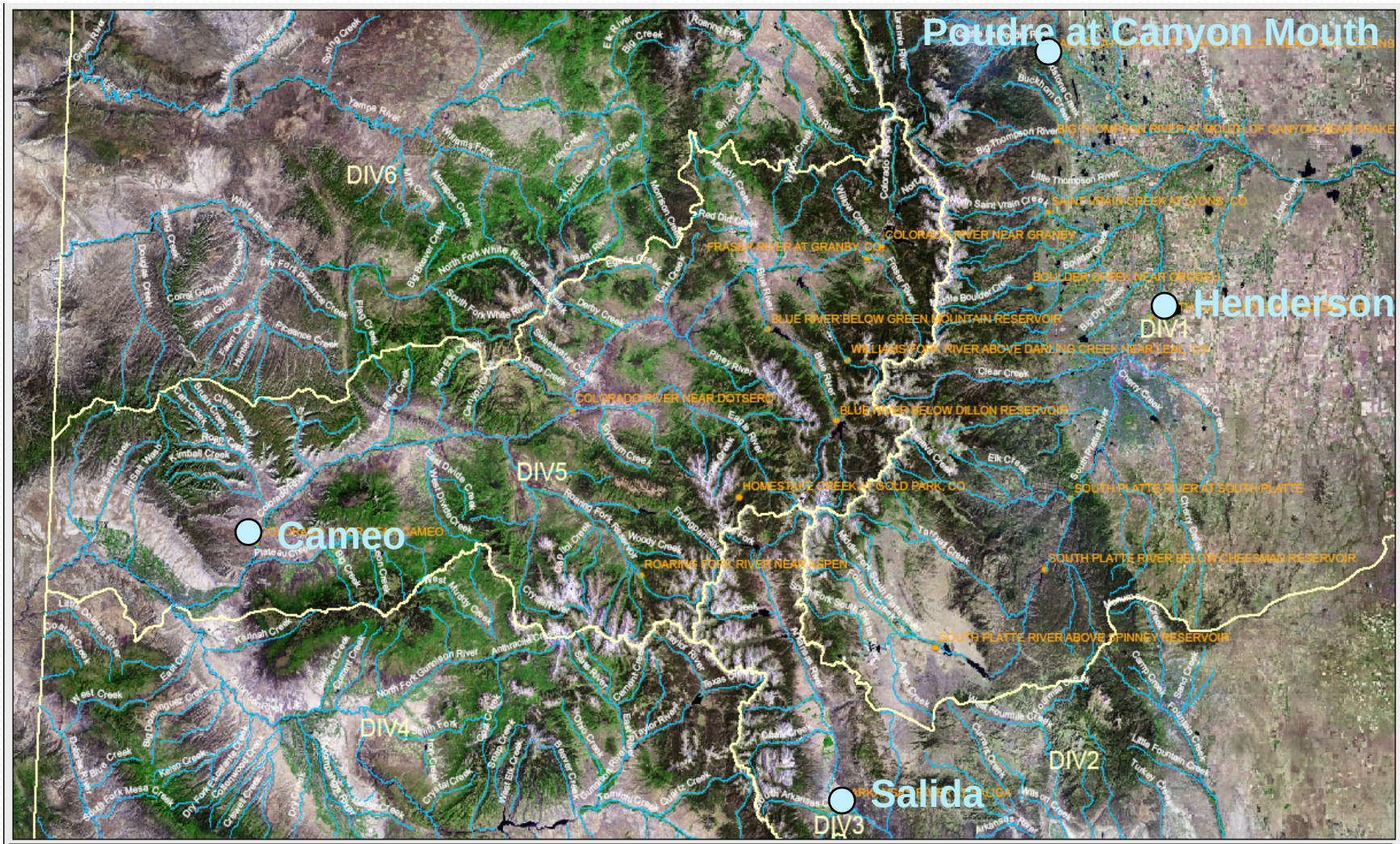
Why?

- Projections are coarse in scale
- Agencies pull water from the same watersheds
  - We can share models
  - We can share expenses

Benefits:

- Start with the same projections
- Communicate with the public and media
- Pool Resources
- Coordinate with the CRWAS

Model Development: 18 Gauges



Hydrology Models

- Goal: Bridge the gap between projections and water supply
- Develop Two Models
  - Water Evaluation and Planning (WEAP) Model
    - Dr. David Yates and Team
  - Linked Sacramento Soil Moisture and Snow-17 Model
    - Mark Woodbury and Riverside Technology, inc. Team
- Why Two?
  - Compare the results
  - Understand the system and results better
  - May use for other purposes – operations
  - Already calibrated for a significant portion of our watersheds

General Methodology

Emission Scenario

- A2 – High Growth
- A1B – Moderate Growth
- B1 – Low Growth

16 GCMs

- Single and multiple runs per model with the above scenarios
- **112** different projections for each global grid

Down-scale

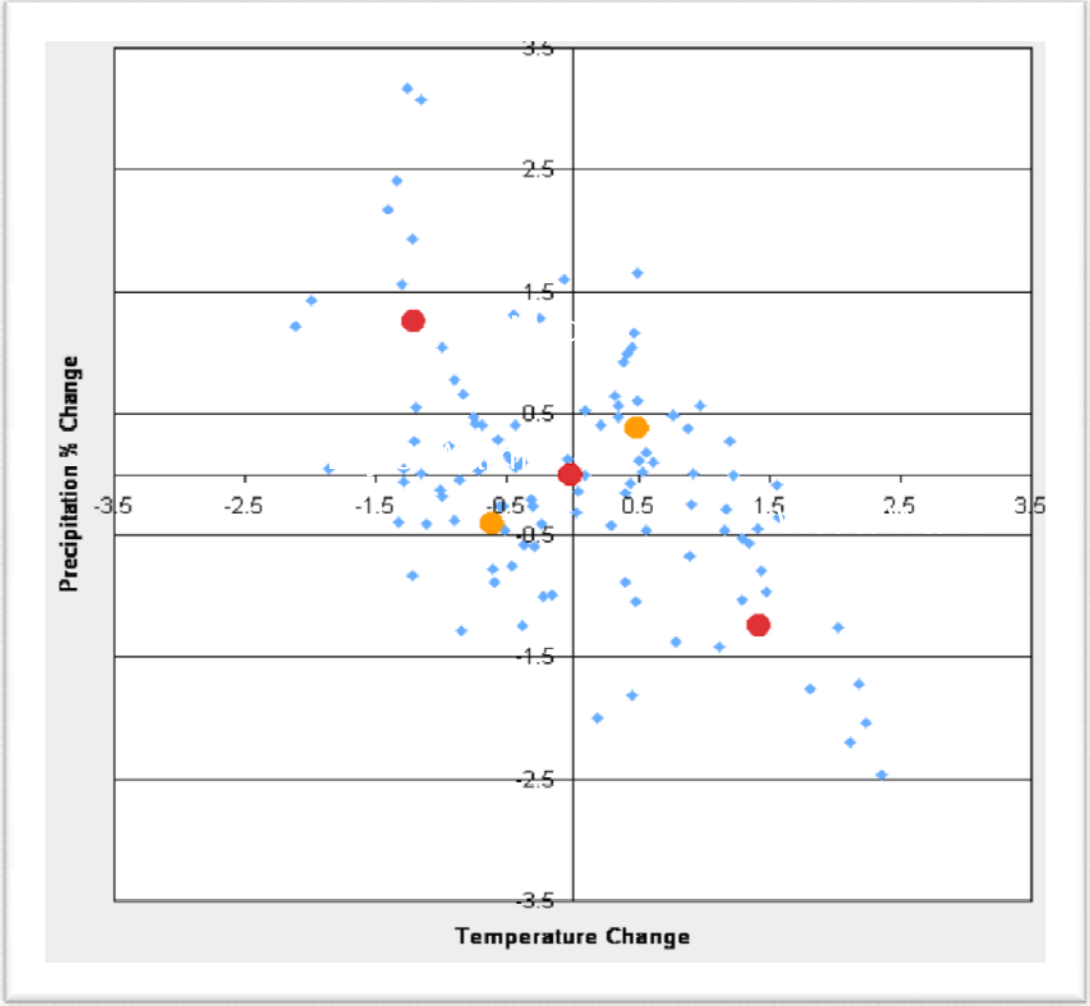
- Select a set of Temperature (T) and Precipitation (P) projections
- Apply those offsets to monthly patterns of predetermined hydrologic areas

Hydro Models

- Model natural (virgin) historic streamflow
- Apply T and P offsets to produce new streamflow sequences

Scenarios: 2040 and 2070

- Constant T or P offsets
  - Increase of 1º C
  - Increase of 4º C
  - Increase of 7.5%
  - Decrease of 3%
- T and P Scenarios
  - warm and wet
  - warm and dry
  - middle
  - very warm and wet
  - very warm and dry



112 Normalized Runs for 2070

Analysis and Results

- Comparison of Model Output:

  Historic natural streamflow

  vs.

  Adjusted streamflow

- Apply the difference to the actual historic streamflow
- Application to Water Allocation Models:
  - Directly input the new streamflow data
  - Apply Factors

Next Steps

- Apply the results to each water portfolio
- Compare and analyze results
- Further develop the hydrology models
- Pursue other options
  - What other mechanisms are there?
- Continue our education

In Summary…

- Science will only take us so far
- Collaboration maximizes our resources
- Consider how you can use this information
  - Apply factors
  - Repeat the investigation
  - Other?

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The Joint Front Range Climate Change Vulnerability Study:
Closing the Gap between Science and Water Management Decisions

There is increasing concern among metropolitan water providers in Colorado's Front Range about the possible impacts of global and regional climate changes on their future water supply. This is of particular worry given that recent studies indicate global warming may lead to unprecedented drought conditions in the Southwest U.S. (IPCC 2007). The City of Aurora, City of Boulder, Colorado Springs Utilities, Denver Water, City of Ft. Collins, and Northern Colorado Water Conservancy District, along with additional water agencies including the Colorado Water Conservation Board, the Water Research Foundation (formerly AwwaRF), and the NOAA-CIRES Western Water Assessment, have come together to participate in a study intended to provide the education, tools, and methodology necessary to examine possible effects of climate change on several common watersheds.

The central objective of this project is to assess possible changes in the timing and volume of hydrologic runoff from selected climate change scenarios centered about the years 2040 and 2070. Two hydrologic models will be calibrated and implemented in the study for this purpose. The future temperature and precipitation scenarios used to generate corresponding future streamflow are based on regionally downscaled temperature and precipitation projections. The projected streamflow obtained by running varied sequences of temperature and precipitation through the hydrologic models will be compared to modeled historic streamflow to estimate the sensitivity of water supplies to climate change.

This regionally unified approach is intended to help Colorado water providers communicate with their customers and the media cohesively, by working with the same historic and projected hydrometeorological data, historic natural streamflow, and methodology. Lessons learned from this collaborative approach can be used to encourage and establish other regional efforts throughout the state. Furthermore, this study will set the stage for future advances in procedures and technologies that may further close the gap between science and decision making.

Bio for CO Governors Conference 10/08

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Laurna Kaatz is the climate scientist for the Planning Division at Denver Water. Her primary responsibility is to coordinate climate investigations and implement the findings into the planning process. Laurna's work incorporates many areas of water resource planning, including climate and drought planning, operational and water rights analysis, and long range integrated resource planning. Before her career at Denver Water, Laurna was a Professor of Physics at Sweet Briar College, and then went on to work as a climate science researcher with Aurora Water. Laurna has a Master's degree in physics and a Bachelor's in physics and mathematics. She is a Colorado native and enjoys all the outdoor activities it has to offer.