

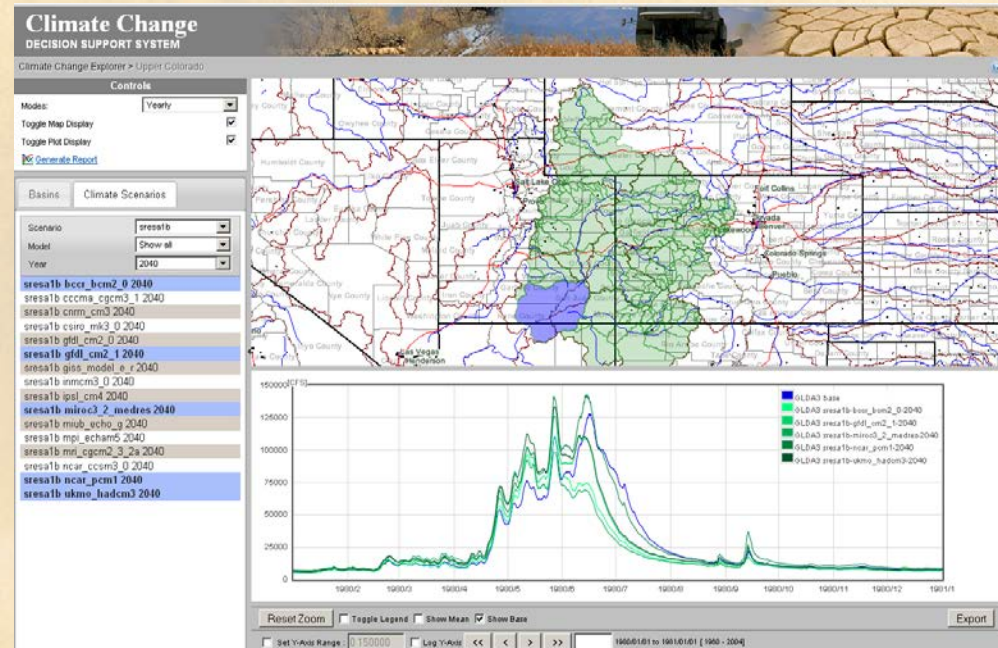


Use of RiverWare for Climate Change Scenarios

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Marc Baldo
James Van Shaar**

Climate Change Decision Support System

- A web-based decision support system to demonstrate the effect of climate change on water availability
- Water Managers need cost-effective tools to explore future climate scenarios and test adaptation alternatives



How the System Works

- The user selects from which scenarios to investigate.

GCM Model Name

Step 1.2: Emissions Scenarios, Climate Models and Runs

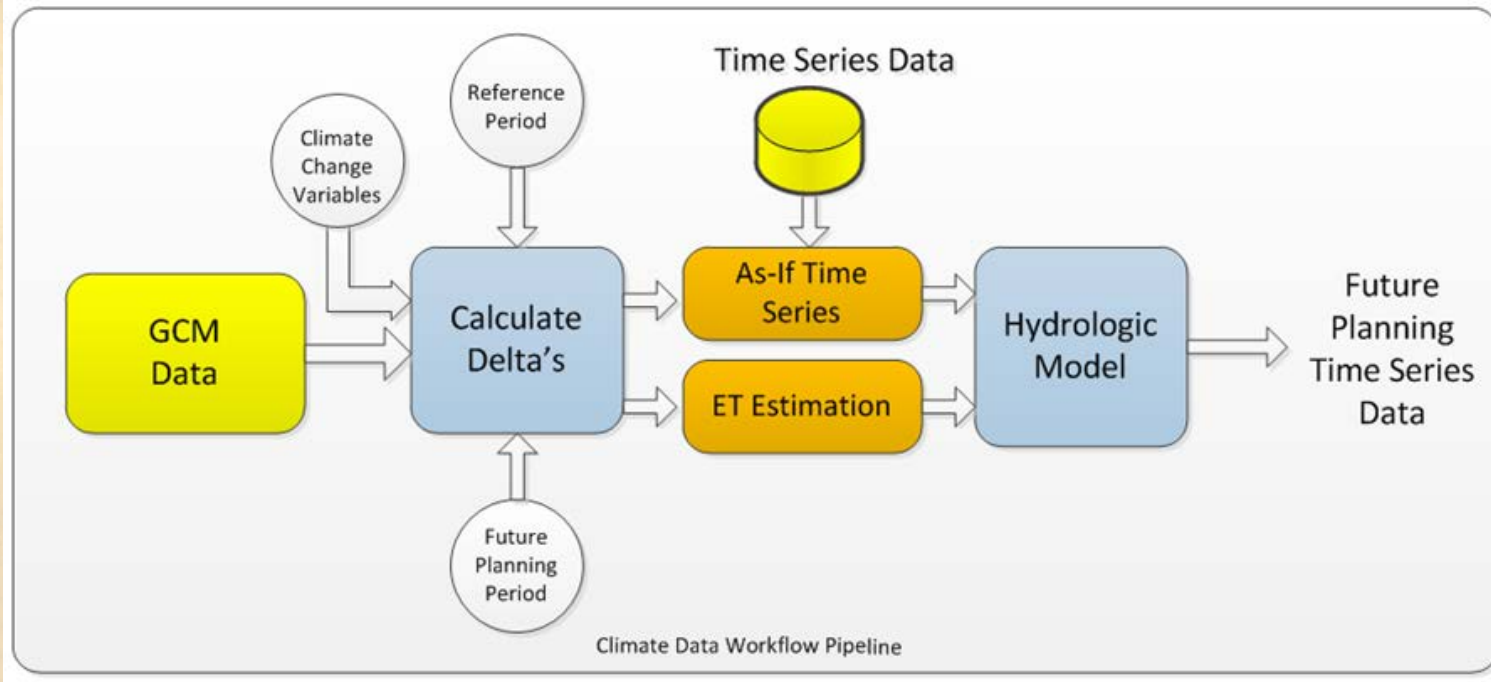
Scenario A1B, A2, B1)

Runs – At least one run per GCM / Scenario

	None	None	None
De-select all runs	None	None	None
Select all runs	All	All	All
Climate Models:	Emissions Path: A1b	Emissions Path: A2	Emissions Path: B1
bccr_bcm2_0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
cccma_cgcm3_1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
cnrm_cm3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
csiro_mk3_0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
gfdl_cm2_0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
gfdl_cm2_1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
giss_model_e_r	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

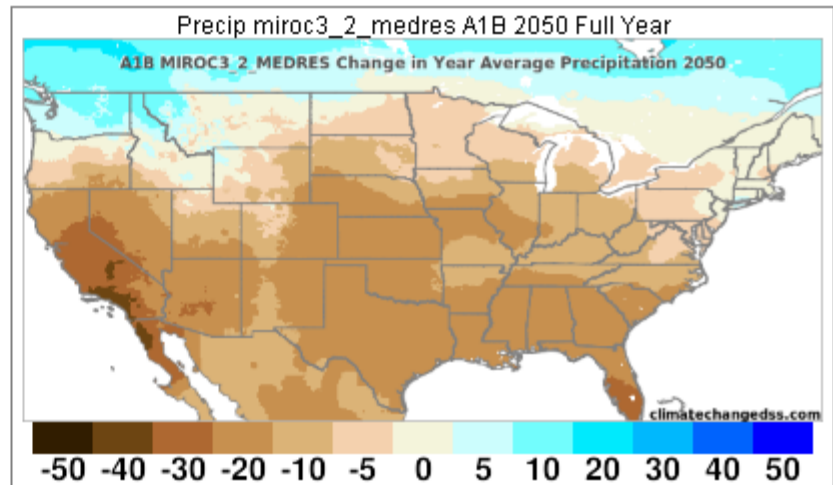
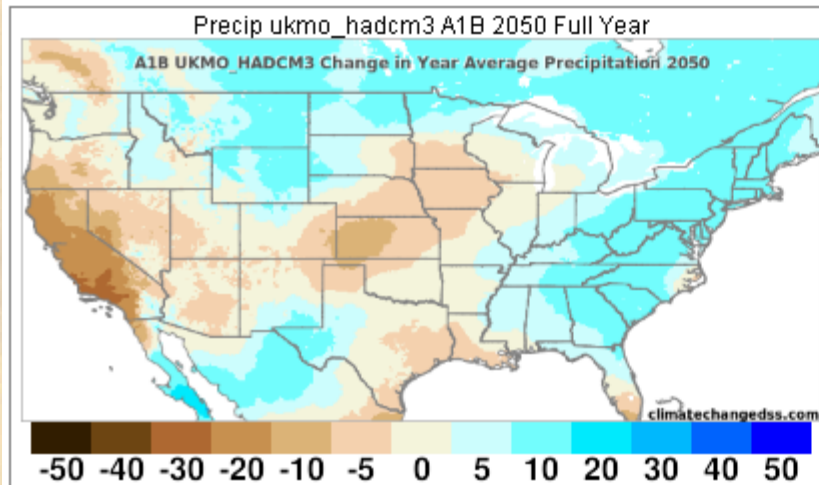
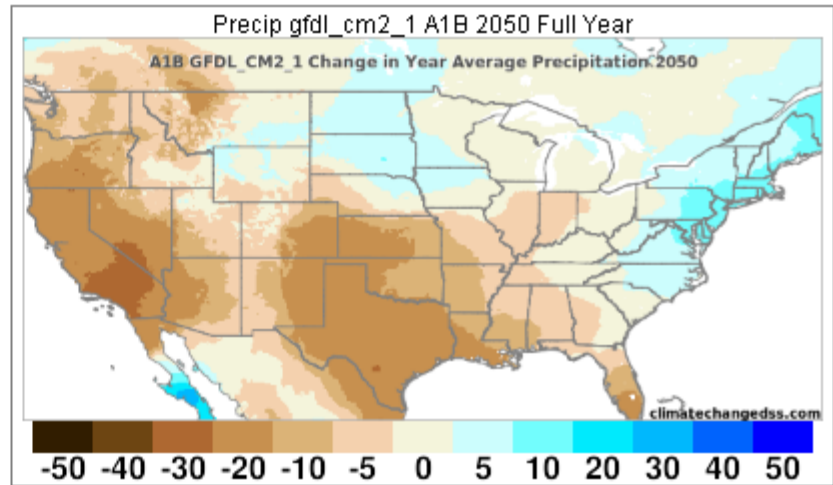
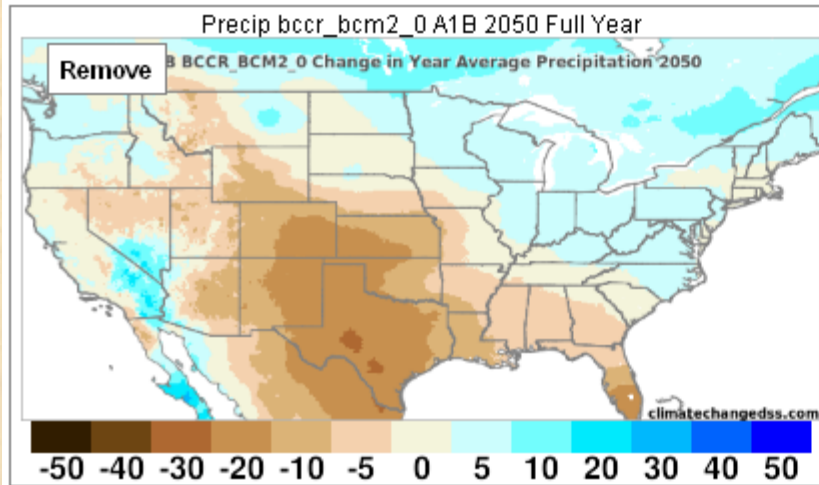
- A scenario is defined by GCM results reflecting emissions conditions.
- The downscaled GCM data for future conditions are compared with historical conditions to calculate a shift (delta) in temperature and precipitation conditions.

How the System Works



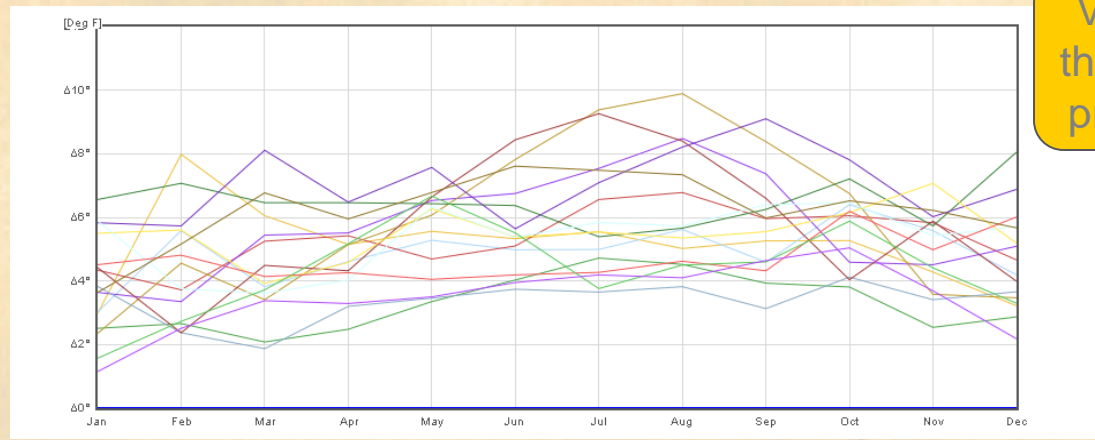
- Historical time series data is shifted using monthly temperature and precipitation deltas
- Potential ET is adjusted using monthly temperature deltas

Data Display: Projected Δ Precip. for 4 GCMs



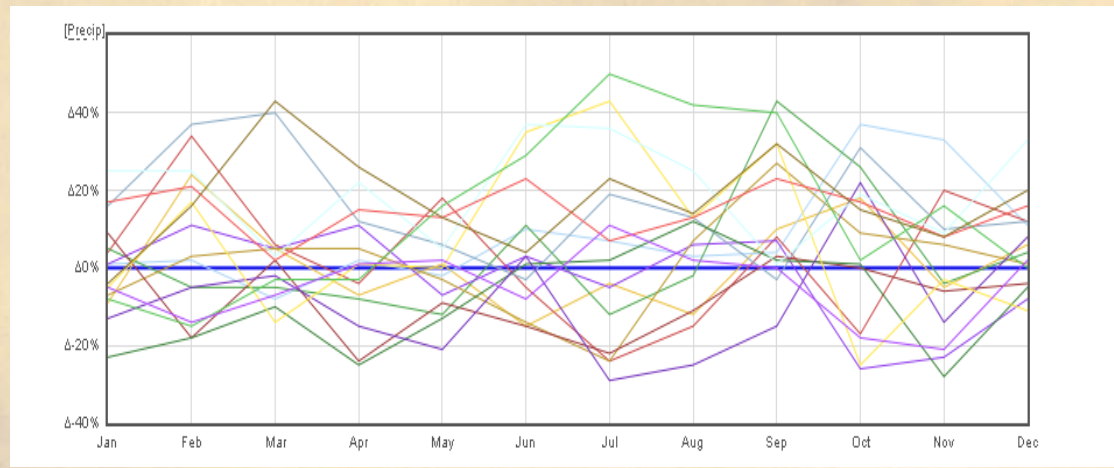
Data Display: Monthly Variability in Δs

Temperature



Visualization to analyze the variability in the GCM projections by sub-basin

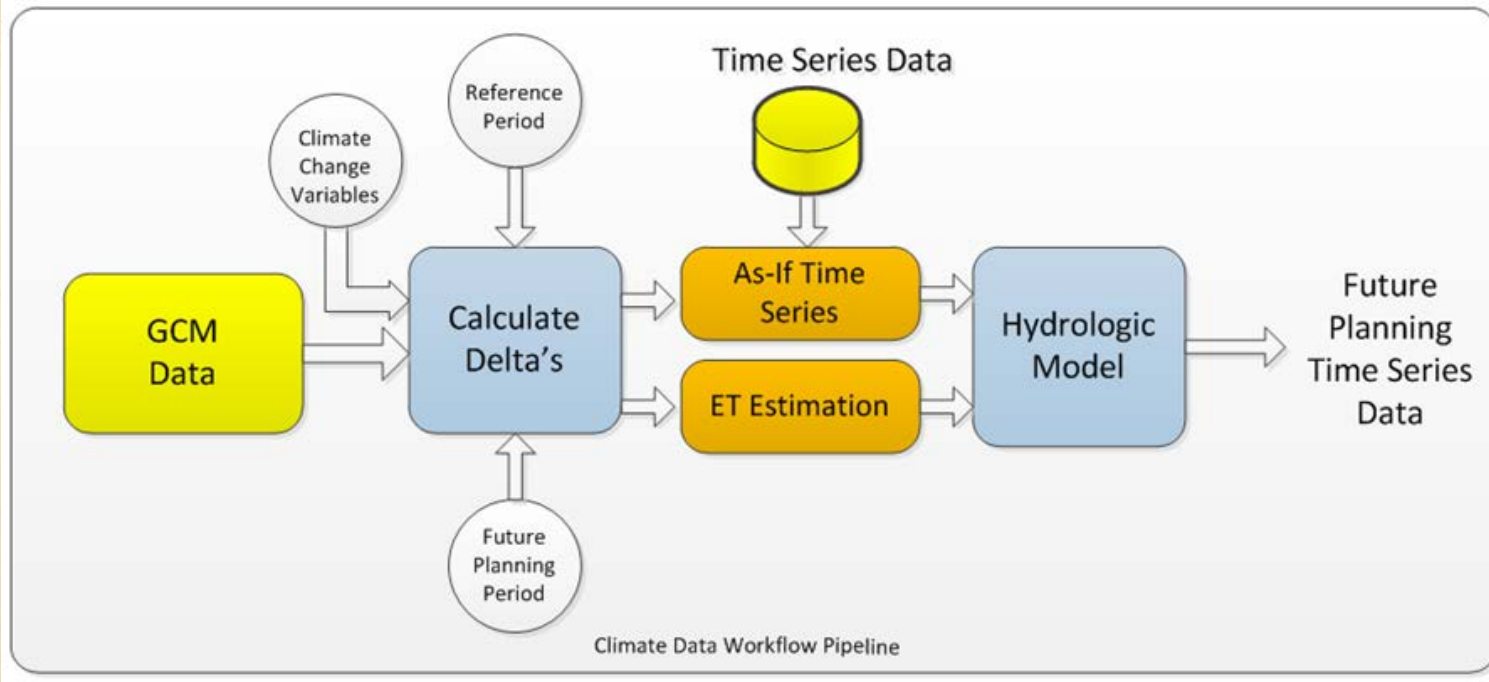
Precipitation



- CMMG1 sresa1b-bccr_bcm2_0-2070
- CMMG1 sresa1b-ccma_cgcm3_1-2070
- CMMG1 sresa1b-cnrm_cm3-2070
- CMMG1 sresa1b-csiro_mk3_0-2070
- CMMG1 sresa1b-gfdl_cm2_0-2070
- CMMG1 sresa1b-gfdl_cm2_1-2070
- CMMG1 sresa1b-giss_model_e_r-2070
- CMMG1 sresa1b-inmcm3_0-2070
- CMMG1 sresa1b-ipsl_cm4-2070
- CMMG1 sresa1b-miroc3_2_medres-2070
- CMMG1 sresa1b-miub_echo_g-2070
- CMMG1 sresa1b-mpi_echam5-2070
- CMMG1 sresa1b-mri_cgcm2_3_2a-2070
- CMMG1 sresa1b-ncar_ccsm3_0-2070
- CMMG1 sresa1b-ncar_pcm1-2070
- CMMG1 sresa1b-ukmo_hadcm3-2070

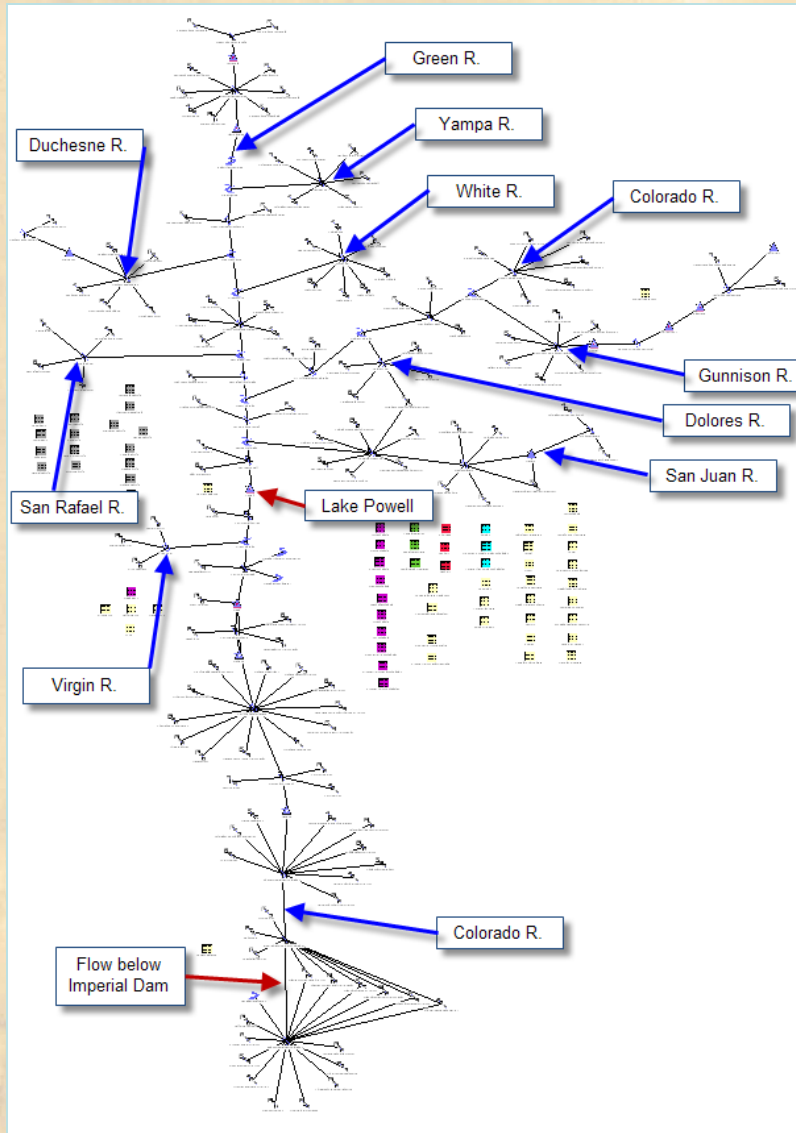


How the System Works



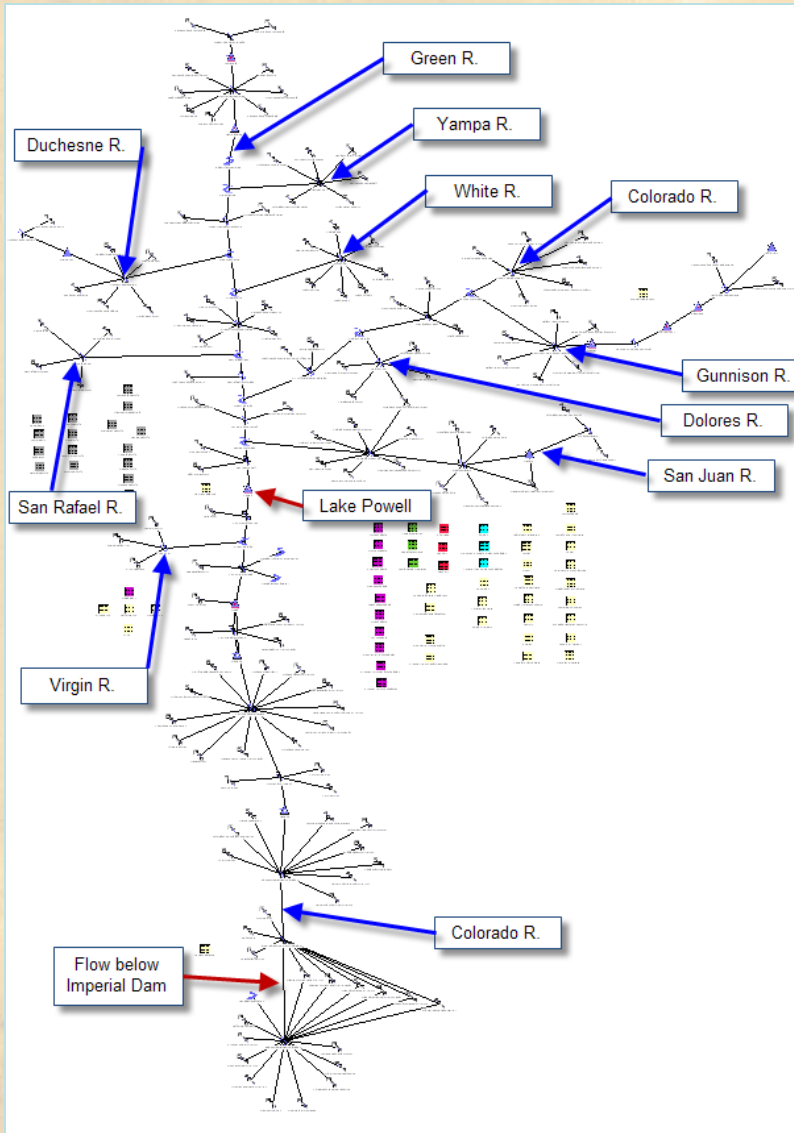
- These time series drive existing NWS watershed-scale hydrologic models.
- Models directly relate altered temperature and precipitation regimes to changes in snowpack, soil moisture, and streamflow.

Regulation Modeling



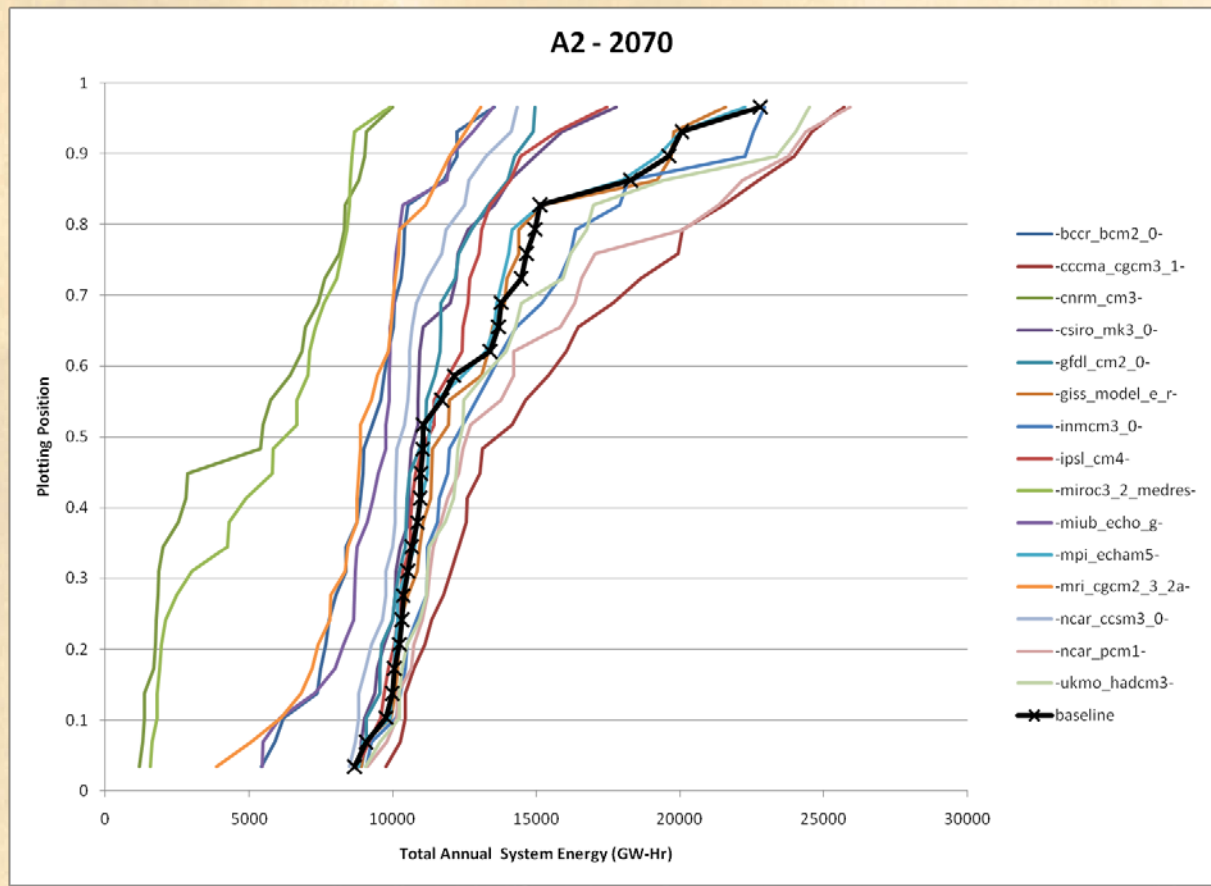
- Hydrologic results are applied to an existing regulation model.
- Results are analyzed.

CRSS Integration



- DMIs
- Data:
 - Extension of Elevation Volume / Area Tables
 - Extension of Stage Flow Tailwater Table
 - Tailwater Table
- RiverWare Control Language
- TSTool and Python

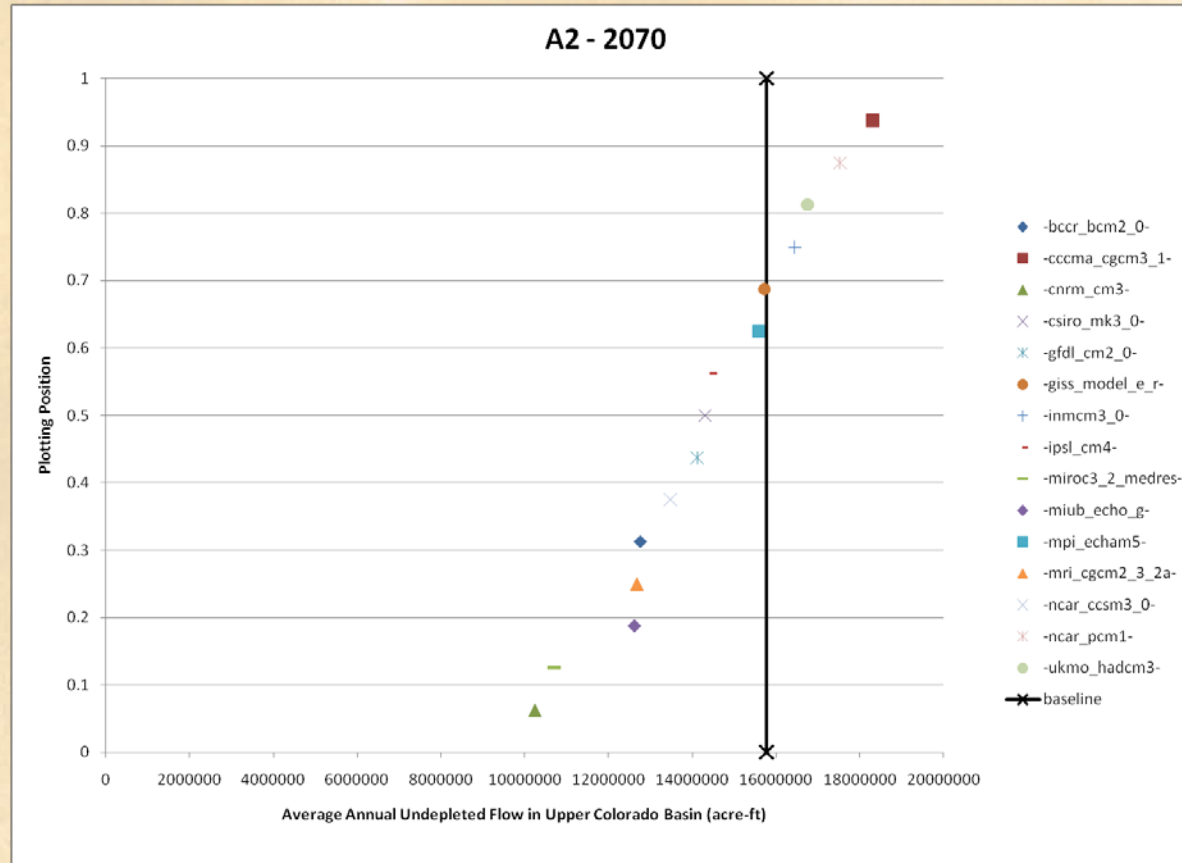
Sample Results



Scenario A2 – 2070 Total Annual System Energy



Sample Results



Scenario A2 – 2070 Average Annual Undepleted Flow in the Upper Colorado Basin

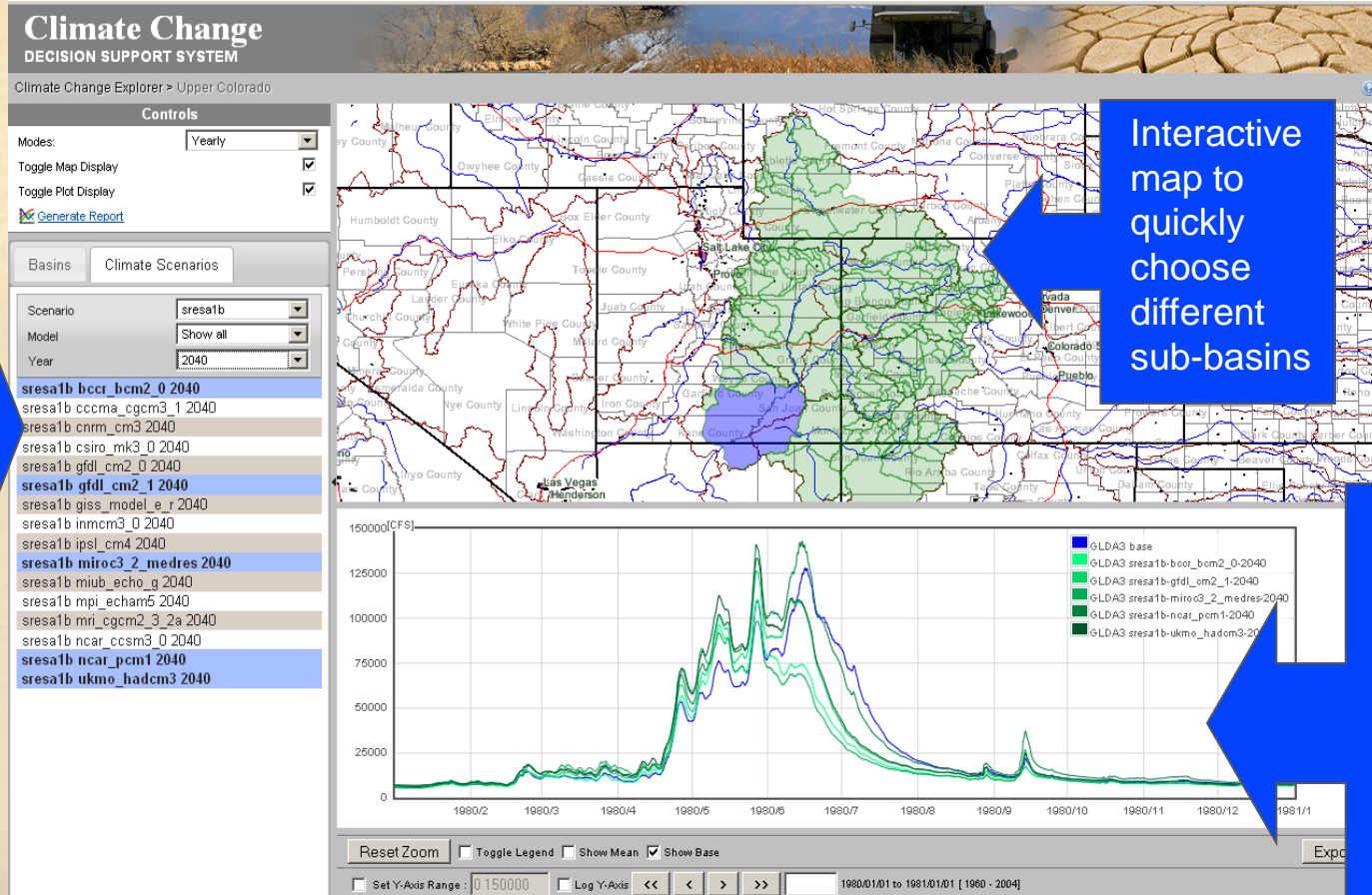
Sample Results

	Ratio: Scenario/Baseline					
	System Inflow	Powell Q	Imperial Q	System Storage	System Evap	System Energy
a2.....2040						
-bccr_bcm2_0-	0.79	0.76	0.65	0.50	0.67	0.59
-ccma_cgcm3_1-	1.13	1.19	1.70	1.11	1.12	1.17
-cnrm_cm3-	0.79	0.76	0.65	0.51	0.68	0.60
-csiro_mk3_0-	1.04	1.06	1.21	1.04	1.05	1.06
-gfdl_cm2_0-	0.93	0.91	0.77	0.92	0.91	0.90
-giss_model_e_r-	1.08	1.12	1.47	1.07	1.09	1.12
-inmcm3_0-	1.12	1.18	1.64	1.11	1.12	1.17
-ipsl_cm4-	1.04	1.06	1.20	1.06	1.02	1.07
-miroc3_2_medres-	0.80	0.77	0.66	0.54	0.69	0.64
-miub_echo_g-	0.82	0.80	0.67	0.62	0.75	0.70
-mpi_echam5-	1.00	1.00	1.00	1.00	0.99	1.00
-mri_cgcm2_3_2a-	0.86	0.82	0.68	0.71	0.81	0.77
-ncar_ccsm3_0-	0.81	0.79	0.67	0.59	0.73	0.67
-ncar_pcm1-	1.12	1.17	1.67	1.09	1.12	1.16
-ukmo_hadcm3-	1.01	1.02	1.05	1.03	1.00	1.01
AVG	0.955	0.960	1.046	0.860	0.915	0.911

Comparison of Results for Scenario a2 – 2040 with Baseline



Web-Based Climate Change DSS



Menu to choose climate models, emission scenarios and time period

Hydrograph depicts climate adjusted streamflow for each GCM run in the chosen sub-basin

Status of Basin Implementation



Climate Change
DECISION SUPPORT SYSTEM

home | **using the system** | system science | account logout

Background

The Climate Change Decision Support System is a project conceived by Riverside Technology, inc. and funded by a Small Business Innovation Research (SBIR) Program award through the National Oceanic and Atmospheric Administration (NOAA). The purpose of this system is to provide a tool that allows users to analyze climate change impacts on their localized area. Similar interactive tools are not available to organizations across the country because of the complexity and cost. This project uses current web-based technology and available global circulation and hydrologic models to create a simple yet complete tool for water managers.

Implemented Basins



The Basic Viewer: With pre-selected combinations of models and plots, the Basic Viewer allows you to quickly generate graphical views for a sub-basin.

The Full Viewer: For more flexibility in configuring what models and emission scenarios to run, use the Full Viewer mode.

[Basic Viewer](#) [Full Viewer](#)

Sample Outputs

Select a sample output to view from the list below:

- [Average Annual Flow Volume Bar Chart \(Dry, Average, and Wet Year Comparison\)](#)
- [Average Monthly Volume Line Plot \(Time Period Comparison\)](#)
- [Annual Flow Volume Bar Chart](#)
- [Cumulative Distribution of Average Annual Flow Volume](#)
- [Average Monthly Flow Volume Box And Whisker Plot](#)
- [Average Annual Flow Volume Box and Whisker Plot \(Emission Scenario Comparison\)](#)
- [Average Monthly Volume Line Plot \(GCM Comparison\)](#)
- [Annual Flow Volume Box and Whisker Plot \(Time Period Comparison\)](#)
- [Cumulative Distribution of Runoff Centroid \(Timing Comparison\)](#)

www.ClimateChangeDSS.com

- Acknowledgements:

- Program for Climate Model Diagnosis and Intercomparison (PCMDI) and the WCRP's Working Group on Coupled Modeling (WGCM)
- Bureau of Reclamation: Jim Prairie, Carly Jerla
- Colorado Basin River Forecast Center (CBRFC)

- References:

- Bureau of Reclamation, 2007. Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead, Final Environmental Impact Statement, 2007. Available at <http://www.usbr.gov/lc/region/programs/strategies/FEIS/index.html>. Accessed 7/22/2011.
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