

RECLAMATION

Managing Water in the West

Overview of Bureau of Reclamation Climate Change and Water Activities

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Climate Change Adaptation Workgroup of the
Advisory Committee on Water Information, March 7, 2013



U.S. Department of the Interior
Bureau of Reclamation

Reclamation Mission

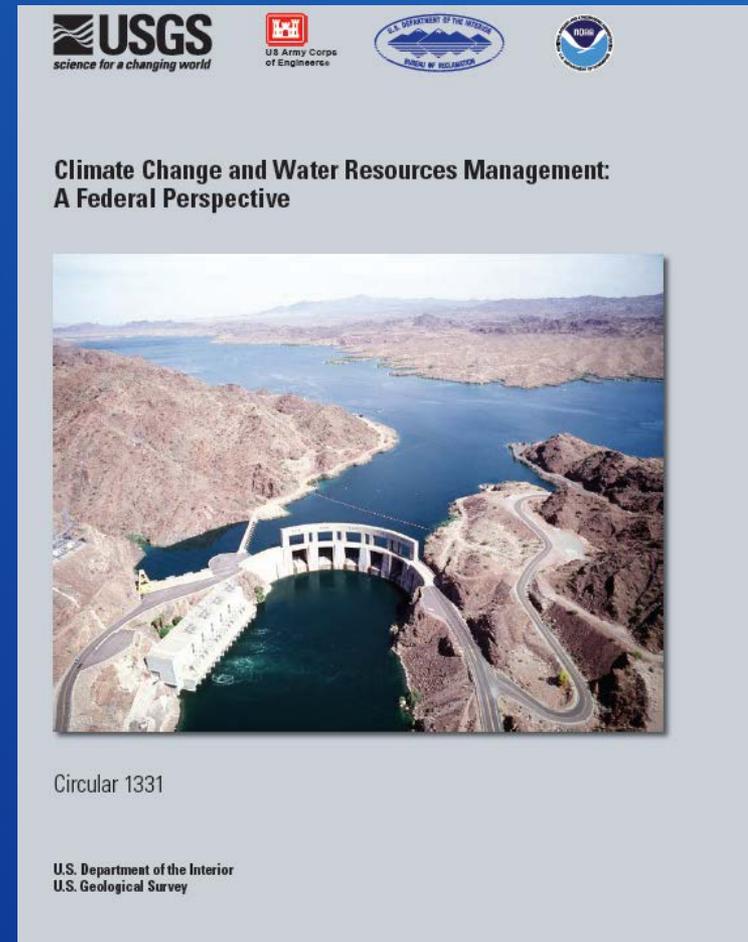
The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.



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Early Framing

- From USGS Circular 1331 (Brekke et al. 2009)
- **Climate change** is occurring, although the effects differ regionally.
- All sectors of water resources management could be affected; hydroclimate conditions becoming **non-stationary**.
- Climate change is but **one of many challenges** facing water resource managers.





WaterSMART - Basin Study Program



- **WWCRAs**
 - Help Reclamation implement **§9503 of the Secure Water Act (SWA)**
 - Apply a **consistent approach** throughout the west to assess impacts of climate change to water supplies, demands and operational risks
 - Key baseline assessments leading towards more in-depth analyses performed through future Basin Studies
- **Basin Studies**
 - Reclamation works on a cost-shared basis with **state and local partners** to develop potential **adaptation strategies** to meet future demands in light of imbalances in supply & demand
- **SECURE Studies**
 - Support state and local partners to **determine feasibility and impacts to ecological resiliency** of adaptation strategies identified in Basin Studies
- **Desert and Southern Rockies LCCs**
 - Partnerships to **develop applied science tools** to help resource managers address landscape-scale threats.
 - Provides a forum to share information developed through the Basin Study Program and to benefit from complementary activities by other agencies

Funded Basin Studies

17 studies have been funded to date starting in 2009. *(Completed)*

2009

- *Colorado River Basin*
- *Milk/St. Mary Rivers Basin*
- *Yakima River Basin*

2010

- Niobrara River Basin
- Truckee River Basin
- Santa Ana River Basin
- Henrys Fork of Snake River
- S.E. California Regional Basin

2011

- Lower Rio Grande River Basin
- Santa Fe Basin
- Klamath River Basin
- Hood River Basin

2012

- Upper Washita River Basin
- Sacramento-San Joaquin Rivers
- Republican River Basin
- Pecos River Basin
- L.A. Basin



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Emerging Activities

- Improving upon analysis used to support the 2011 §9503 Report to Congress
 - **CMIP5**: Developing a programmatic framework to incorporate the next generation of climate projections in a practical, relevant and reliable manner
 - **Groundwater**: Develop new methodological approaches to improve analysis of climate change impacts to groundwater hydrology
 - **Demands**: Expand upon the current West wide analysis of impacts to crop ET to include other forms of demand that affects Reclamation operations
- Development of new Climate Change **Guidance**
 - Incorporated climate change information into Reclamation *planning processes*
 - Assessing impacts to *Reclamation facilities and activities* (e.g. Dam Safety, Reservoir operations, environmental compliance)

Science & Technology (S&T) Program: Research to Improve Methods/Tools

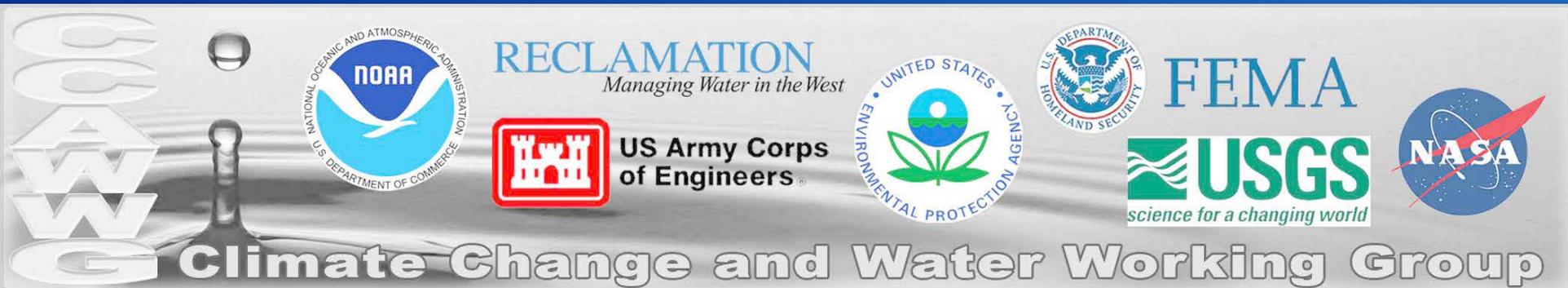
- Developing solutions for water & power management
 - Traditional areas
 - Environmental Stewardship for Water Delivery and Management
 - Water and Power Infrastructure Reliability
 - Water Operations Decision Support
 - Conserving or Expanding Water Supplies
 - Priority themes intersecting research Traditional areas:
 - **climate change and variability**
 - zebra/quagga mussels
 - advanced water treatment
 - renewable energy
 - S&T Portfolio: ~150 projects, ~8M per year
 - **recent Climate Change and Variability activity: ~1.5M/yr.**

<http://www.usbr.gov/research/climate>

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S&T Climate Change investments:

prioritized by user needs collaboratively identified by the
Climate Change and Water Working Group



<http://www.ccawwg.us/index.php/activities>

- Defining User Needs, Developing Research Strategy
- Fostering collaborative R&D
- Developing Training Resources (addresses NAP Action 21)
- Hosting Workshops on Emerging Topics (e.g., Nonstationarity, Portfolio of Assessment Approaches)

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S&T product (2007-present): Downscaled Climate Projections

http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/

- Collaboratively hosted web data-service
- Goal
 - Develop and maintain a projections-rich information resource consistently developed over contiguous U.S. that supports risk-based climate adaptation planning.
- Content
 - climate projections (monthly BCSD, daily BCCA), **CMIP3 (2007-2011), CMIP5 (2012-2013) through support from WaterSMART grant**
- Collaborators
 - Reclamation (S&T, PMO (2011-present))
 - USACE IWR
 - Santa Clara University
 - Climate Central
 - LLNL Green Data Oasis
 - Scripps Institution of Oceanography / USGS

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CLIMATE CENTRAL
Santa Clara University
SCRIPPS INSTITUTION OF OCEANOGRAPHY

Bias Corrected and Downscaled WCRP CMIP3 Climate and Hydrology Projections

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Summary

This archive contains fine spatial-resolution translations of:

- climate projections over the contiguous United States (U.S.) developed using two downscaling techniques (monthly BCSD Figure 1, and daily BCCA Figure 2), and
- hydrologic projections over the western U.S. (roughly the western U.S. Figure 3) corresponding to the monthly BCSD climate projections.

Archive content is based on global climate projections from the [World Climate Research Programme's \(WCRP's\) Coupled Model Intercomparison Project phase 3 \(CMIP3\)](#) multi-model dataset, which was referenced in the Intergovernmental Panel on Climate Change Fourth Assessment Report. Please see the "About" page for information on data development, including the methodology to perform climate model bias-correction and spatial downscaling.

Purpose

The archive is meant to provide planning analysts access to climate and hydrologic projections that are spatially downscaled to a "basin-relevant" resolution. Such access permits several types of analyses, including:

- assessment of local to regional climate projection uncertainty,
- assessment of climate change impacts on natural and social systems (e.g., watershed hydrology, ecosystems, water and energy demands),
- risk-based exploration of planning and policy responses framed by potential climate changes evident in these projections.

Archive History

November 2007: Archive additions include:

- 112 projections of monthly temperature and precipitation at 1/6d resolution over the contiguous U.S., developed using the "Bias-Correction Spatial Disaggregation" (BCSD) downscaling technique (see "About").

December 2010: Archive additions include:

- gridded meteorological observations (see "About") used to guide the BCSD application, and
- the intermediate datasets developed during BCSD application (i.e. 2d regridded global climate projections over the contiguous U.S. (2d Raw) and bias-corrected versions of these projections (2d BC)).

August 2011: Archive additions include:

- 63 projections of daily minimum temperature, maximum temperature and precipitation

Figure 1. BCSD CMIP3 Monthly Climate Analysis example - Median projected change in average-annual precipitation (cm/year), 2041-70 versus 1971-2000.

Figure 2. BCCA CMIP3 Daily Climate Analysis example - Calendar-day, ensemble-mean change in 20-year diurnal temperature range for three percentiles of diurnal range: 10th, 50th and 90th for the period pairs shown.

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S&T & WaterSMART collaboration: WWCRA hydrology projections (2011)

112 Transient Climate Projections...

http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/dcpInterface.html

Bias Corrected and Downscaled WWCRA CMIP3 Climate Projections

This site has been submitted for Journal of Geophysical Research (JGR) 116: F11 and F12, and F13, and F14, and F15, and F16, and F17, and F18, and F19, and F20, and F21, and F22, and F23, and F24, and F25, and F26, and F27, and F28, and F29, and F30, and F31, and F32, and F33, and F34, and F35, and F36, and F37, and F38, and F39, and F40, and F41, and F42, and F43, and F44, and F45, and F46, and F47, and F48, and F49, and F50, and F51, and F52, and F53, and F54, and F55, and F56, and F57, and F58, and F59, and F60, and F61, and F62, and F63, and F64, and F65, and F66, and F67, and F68, and F69, and F70, and F71, and F72, and F73, and F74, and F75, and F76, and F77, and F78, and F79, and F80, and F81, and F82, and F83, and F84, and F85, and F86, and F87, and F88, and F89, and F90, and F91, and F92, and F93, and F94, and F95, and F96, and F97, and F98, and F99, and F100, and F101, and F102, and F103, and F104, and F105, and F106, and F107, and F108, and F109, and F110, and F111, and F112.

112 Transient Hydrologic Projections covering western U.S....



Data-service, Reclamation and broader public use (Summer 2011)

SECURE Report to Congress, 2011 focus on median changes; future reports have broader scope

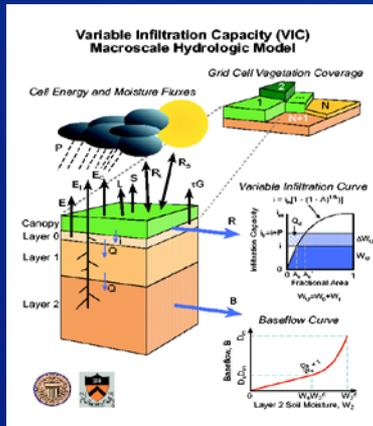
Analyses of Period-changes in climate and hydrology

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SECURE Water Act Section 9503(c) – Reclamation Climate Change and Water 2011 DRAFT



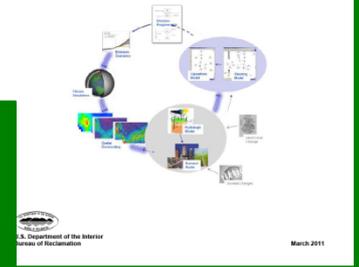
8 "big basin" VIC hydrology model-apps from Univ. of WA...



Technical Report, data-development (TSC 86-68210, March 2011)

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Technical Memorandum No. 86-68210-2011-01
West-Wide Climate Risk Assessments: Bias-Corrected and Spatially Downscaled Surface Water Projections



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<http://www.usbr.gov/WaterSMART/wwcra.html>

WWCRA Hydrologic Projections are now served at Downscaled Climate archive

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- Content
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 - Hydrologic projections (from WWCRA effort, associated with monthly BCSD)
 - **CMIP3 (2007-2011), CMIP5 (2012-present)**
- Collaborators
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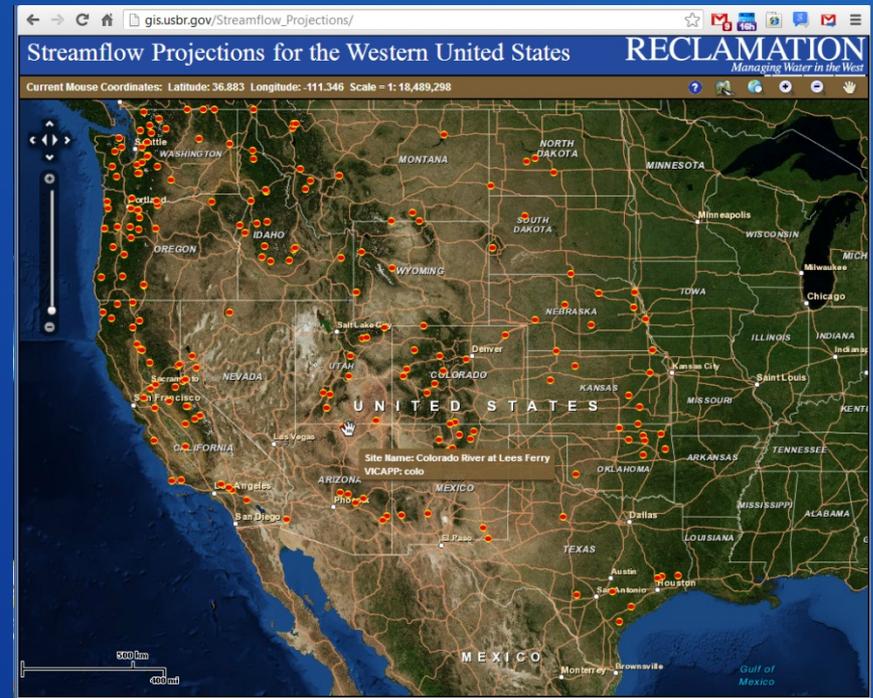
Figure 2: BCCA CMIP3 Daily Climate Analysis example - Calendar-day, ensemble-mean change in 20-year diurnal temperature range for three percentiles of diurnal range: 10th, 50th and 90th for the period pairs shown.

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Reclamation also supports another tool to access **WWCRA Streamflow Projections**

http://gis.usbr.gov/Streamflow_Projections/

- Reclamation hosted web data-service funded through **WaterSMART**
- Goal
 - Distill WWCRA hydrology projections into streamflow projections at locations of interest
 - Develop web-tool to provide easy-access
- Content
 - 112 streamflow projections at 195 locations in the western U.S., including locations featured in Reclamation's 2011 SECURE report.
 - streamflow projections correspond to WWCRA BCSD CMIP3 hydrology projections ([previous slide](#))
- Collaborators
 - Reclamation (TR-PMO, R&D)
 - Univ. of Washington Climate Impacts Group
 - NOAA Colorado Basin River Forecast Center



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Questions?

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