

### Downscaled Climate and Hydrology Projections Web Site

*New daily climate and Western U.S. hydrology projections are now available*

#### Bottom Line

New climate and hydrology projections help users answer local questions about daily climate, streamflow, and water resources.

#### Projections Web Site

“Bias Correction and Downscaled WCRP CMIP3 Climate and Hydrology Projections” available at: [http://gdo-dcp.ucllnl.org/downscaled\\_cmip3\\_projections/](http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/)

#### Better, Faster, Cheaper

Via the web site, Reclamation makes downscaled climate and hydrology projections available to scientists and engineers quickly and easily. Use of this web service reduces assessment costs and supports risk-based climate adaptation planning.

#### Reclamation R&D Office Contact

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#### Collaborators

Reclamation (Science and Technology Program, WaterSMART Basin Studies Program), Santa Clara University, LLNL Green Data Oasis, Climate Central, Scripps Institution of Oceanography, and the U.S. Geological Survey.

#### What Was the Problem?

Global climate models (GCM) are used to simulate future climate responses to scenario increases in atmospheric greenhouse gases (GHGs). Climate responses include changes in surface temperature and precipitation. However, GCM outputs are spatially coarse and not adequate for evaluating local climate impacts.

Users need to quickly and easily access GCM output translated spatially to locally relevant resolution (i.e., “downscaled”). They also need this output to be finely resolved in time so that they may address monthly to daily climate questions (e.g., precipitation amounts, reoccurrence of wet and dry weather patterns, daily temperature range). Users also need (1) a way to account for the GCM’s tendencies to simulate climate that is too warm or cool and/or too wet or dry, which varies by location; (i.e., model “bias”) and (2) understanding of what these climate projections mean for local hydrology (e.g., streamflow, snowpack, water supplies).

#### Initial Solution

In 2007, Reclamation collaborated with U.S. Department of Energy’s National Energy Technology Laboratory (DOE NETL), Santa Clara University, Lawrence Livermore National Laboratory (LLNL), and University of California’s Institute for Research on Climate Change and Its Societal Impacts (IRCCSI) to apply a proven technique called “Bias Correction Spatial Disaggregation” (BCSD, see “About on the Web site” to 112 contemporary global climate projections made available through the World Climate Research Program Couple Model Intercomparison Project, Phase 3 (WCRP CMIP3). These projections represent 16 GCMs simulating climate responses to three GHG scenarios from multiple initial climate system conditions.

The effort resulted in development of 112 monthly temperature and precipitation projections over the continental U.S. at 1/8° (12 kilometers) spatial resolution during a 1950–2099 climate simulation period. These projections were the first information resources on the Web site.



#### Bias Corrected and Downscaled WCRP CMIP3 Climate and Hydrology Projections

*This site is best viewed with Chrome (recommended) or Firefox. Some features are unavailable when using Internet Explorer. Requires JavaScript to be enabled.*

**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**

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

The map shows the western United States with a color scale from -20 to 20 cm/year. The map indicates a decrease in precipitation (blue/purple) across most of the region, with some localized increases (red) in the southern and eastern parts of the western U.S.

Web site screenshot.

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## New Needs, New Solutions

### Daily Climate Projections

Since 2007, about 1,000 users have downloaded the monthly climate projection information from the Web site for various educational, research, and planning uses. However, the monthly climate projections do not address potential changes in daily temperature range (important for ecological studies) nor potential changes in daily precipitation conditions and wet/dry spell reoccurrences. To address this, the collaboration expanded in 2010 to leverage a new technique developed at Scripps Institution of Oceanography, U.S. Geological Survey, and Santa Clara University, “Bias Correction Constructed Analogs” (BCCA). The technique operates on daily GCM output, producing daily projections of minimum temperature, maximum temperature, and precipitation at the same spatial resolution as BCSO information. Based on available daily CMIP3 information reported at PCMDI (see “More Information” on the Web site), and through additional support from U.S. Army Corps of Engineers and Climate Central, BCCA was applied to 53 of the 112 BCSO projections for periods 1961–2000, 2046–2065, and 2081–2100. These new projections are now available to support a variety of studies, including those related to ecological and flood-related impacts.

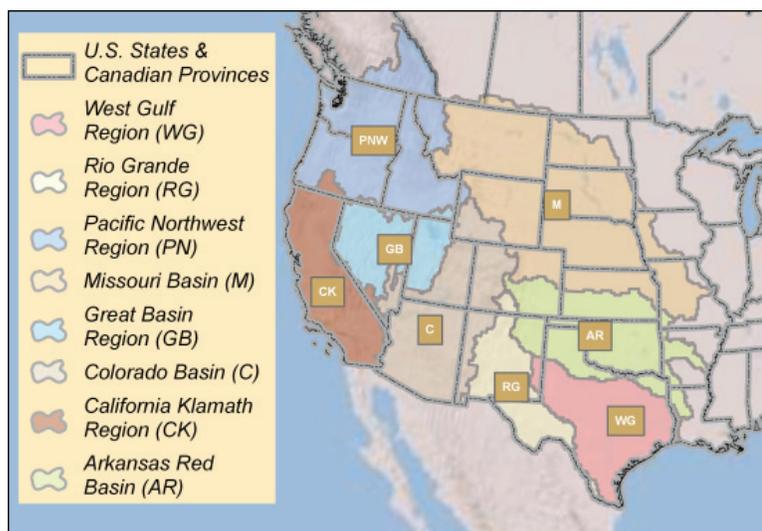
### Western U.S. Hydrologic Projections

Translating downscaled climate projections into associated hydrologic projections requires considerable time and effort. As hydrologic model tools to support such assessment are often not readily available, local analysts have been forced to conduct their own hydrologic model development and application exercises. These are often done inconsistently, making regional impact assessments or intercomparison and prioritization difficult.

Motivated by an interest in addressing both the challenges of interregional assessment and providing access to hydrologic projections for local planning efforts, Reclamation collaborated with the University of Washington’s Climate Impacts Group (CIG) and the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) Colorado Basin River Forecast Center to generate hydrologic projections over the Western United States, corresponding to the monthly BCSO climate projections contained at this Web site. These 112 hydrologic projections were developed through support from the Reclamation WaterSMART Basin Studies Program as part of the West-Wide Climate Risk Assessments activity.

This web site provides hydrologic projections in monthly and daily form. Monthly projections can be flexibly accessed using a new interface that permits tributary basin identification above a “pour cell,” and then retrieval of monthly climate and hydrology

projections above that location. Monthly projections include: precipitation, mean daily maximum and minimum temperatures, wind speed, evapotranspiration (actual and potential), soil moisture, snow water equivalent, and runoff. Daily projections include the four weather variables plus runoff.



BCSO CMIP3 Hydrologic Projections—Geographic Extent of Hydrologic Modeling.

*“Through July 2011, this web site has served projections to about 1,000 users, collectively issued through approximately 11,000 downloads. The requests have covered the contiguous U.S. and parts of southern Canada and northern Mexico.”*

*Levi Brekke, Water and Climate Research Coordinator, Reclamation*

### Who Can Benefit?

Researchers and decision-makers can use these projections to evaluate potential future climate and hydrology, assess societal impacts, and explore adaptation options.

### Future Development Plans

In 2012, archive collaborators plan to apply both downscaling techniques to new global climate projections (CMIP5) and also to develop hydrologic projections associated with the daily BCCA CMIP3 projections.

### More Information

CMIP3:  
[http://www-pcmdi.llnl.gov/ipcc/about\\_ipcc.php](http://www-pcmdi.llnl.gov/ipcc/about_ipcc.php)

CMIP5:  
<http://cmip-pcmdi.llnl.gov/cmip5/>

### Hydrology Projections:

[www.usbr.gov/WaterSMART/docs/west-wide-climate-risk-assessments.pdf](http://www.usbr.gov/WaterSMART/docs/west-wide-climate-risk-assessments.pdf)