



# RECLAMATION

*Managing Water in the West*

## **Incorporation of Climate Change into Bureau of Reclamation Water Management Activities: Climate Change Adaptation Strategy**

April, 2015, 7<sup>th</sup> World Water Forum, Daegu, South Korea



U.S. Department of the Interior  
Bureau of Reclamation

# Climate Change Impacts in The Western States



Increasing Temperature



Decreasing Precipitation



Increasing Precipitation



Decreasing Snowpack



Flood Control Challenges



Water Supply Availability



Hydropower Generation Availability

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# Significant Progress ...

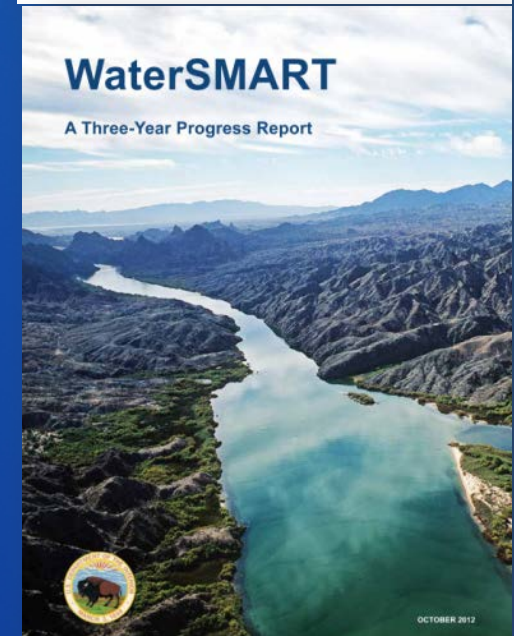
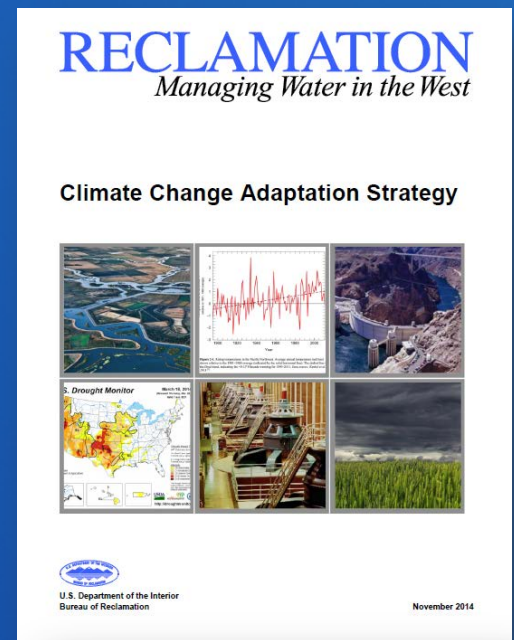


- **assessing** the impacts of climate change to water resources, and
- **implementing** on-the-ground actions to mitigate impacts

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# Outline

- **Climate Change Adaptation Strategy**
  - Improve Reclamation's ability to consider climate change in Agency decision making
- **Examples of Detailed Implementation Actions**
  - WaterSMART Basin Studies Program
  - Hydroclimate data development and sharing



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# Climate Change Adaptation Strategy

## Four Primary Goals

1. Increase Water Management Flexibility
2. Enhance Climate Adaptation Planning
3. Improve Infrastructure Resiliency
4. Expand Information Sharing



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# Phased Approach



Programmatic Activity  
for Goals 1-4

Develop  
Technical and  
Personnel  
Capabilities

Test  
Implementation

Reclamation  
Directives and  
Standards

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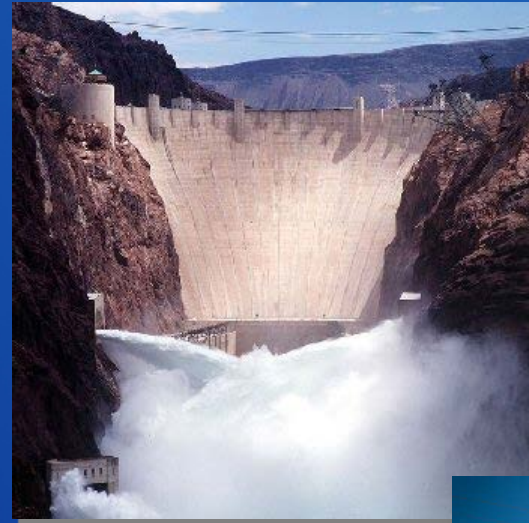
# 1. Increase Water Management Flexibility

- **Strategy Goal:** Increase water management flexibility through climate informed reservoir management.
- **Guidance, Science and Capacity:** Develop conceptual approaches for considering climate change within reservoir operations and identify the statistical tools and models necessary to implement those approaches.
- **Pilot Study / Demonstration:** Reclamation will initiate a pilot study to evaluate how weather, hydrology, and climate change information could better inform reservoir operations at one Reclamation reservoir by the end of FY 2015. Multiple pilot demonstrations at different sites will follow, continuing through 2017.
- **Formalize Process and Implement:** Update guidance based on pilot activities and incorporate consideration of climate change information in future reservoir operations planning.

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# 1. Increase Water Management Flexibility – Implementation Actions

- Reservoir operations pilot initiative
- Improve canal lining and water treatment technology
- Implement water management improvements
- Support water reuse and recycling projects
- Optimize hydropower production



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## 2. Enhance Climate Adaptation Planning

- **Strategy Goal:** Enhance planning efforts to better understand and address climate change impacts to the delivery of water and power, to infrastructure, and to ecosystems and habitat affected by Reclamation projects.
- **Guidance, Science and Capacity:** Reclamation will identify opportunities to expand General Planning by providing technical and financial assistance to stakeholders to incorporate climate information into planning activities.
- **Pilot Study / Demonstration :** Building on the Basin Studies and West-wide Climate Risk Assessments, Reclamation is incorporating climate change information into other Reclamation planning efforts, including feasibility studies and drought contingency planning.
- **Formalize Process and Implement:** In 2015, Reclamation will adopt policy to incorporate climate change in relevant planning studies

# 2. Enhance Climate Adaptation Planning – Implementation Actions

- Enhanced Basin Studies and WWCRA (West-Wide Climate Risk Assessment) Impact Assessments
- Research climate impacts to extreme events and ecosystems
- Drought Response Program
- Expanded General Planning
- Climate Change Training



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# 3. Improve Infrastructure Resiliency

- **Strategy Goal:** Increase infrastructure resiliency by considering future climate in evaluating Dam Safety and infrastructure replacement, repair and renovations.
- **Guidance, Science and Capacity** Develop reliable methods for projecting climate change impacts on floods and underlying weather events, expected occurrence over different western U.S. basins, and future likelihood. Revise criteria for prioritizing infrastructure replacement, repair and renovations to incorporate climate considerations.
- **Pilot Study / Demonstration :** The Dam Safety Program has initiated a pilot study at Friant Dam in California to develop procedures to apply climate information in the dam safety risk assessment process. Additional pilot studies continuing through FY 2017.
- **Formalize Process and Implement:** Establish requirements for consideration of climate change as part of the Dam Safety risk assessment process, based on pilots. Use revised criteria to consider climate change in decisions regarding infrastructure replacement, repair and renovations.



# 3. Improve Infrastructure Resiliency – Implementation Actions

- Dam Safety Climate Change Assessment Pilots
- Western Watershed Enhancement Partnership
- Climate-resilient infrastructure replacement, repair and renovations



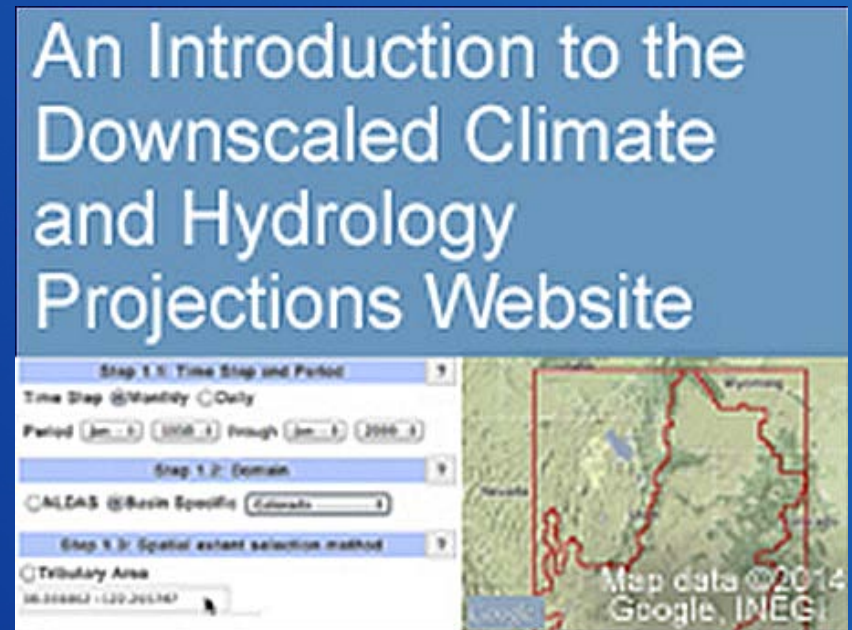
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# 4. Expand Information Sharing

- **Strategy Goal:** Make data and tools supporting water operations and climate change adaptation more available to partners and stakeholders.
- **Guidance, Science and Capacity:** Provide critical operations data and climate change information to Reclamation's partners and stakeholders, including Geographical Information Systems, implementation of security protocols, and integration with other relevant information sharing efforts.
- **Pilot Study / Demonstration:** Beginning in 2014 the Lower Colorado Region is developing a pilot to provide reservoir data available through web based services. The Pacific Northwest Region is developing a Reclamation-wide Geographical Information System to serve localized climate change data sets.
- **Formalize Process and Implement:** A formalized and regularly updated Reclamation-wide system of distribution of information that can support Reclamation and its partners making real time and planning level decisions.

# 4. Expand Information Sharing – Implementation Actions

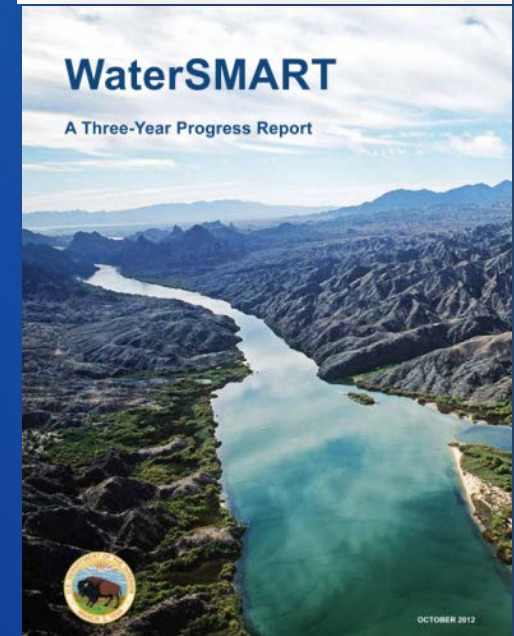
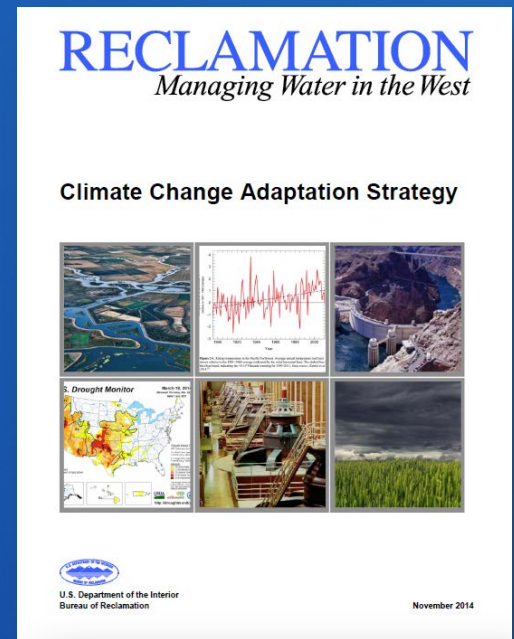
- Improve access to water and hydropower data
- Coordinate climate adaptation activities with partners and stakeholders.





# Outline

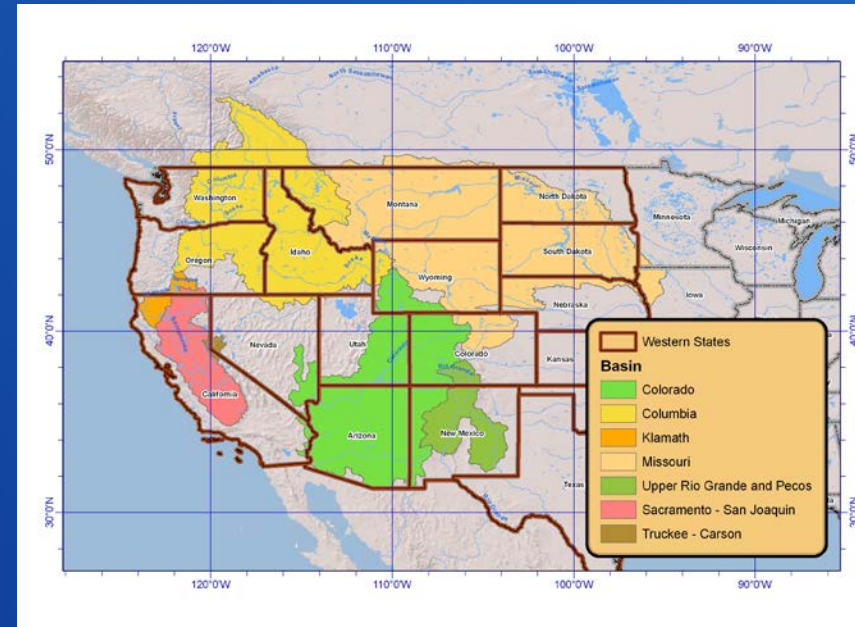
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# WaterSMART Basin Studies Program

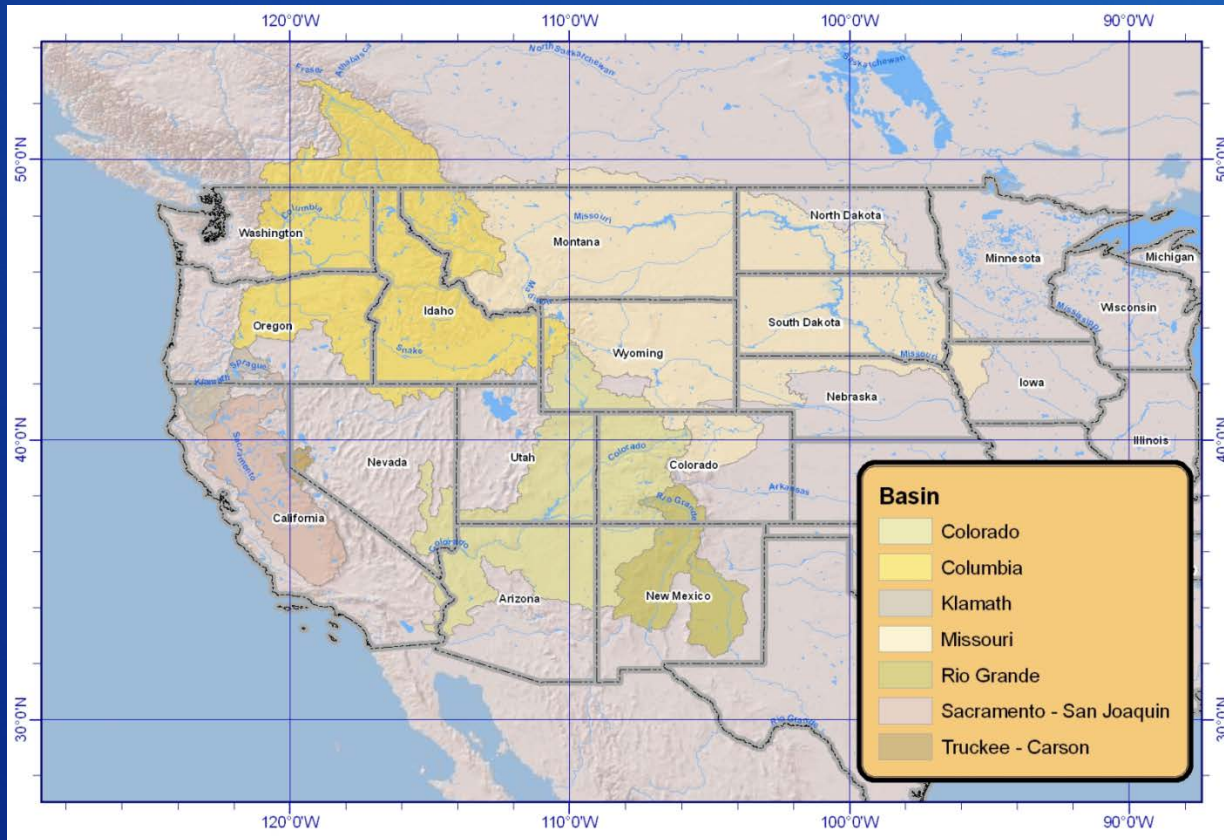
- Public Law 111-11, Subtitle F (SECURE Water Act, **SWA, 2009**) § 9503.
- Climate change risks for water and environmental resources in “**major Reclamation river basins.**”
- Reclamation’s WaterSMART (**S**ustain and **M**anage **A**merica’s **R**esources for **T**omorrow) Basin Study Program
  1. West-Wide Climate Risk Assessments (**WWCRAs**)
  2. Basin Studies
  3. Landscape Conservation Cooperatives (**LCCs**)



**8 major Reclamation River Basin**

SECURE – Science and Engineering to Comprehensively Understand and Responsibly Enhance

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# WEST WIDE CLIMATE RISK ASSESSMENTS

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# What are WWCRAAs?

- WWCRAAs involve **three basic climate change assessments** conducted across the western 17 states:
  1. Assess **water supply** in a consistent west-wide manner
  2. Assess **water demands** in a consistent west-wide manner
  3. **Impact assessment** conducted on **individual basins or sub-basins** to address **risks to focal areas** identified in the SECURE Water Act
    - using **current operating requirements**
- Reclamation wide **technical implementation team** (w/ participation from other agencies)
  - Generating **information resources and tools** for Reclamation staff and stakeholders to use in studies
  - Developing **technical guidance** to assist Reclamation staff and stakeholders incorporate climate change into their analyses

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# BASIN STUDIES

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# Phases of a Basin Study

**Phase 1:**  
Water Supply and Demand  
Assessment

Assess current and projected water supply and demand in a changing climate

**Phase 2:**  
System Reliability Analysis

Analyze how the basin will respond to water supply and demand projections according to identified measures

**Phase 3:**  
Development of Adaptation  
Strategies

Develop adaptation strategies to reduce any identified gaps

**Phase 4:**  
Evaluation of Adaptation  
Strategies

Evaluate adaptation strategies, findings, and recommendations as appropriate

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# Funded Basin Studies

22 Basin Studies funded since 2009

2009

- Colorado River Basin
- Milk/St. Mary River Basins
- 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

2013

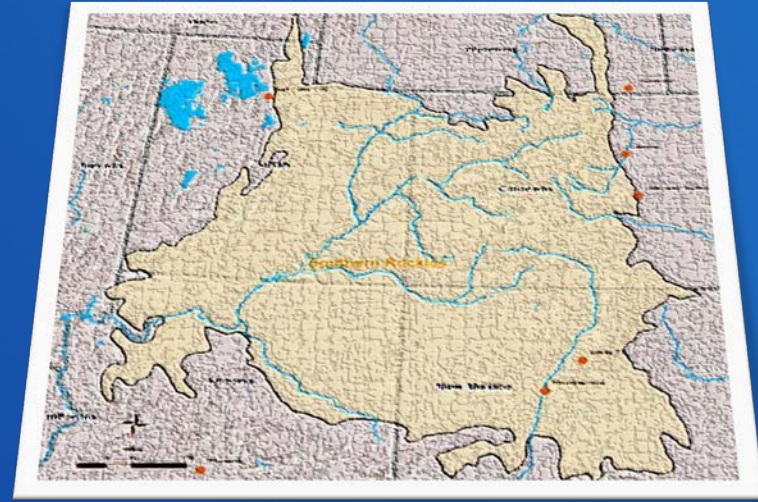
- San Diego Watershed
- West Salt River Valley

2014

- Deschutes River Basin
- Upper Missouri River Basin
- Upper Red River Basin



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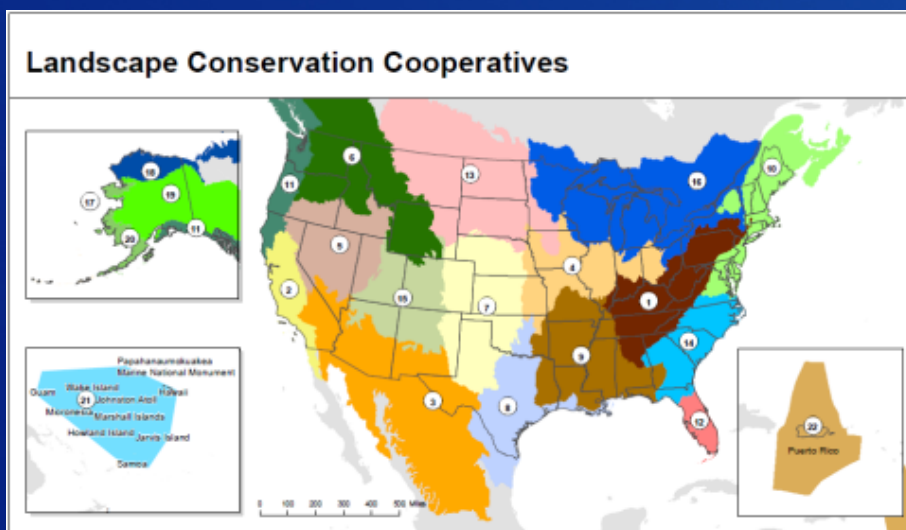
# LANDSCAPE CONSERVATION COOPERATIVES

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# Basin Study Program - LCCs

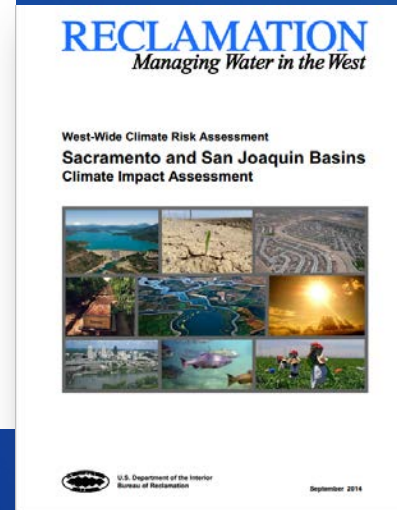
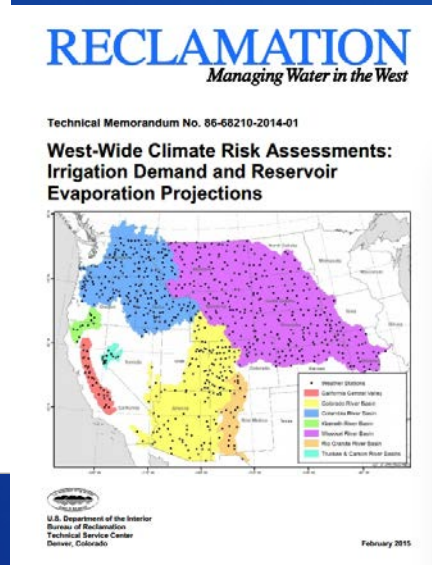
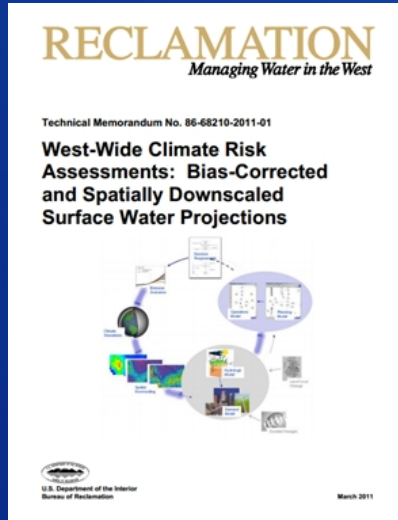
- On-the-ground strategic conservation & resource management efforts at the landscape level
- In 2010, the Department of Interior developed a plan for a **coordinated, science-based response** to climate change impacts on our land, water, and wildlife resources.
- LCCs are the **applied science** branch of this strategy
  - Each LCC will function in a specific geographic area, and will form a national and possibly an international network.
- Reclamation co-leads the **Desert LCC** and **Southern Rockies LCC** with FWS that encompass the Colorado River Basin



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# Example Reports



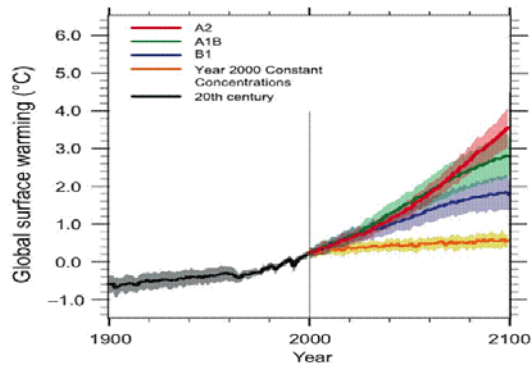
[http://www.usbr.gov/international/wwf\\_climate.html](http://www.usbr.gov/international/wwf_climate.html)

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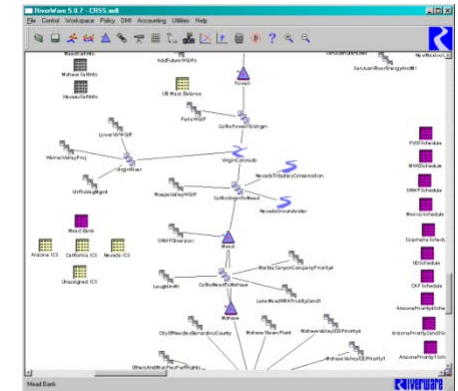
# HYDROCLIMATE DATA

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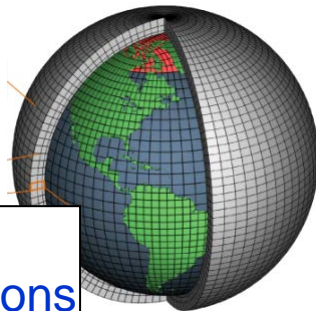
Emissions  
Scenarios

Translating  
climate  
projections to  
hydrology  
projections

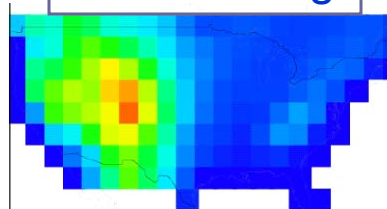


Operations  
Model

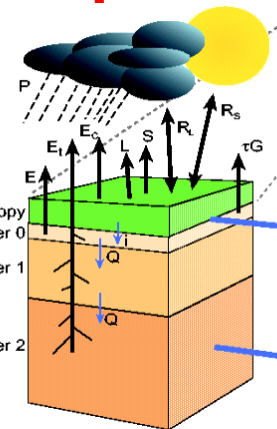
Climate  
Simulations



Spatial  
Downscaling



Hydrologic  
Model



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# Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections

[http://gdo-dcp.ucllnl.org/downscaled\\_cmip\\_projections/dcpInterface.html](http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html)



## Downscaled CMIP3 and CMIP5 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.*

[Welcome](#)[About](#)[Tutorials](#)[Projections: Subset Request](#)[Projections: Complete Archives](#)[Feedback](#)[Links](#)

Downscaled CMIP5 climate and hydrology projections' documentation and release notes available [here](#).

### 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), CMIP3 hydrologic projections over the western U.S. (roughly the western U.S. Figure 3), and CMIP5 hydrology projections over the contiguous U.S. corresponding to 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 referenced in the Intergovernmental Panel on Climate Change Fourth Assessment Report, and the phase 5 (CMIP5) multi-model dataset that is informing the IPCC Fifth Assessment.

For information about downscaled climate and hydrology projections development, please see the [About](#) page.

### Purpose

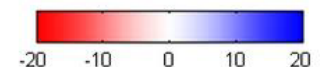
The archive is meant to provide access to climate and hydrologic projections at spatial and temporal scales relevant to some of the watershed and basin-scale decisions facing water and natural resource managers and planners dealing with climate change. Such access permits several types of analyses, including:

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

[Archive History](#)

Figure 1. Central Tendency Changes in Mean-Annual Precipitation over the contiguous U.S. from 1970-1999 to 2040-2069 for BCSD3, BCSD5, and Difference.

Mean-Annual Precipitation Change, percent  
CMIP3,1970-1999 to 2040-2069,50%tile



Mean-Annual Precipitation Change, percent  
CMIP5,1970-1999 to 2040-2069,50%tile



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# Streamflow Projections for the Western United States

[http://gis.usbr.gov/Streamflow\\_Projections/](http://gis.usbr.gov/Streamflow_Projections/)



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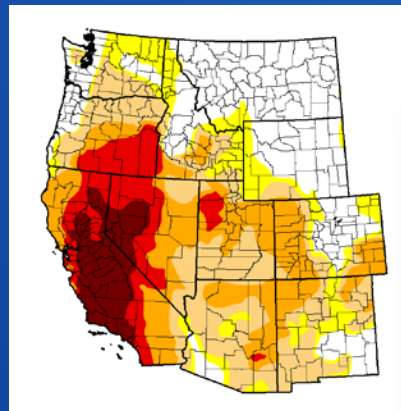
# Summary

- **Risks from a Changing Climate**

- Change in snowpack
- Groundwater recharge and discharge
- Increases in water demand or reservoir evaporation as a result of increasing temperature

- **Climate Change Impacts**

- Ability to deliver water
- Hydroelectric power generation
- Recreation at Reclamation facilities
- Fish and wildlife habitat
- Endangered, threatened, candidate species
- Water quality issues
- Flow dependent ecological resiliency
- Flood control management

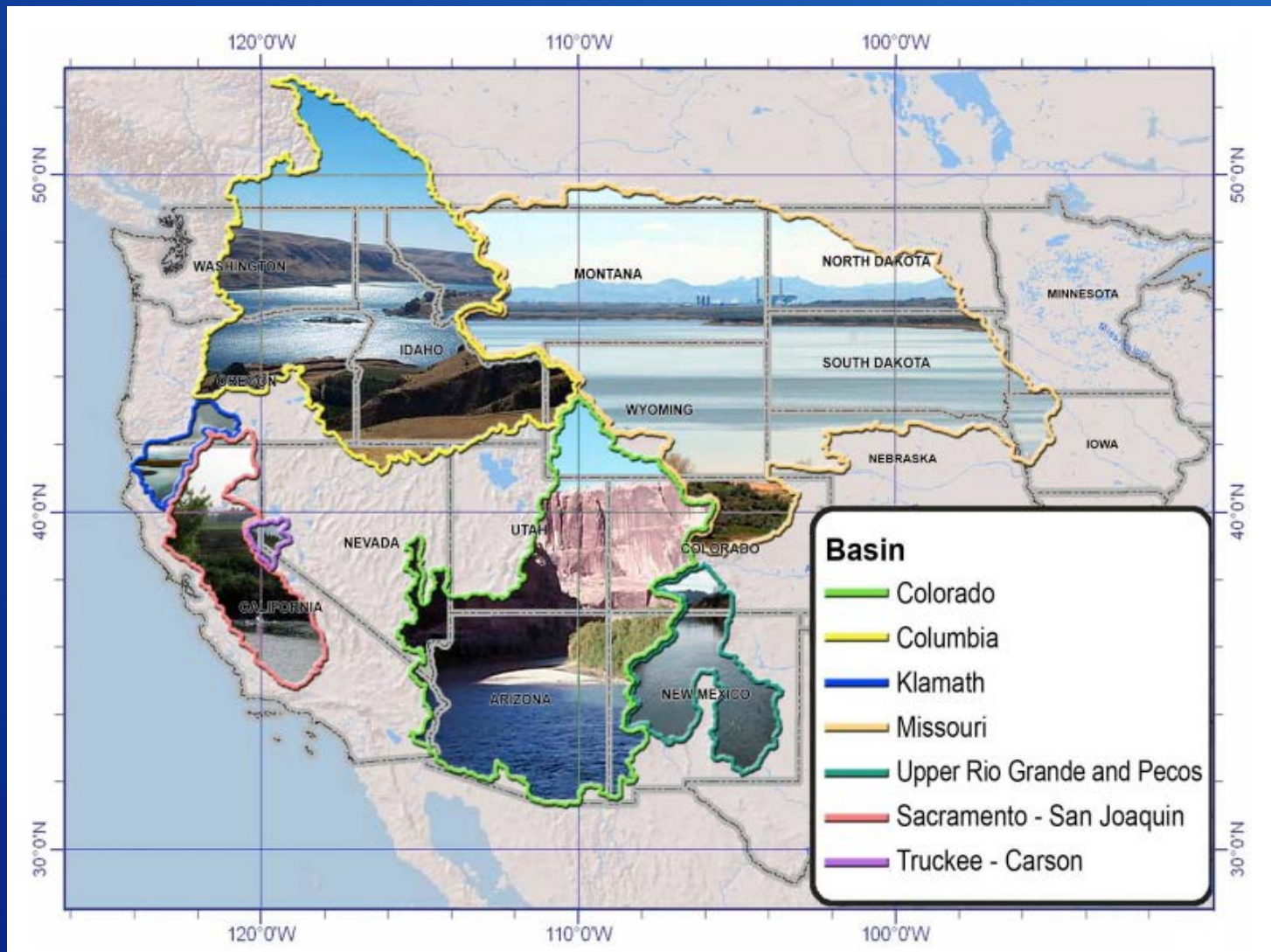


## Climate Change Adaptation Strategy

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# Questions?



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