

Enhancing California's Water Resource Management and Decision Support System to Address Impacts of Climate Change (NNH08ZDA001N) (2009-2012)

A Joint project of UCI, JPL, CDWR, and MWD

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NASA Water Resources Program Review and Meeting

(Statement of problem/need/opportunity)

Growth of California's population and economy raises a severe water managing problem for increasing demand and limited supply.

Snow water in Sierra Nevada is the major water resources for the state.

CDWR, the state water agency, relies on ground snow measurements before April to estimate annual water availability and model-predicted variations of precipitation and temperature to plan future water managements in changing climate.

NASA satellite remote-sensing snow products can provide the needed information of snow distribution and quantity and their variations accurately and timely.



Main Project objectives

- * **Improve California's major water management and planning system-CalSim-III (CDWR)**
- * **Support statewide assessments of climate-change impacts on water resources by applying NASA remote sensing observations**
- * **Enhance hydro-meteorological modeling with uncertainty analysis**
- * **Develop GIS-enabled GUI to run the system and visualize the results for decision-making support**



Partners/ User Communities

Research Partners:

JPL

CDWR

MWD

User Communities:

- 1) CDWR in charge state-wide water allocation through the SWP and CVP.
- 2) Metropolitan Water District of Southern California-the local water management agency for LA, OC, and RC.



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Key datasets, and scientific and technical tools

Key datasets

MOD10C1 from Terra satellite

MYD10C1 from Aqua satellite

Scientific and technical tools

Using EOF/PCA method, analyze uncertainty in (GCM-RCM) predicted climate change over California: Dominant EOFs provide a useful guide for water management.

Develop Variational Interpolation to clear cloud obscurations in MODIS snow maps and retrieve the dynamic process of snow cover variation.

Develop a GIS-based Graphic User Interface for the new-generation California water managing system—CalSim-III.

Develop skill for multi-objective optimization of water management networks.



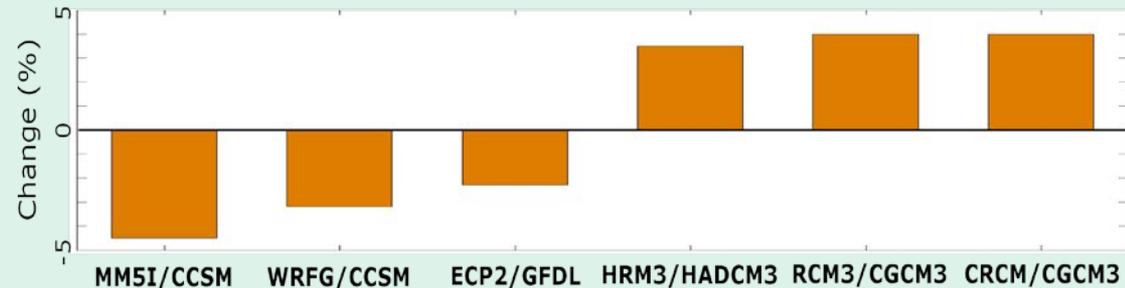
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California water management in response to the changing climate needs to understand the uncertainty/certainty in the model predictions.

Six-model predicted changes of precipitation over western US show high differences – **uncertainty** in model predictions

Percentage deviations of precipitation in 2040-2070 from that in 1970-2000 (observations)

Regional Models	Climate Models			
	GFDL	CGCM3	HADCM3	CCSM
CRCM	_____		_____	_____
ECP2		_____	_____	_____
HRM3	_____	_____		_____
MM5I	_____	_____	_____	
RCM3	_____		_____	_____
WRFG	_____	_____	_____	



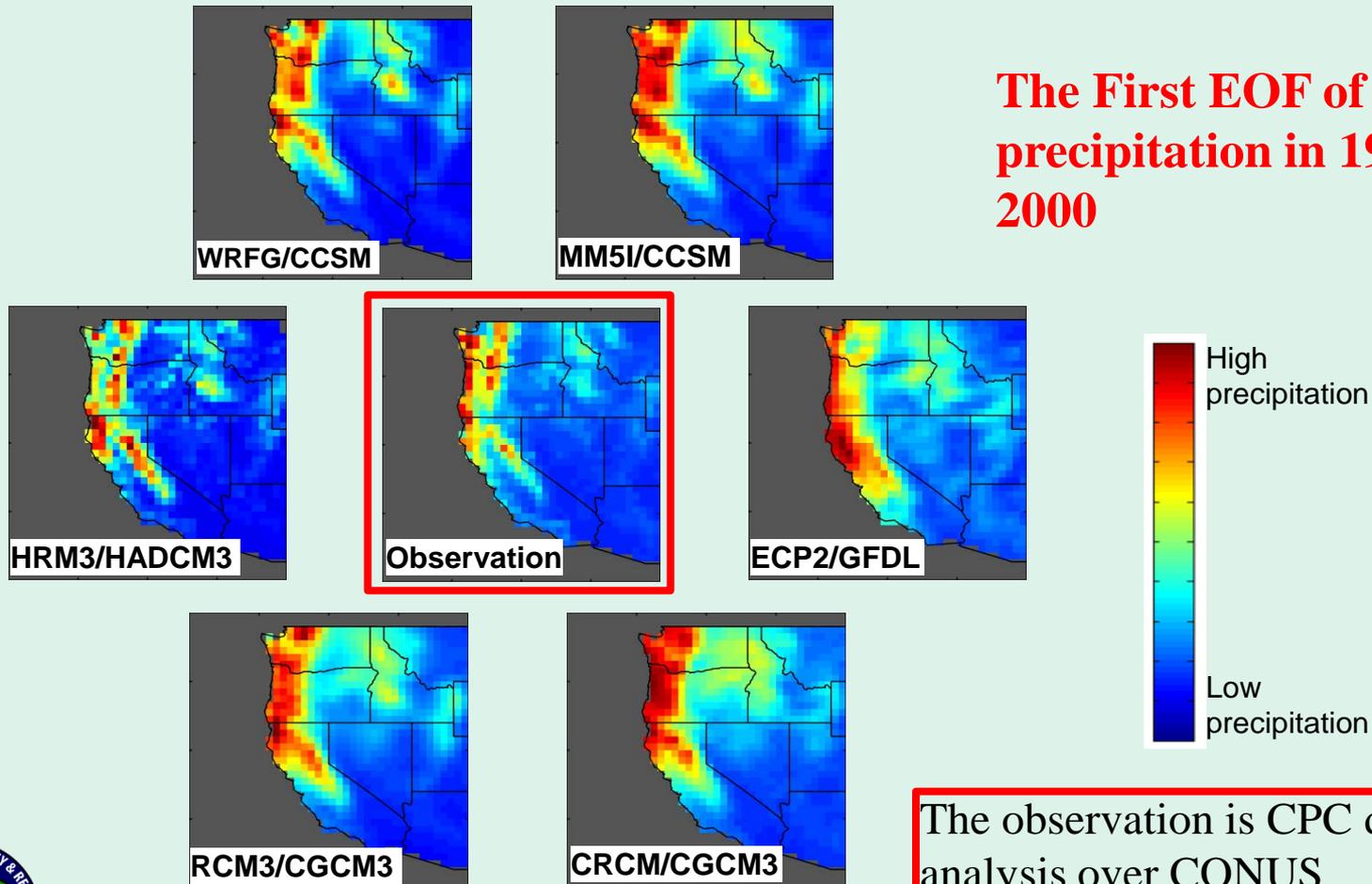
Emissions Scenario:

A2: regionally oriented and fast economic growth



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Similarity in dominant EOFs between observation (center) and predictions indicates persistent patterns even under projected climate change



The First EOF of precipitation in 1971-2000

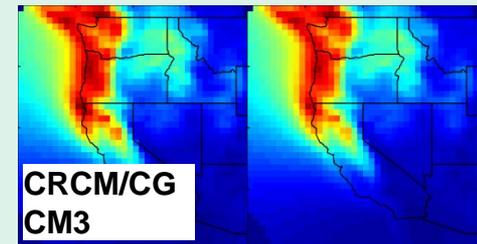
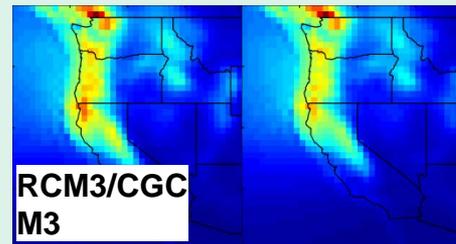
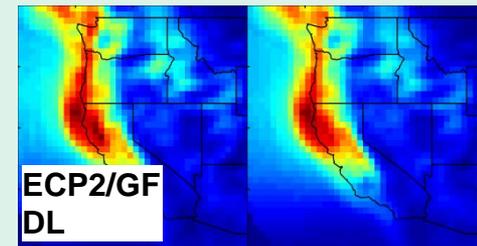
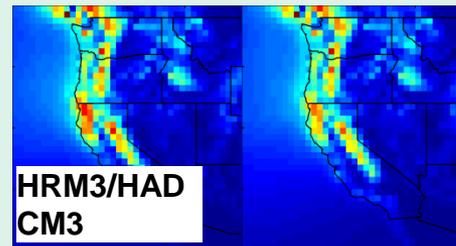
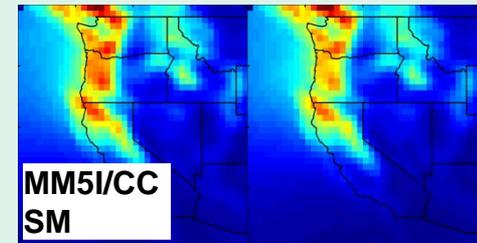
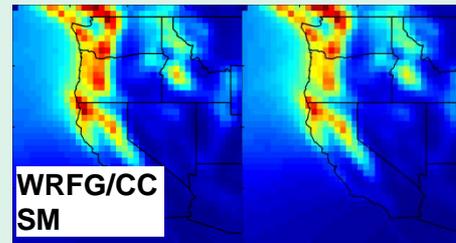
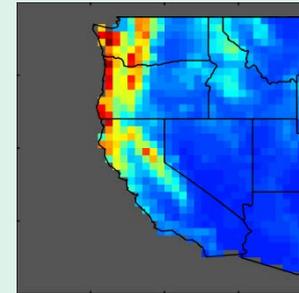
The observation is CPC daily gauge analysis over CONUS



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Models unanimously indicate that the EOF spatial distribution patterns are persistent even under the projected climate change.

The **certainty** parts of predicted climate change.



1971-2000

2041-2070

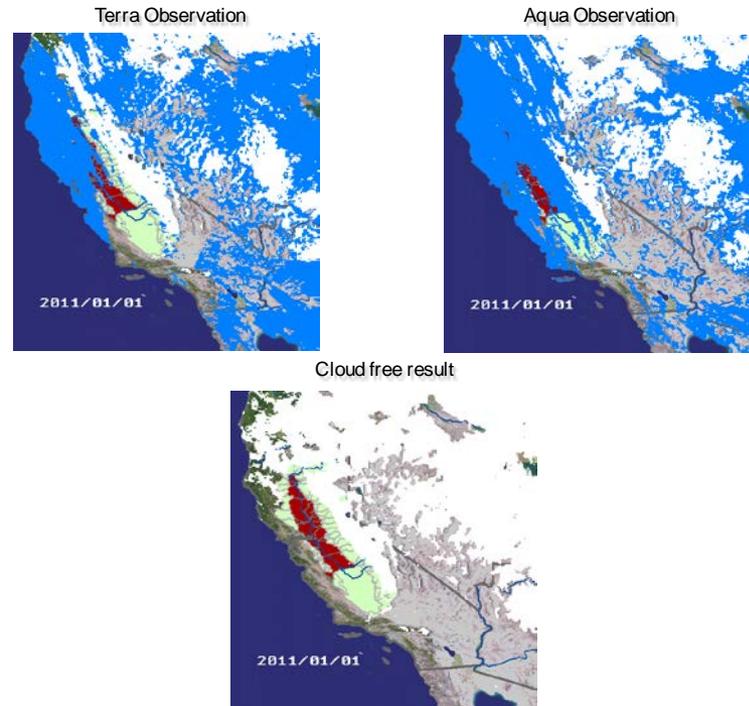
1971-2000

2041-2070



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**Develop VI technique
clearing clouds from MODIS
snow products and
monitoring snow dynamic
maps for the use of
operational water
managements in CDWR.**



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Develop a Graphic User Interface letting the user communities in Central Valley (WBA) run water budget models and put their water demands into state water managing system (CalSim-III) also demonstrate the optimal responses from the system.

The screenshot shows the CalSimHydro 1.0 Preprocessor web interface. At the top, there are logos for the Department of Water Resources, U.S. Department of the Interior Bureau of Reclamation, and NASA. The main content area is divided into an 'Input' section and an 'Output' section. The 'Input' section includes radio buttons for 'WBA Precipitation', 'WBA Evapotranspiration', 'DU Ag Land Use', 'Fixed values', and 'Time series'. The 'Output' section includes radio buttons for 'WBA Deep Percolation', 'WBA Surface Runoff', 'DU variables', 'Applied Water', 'Return Flow', and 'Urban Demand'. Below these sections are buttons for 'Run', 'Reset', 'Download', 'Retrieve session ID', and 'View change history'. A map of the Sacramento region is displayed on the right, with various Water Budget Areas (WBAs) numbered. A callout box for WBA 24 provides detailed information: 'WBA 24 Placer Foothills, Placer West Total Area 185,757 acres Avg. Annual Percip: 24.3in'. The interface also includes a 'Home' link and a date 'Friday, June 24, 2011'.

Home Friday, June 24, 2011

DEPARTMENT OF WATER RESOURCES CALIFORNIA U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION NASA

CalSimHydro 1.0 Preprocessor

Input

- WBA Precipitation
- WBA Evapotranspiration
- DU Ag Land Use
- Fixed values
- Time series

Run Reset

Output

- WBA Deep Percolation
- WBA Surface Runoff
- DU variables
- Applied Water
- Return Flow
- Urban Demand

Download

Retrieve session ID

View change history

WBA 24
Placer Foothills, Placer West
Total Area 185,757 acres
Avg. Annual Percip: 24.3in

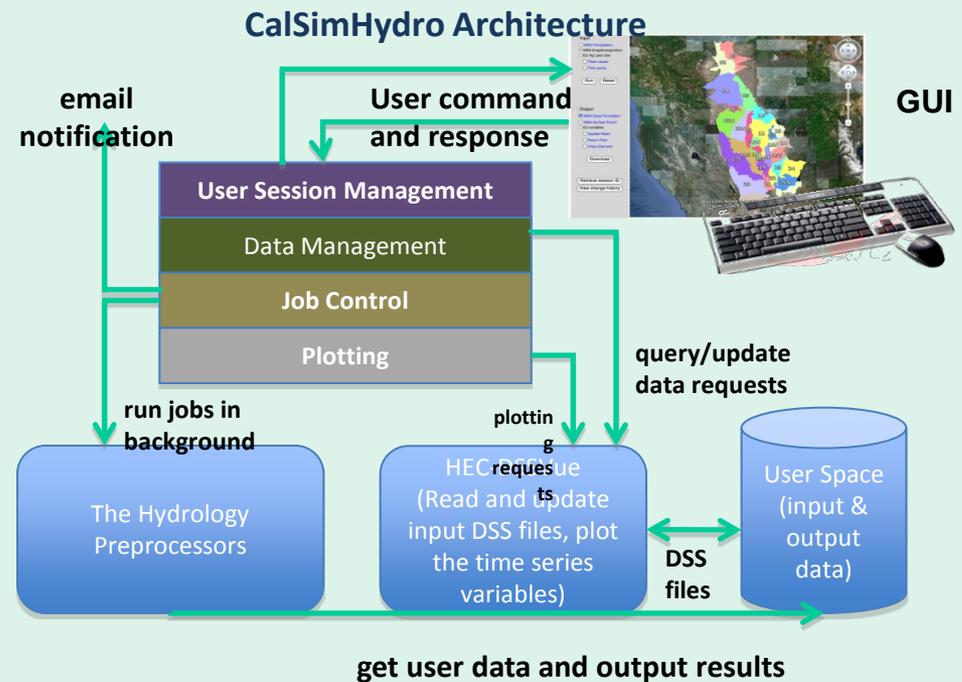
Google Earth display with Sacramento WBA Map

Mouse over to see the detailed Information for a WBA



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Develop Water Budget Model-**CalSimHydro** for local water-user communities to estimate and submit water demands to CalSim- the state water managing system based on changes in climate, local environments, and economy - population growth.



Strategy for quantify impacts

Provide near-real-time satellite snow data and water management tools to the Operation Offices of CDWR and MWD as the reference in their daily water managements.

Obtain feedback comments and suggestion from the operational agencies to improve the values of our developments in water managements.

Make long-term evaluation of the products in comparing with the ground measurements used by the operational office.



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Center for Hydrometeorology and Remote Sensing, University of California, Irvine

Impacts (achieved or anticipated)

Analyze the certainty and uncertainty of climate predictions for regional water resource managements.

Near-real-time monitoring of snow cover variation over mountains.

Provide snow information to CDWR for operational managements and annual planning.

Snow water equivalent and snow water storage estimation (anticipated).

GUI applications in the input/output of the state water managing system-CalSim to enhance the function for decision-making support.

