



“Societal Dimensions”:
What Does THAT Mean?!

David Behar
San Francisco Public Utilities Commission
Water Utility Climate Alliance

CESM Societal Dimensions Work Group Meeting, Boulder
February 27, 2012

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Services of the San Francisco Public Utilities Commission

WUCA
Water Utility Climate Alliance

Symbiosis

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The Stakes on Climate Change:
Water and Clean Water Sector Only

2011-2031: Without Adaptation

Drinking Water
Infrastructure Investment

$335 Billion [1]

Clean Water
Infrastructure Investment

$298 Billion [2]

By 2050: Potential Adaptation Costs

Drinking Water + Clean Water Sector:

$448 - 944 Billion [3]

[1] "2009 Drinking Water Infrastructure Needs Survey and Assessment: Third Report to Congress." USEPA Office of Water, 2005.

[2] "Clean Watersheds Needs Survey 2008: Report to Congress." USEPA, May 2010.

[3] "Confronting Climate Change: An Early Analysis of Water and Wastewater Adaptation Costs," Association of Metropolitan Water Agencies, National Association of Clean Water Agencies, 2009.

Water Utility Climate Alliance

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WUCA Water Utility Climate Alliance

43 million drinking water customers

__Mission Statement__

The Water Utility Climate Alliances provides leadership in assessing and adapting to the potential effects of climate change through collaborative action. We seek to enhance the usefulness of climate science for the adaptation community and improve water management decision-making in the face of climate uncertainty.

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2012 WUCA Work Plan: Item 3

WUCA Water Utility Climate Alliance

WUCA 2012 Work Plan

Workplan Item		Details	Staff Time (Hours)	Cost ($)	Timeframe
1	**Develop and implement two partnership plans: one for water sector associations and one for non water sector entities.**	Create partnership plan(s) to address roadblocks and areas of mutual advantage. Establish a contact list of individuals and orgs we may want to partner with from water sector and non-water sector associations. Appoint WUCA liaison(s) to different associations. Identify current activities and initiatives by each, known strengths and weaknesses, and identify opportunities for collaboration by building on partnerships with user organizations that are mutually beneficial and non-duplicative. Develop a coordination strategy for working with key municipal water provider organizations such as AWWA, AMWA, and WRF, and non-water sector entities such as RISA's, federal agencies, and NGOs on climate change issues of mutual importance.	196	$ -	Plans - 1st Quarter Implementation - Ongoing
10	**Invite an AMWA representative to participate in WUCA meetings to provide legislative updates.**	Determine what is the most effective and efficient way for WUCA to remain current on legislative initiatives. This activity will require coordination with colleagues at AMWA and other water sector organizations, status updates on regularly scheduled monthly WUCA calls, and intermittent review of letters of support for legislative initiatives.	23	$ -	Ongoing through 2012
11	**Develop guidelines or operating principles regarding work plan implementation and coalition leadership**	Address but not be limited to: establish a structure and annual process for implementing 2012 and future work plans, including resource commitments from members; assign project leaders and their			

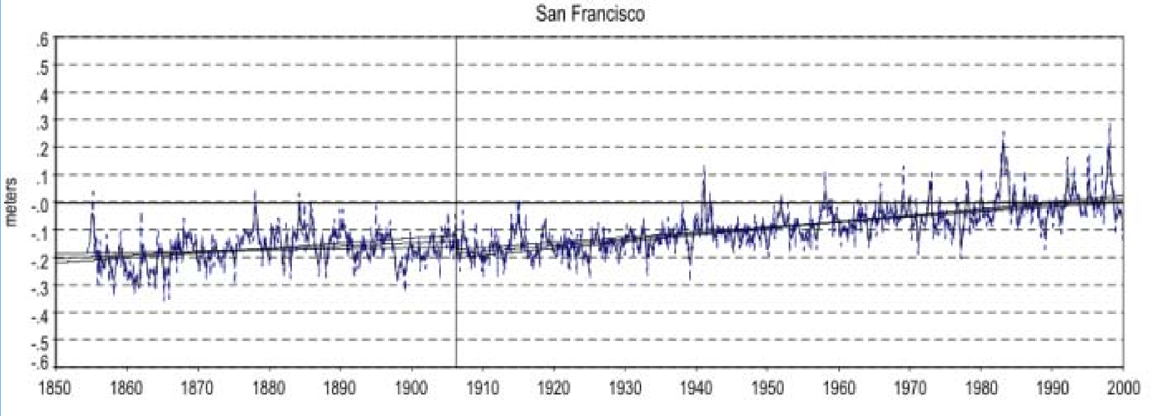
Workplan Item		Details	Staff Time (Hours)	Cost ($)	Timeframe
3	Participate actively in first year of the Societal Dimensions Work Group of the Community Earth System Model (CESM).	The CESM, one of three GCM's in the United States, created this workgroup in 2011 to "foster and sustain dialogue" between CESM modelers and communities evaluating climate change impacts on society. WUCA provided guidance during the work group creation process and lobbied for the water resource focus that CESM has adopted. Leverage initial focus of workgroup on water resources to create innovation in modeler/decision-maker collaboration and co-production of knowledge. Work to bring innovation to attention of other climate modeling centers in U.S. or globally and federal policymakers. Seek to create actionable science from process. This effort is just getting off the ground and has the potential to blend the needs of the water sector in with the science of climate change modeling.	299	$	Ongoing through 2012

A core objective…

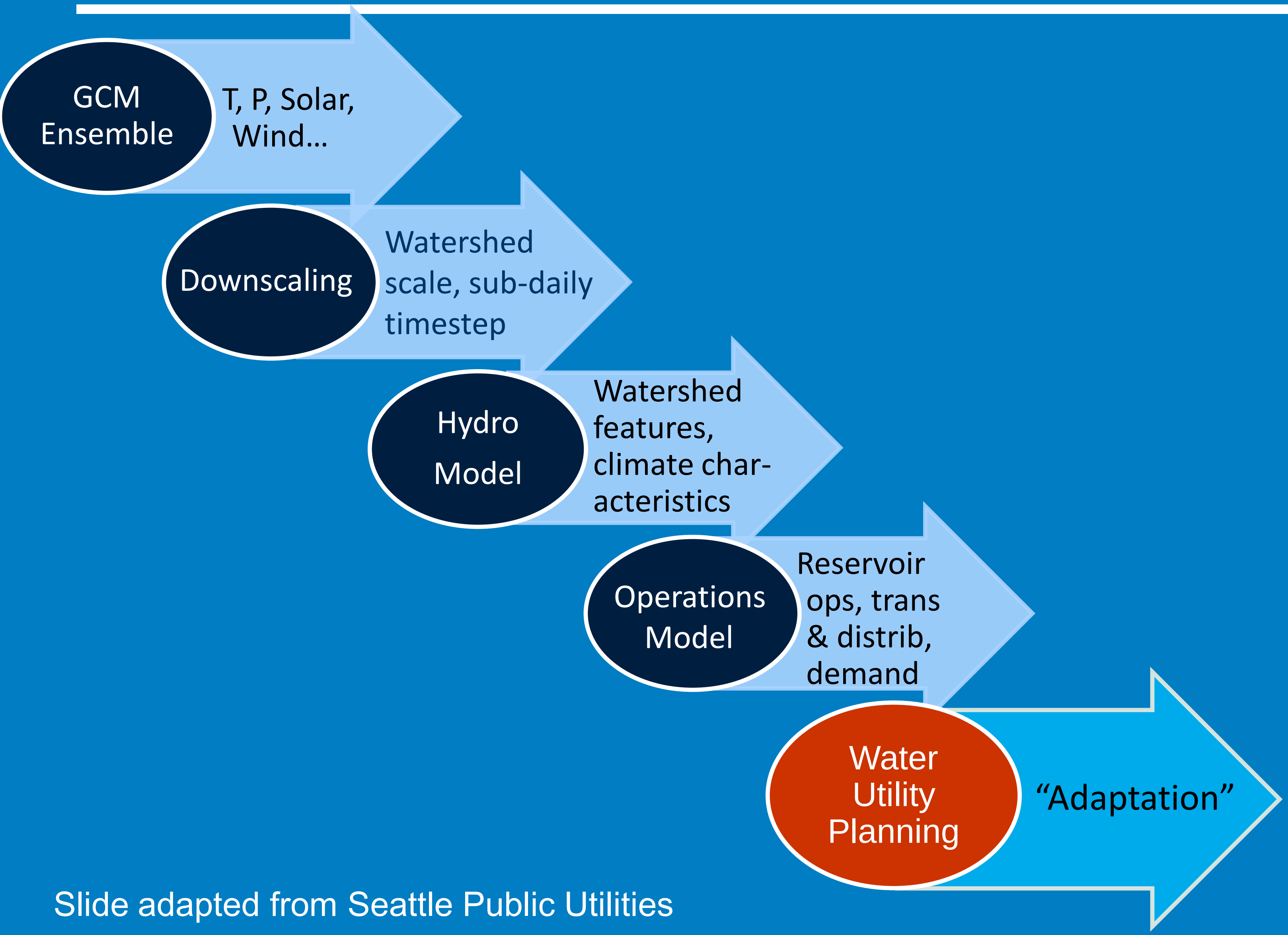
“Actionable Science”

A Working Definition:

Data, analysis, and forecasts that are sufficiently predictive, accepted and understandable to support decision-making, including capital investment decision-making.

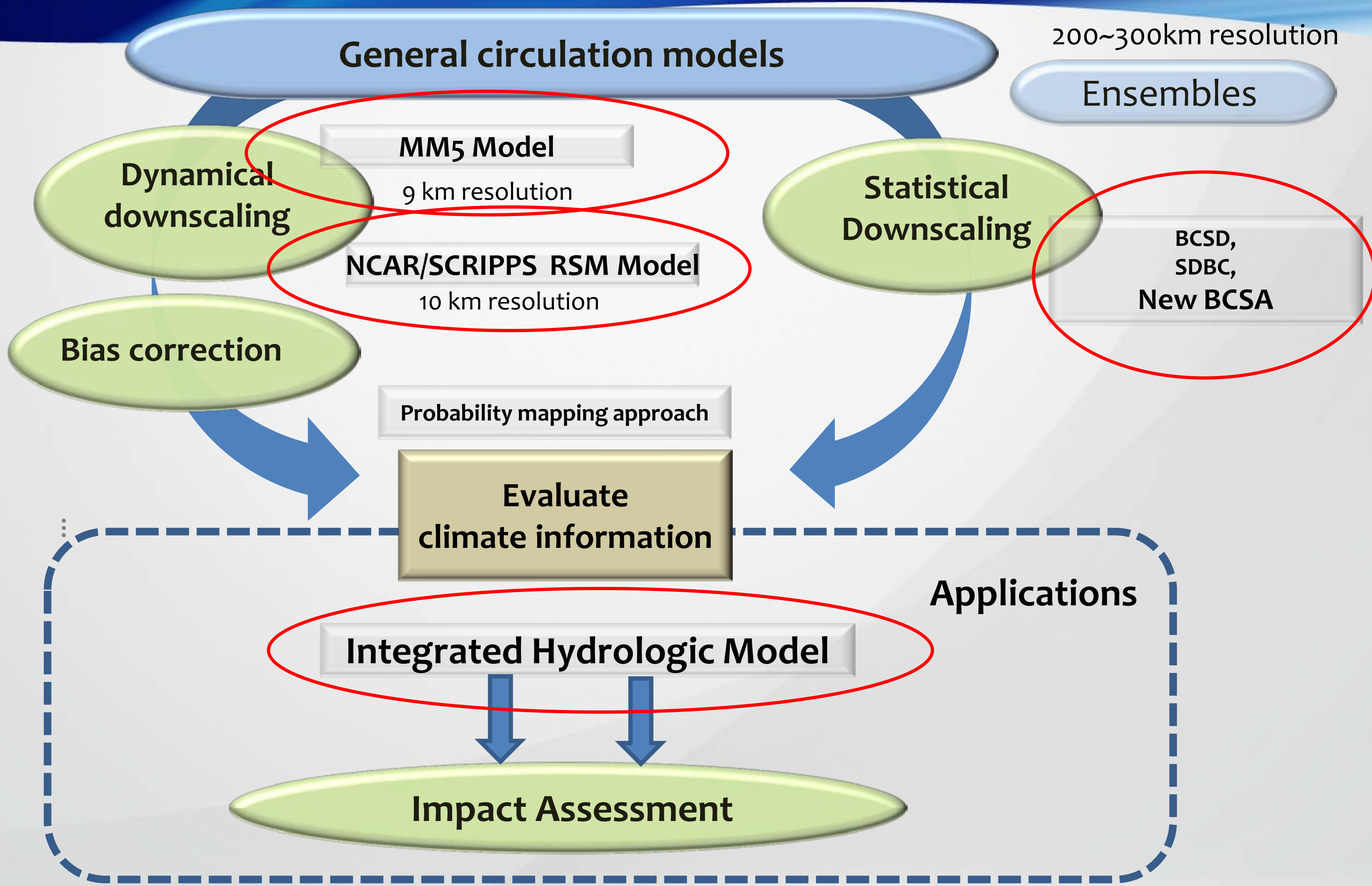


Chain of Models



Slide adapted from Seattle Public Utilities

Climate Change Assessment Framework



Sensitivity Analysis – Streamflow to Temperature and Precipitation Change

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	2040	2070	2100
Temperature Precipitation	+ 0.6 deg C + 0%	+ 1.3 deg C + 0%	+ 2 deg C + 0%
Temperature Precipitation	+ 1 deg C + 0%	+ 2.2 deg C + 0%	+ 3.4 deg C + 0%
Temperature Precipitation	+ 1 deg C - 5%	+ 2.2 deg C - 10%	+ 3.4 deg C - 15%
Temperature Precipitation	+ 1 deg C + 2%	+ 2.2 deg C + 4%	+ 3.4 deg C + 6%
Temperature Precipitation	+ 1.65 deg C + 0%	+ 3.5 deg C + 0%	+ 5.4 deg C + 0%
Temperature Precipitation	+ 1.65 deg C -5%	+ 3.5 deg C -10%	+ 5.4 deg C -15%

Median Runoff into Hetch Hetchy
(results based on 1975-2008, median year is 2003)

Change in Median Runoff volume for future climate conditions

Climate Change Scenario		Hetch Hetchy Runoff (% change from 2010) 2040	2070	2100
1A	Low temperature increase No precipitation change	-1%	-2%	-3%
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Extremely Wet, Median and Critically Dry Year Runoff

Change in runoff volume for two future climate conditions for Extremely Wet, Median, and Critically Dry Years (results based on 1975-2008)

Climate Change Scenario		Year Type	Hetch Hetchy Runoff (% change from 2010)		
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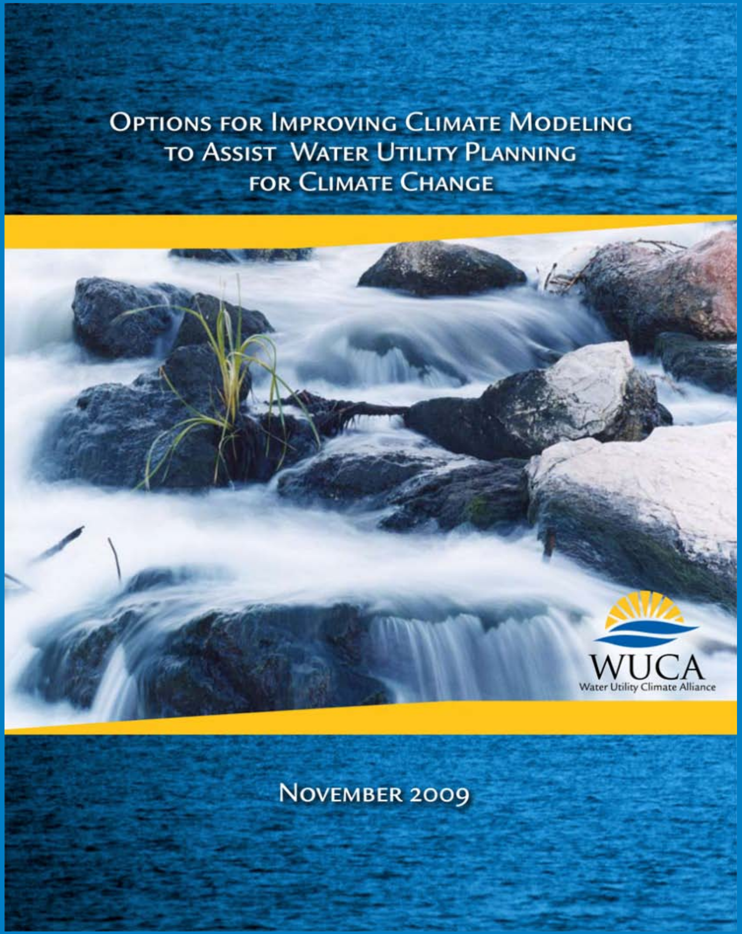
Climate Modeling White Paper

"Options for Improving Climate Modeling to Assist Water Utility Planning for Climate Change"

Authors:
Joe Barsugli, Chris Anderson, Joel Smith, Jason Vogel

Available at
www.wucaonline.org



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Approaches

1. Improving understanding of how climate system works and how it is represented in models

2. Improving archiving of data from models that currently exist to enhance accessibility and downstream experiments

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Objectives for improved science

1. Improve model agreement on change in key parameters.
2. Narrow range of model output
3. Match model resolution with scales of water utility hydrologic and systems models (and other users' tools)
4. Improved projections within planning horizons of decisionmakers, i.e. several decades

Options for Improving Modeling - 1

- **GCM Options**
  1. Development and enhancement of global climate model ensembles
  2. Improved use of observations to constrain climate model projections
  3. Improved modeling of the Tropical Pacific
  4. Improved decadal prediction

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Options for Improving Modeling - 2

- **Downscaling Options**

1. Development of regional ensembles
2. Development of regional climate model components
3. Development of statistical downscaling techniques for probabilistic downscaling, extremes, and daily data

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Projections Inventory – Work in Progress

Compiled by Rupp, OCCRI and Behar, SFPUC

Emissions/ Concentration Scenario	Spatial Domain	Temporal Domain	Spatial Resolution*	Finest Temporal Resolution Available*	GCM	RCM
Contact: Chris Castro, U of Arizona (Dominguez et al, 2011, PNAS)						
SRES A2	US and N. Mexico	1967-2081	35 km	6 hr	HADCM3	WRF
SRES A2	US and Mexico	1950-2100	35 km	6 hr	ECHAM5	WRF
SRES A2	US and Mexico	1950-2100	35 km	6 hr	CESM (CMIP5)	WRF
Contact: L. Ruby Leung, PNNL						
RCP4.5	North America	1975 - 2005, 2005 - 2100	20 km	hourly	CCSM4	WRF-CLM
Contact: Xin-Zhong Liang, Univ Maryland						
SRES A2	US+PartialMex/Can	2090-2099	30 km	3 hr	HadCM3P	CMM5
SRES B2	US+PartialMex/Can	2090-2099	30 km	3 hr	HadCM3P	CMM5
SRES B1	US+PartialMex/Can	2045-2055, 2090-2099	30 km	3 hr	PCM	CMM5
SRES A1Fi	US+PartialMex/Can	2090-2099	30km	3 hr	PCM	CMM5
SRES A1b	US+PartialMex/Can	2045-2055, 2090-2099	30 km	3 hr	CCSM	CMM5
SRES B1	US+PartialMex/Can	2045-2055, 2090-2099	30 km	3 hr	CCSM	CMM5
SRES A1Fi	US+PartialMex/Can	2045-2055, 2090-2099	30 km	3 hr	CCSM	CMM5
Contact: Steve Hostetler, USGS						
SRES A2	US & S. CANADA	2010-2099	50 km	Monthly stats	MPI ECHAM5	RegCM3
SRES A2	US & S. CANADA	2038-2069	50 km	Monthly stats	GFDL CM2.0	RegCM3
SRES A2	US & S. CANADA	2010-2099	50 km	Monthly stats	PSU/SGS GENMOM	RegCM3
SRES A2	W. US (with Canada)	2010-2099	15 km	Monthly stats	MPI ECHAM5	RegCM3
SRES A2	W. US (with Canada)	2038-2069	15 km	Monthly stats	GFDL CM2.0	RegCM3
SRES A2	W. US (with Canada)	2010-2099	15 km	Monthly stats	PSU/USGS GENMOM	RegCM3
SRES A2	E. US (with Canada)	2020-2099	15 km	Monthly stats	MPI ECHAM5	RegCM3
SRES A2	E. US (with Canada)	2038-2069	15 km	Monthly stats	GFDL CM2.0	RegCM3
SRES A2	E. US (with Canada)	2020-2080	15 km	Monthly stats	PSU/USGS GENMOM	RegCM3
Total						
Contact: John Mejia, Desert Research Institute, Nevada						
SRES A2	Western N. America	1980-2000, 2041-2070	36 and 12 km	3 hr	CCSM	WRF
SRES A2	Western N. America	1980-2000	36 and 12 km	3 hr	CCSM-SST biases	WRF
Contact: Norm Miller, Lawrence Berkeley Laboratory						
SRES or RCP x	Western US and CA/NV	1985-1994, 2060-2069	32 km (10 km CA/NV)	?	CCSM3	WRF-CLM
SRES or RCP y	Western US and CA/NV	1985-1994, 2060-2070	32 km (10 km CA/NV)	?	CCSM3	WRF-CLM
			32 km (10 km			

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Priorities

- T, P, Wind, Solar: What we care about most
- Subdaily saved data: Can we make it available?
- Higher resolution GCM runs: Next best thing?
- Focus on central latitude precipitation: Continued improvement to Tropical Pacific, etc.
- Improved characterization of uncertainty
- “Community” archived datasets: Accessible multi-model ensembles
- Dynamical, other downscaling experiments that respond to our scale needs
- CORDEX-inspired experiments

Provided to National Academies Committee on the Future of Climate Modeling in the United States

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Piloting Utility Modeling Applications (PUMA): An "Assessment Expedition"

Five Utilities

San Francisco PUC
Portland Water Bureau
Seattle Public Utilities
Tampa Bay Water
New York City DEP

Four Climate Science Consortiums

NCAR/Climate Central/CNAP (CA-NV RISA)
Climate Decision Support Consortium (Northwest RISA)
Southeast Climate Consortium
CUNY/University of Kansas/Columbia Univ.

Modeling Advisory Committee (MAC)

Phil Duffy (Climate Central); Ed Maurer (Santa Clara); Tom Johnson (EPA); Levi Brekke (BoR); Linda Mearns (NCAR); John Abatzaglou (U. Idaho); Mike Dettinger (Scripps); Claudia Tebaldi (Climate Central); Joe Barsugli (Western Water Assessment)

Project Mgr, WUCA: David Behar

WUCA
Water Utility Climate Alliance

Project Mgr, RISAs: Phil Mote

Summary

- A Key Challenge
  - Creating Symbiosis
    - Collaboration, Co-production of knowledge
- A Core Strength
  - Commitment from all sides
- Some Concrete Tasks
  - Data archiving
  - Enhancement of GCM Ensembles
  - Development of Regional Ensembles
  - Doing Both at the Same Time?!
  - Actionable Science: Creating Value for Assessment

Community Involvement: CESM Management

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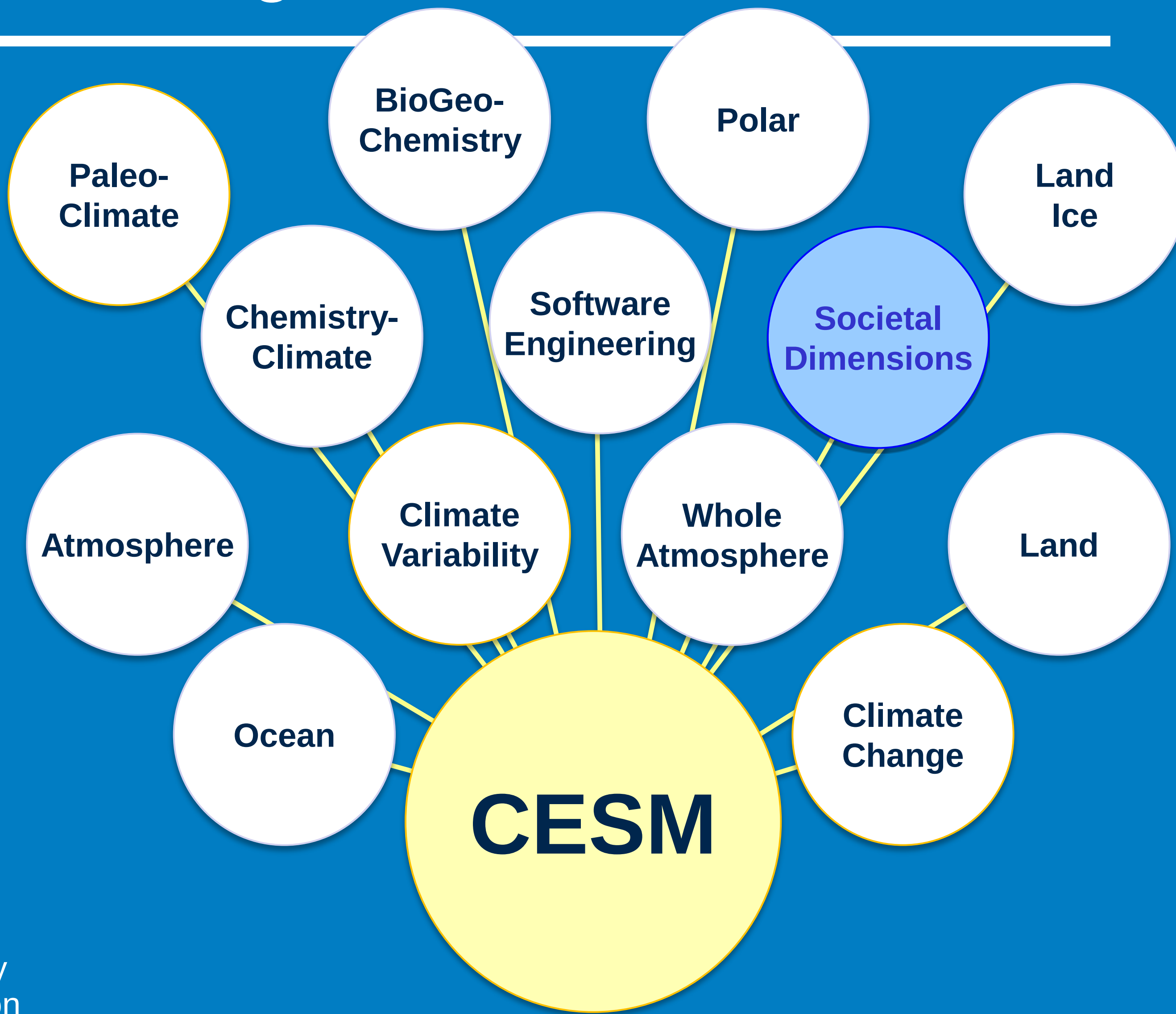
CESM Advisory Board

CESM Scientific Steering Committee



CESM is primarily sponsored by the National Science Foundation and the Department of Energy

http://www.cesm.ucar.edu/management

Thank you

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Chair Emeritus, Water Utility Climate Alliance
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San Francisco, CA 94103
dbehar@sfwater.org 415-554-3221

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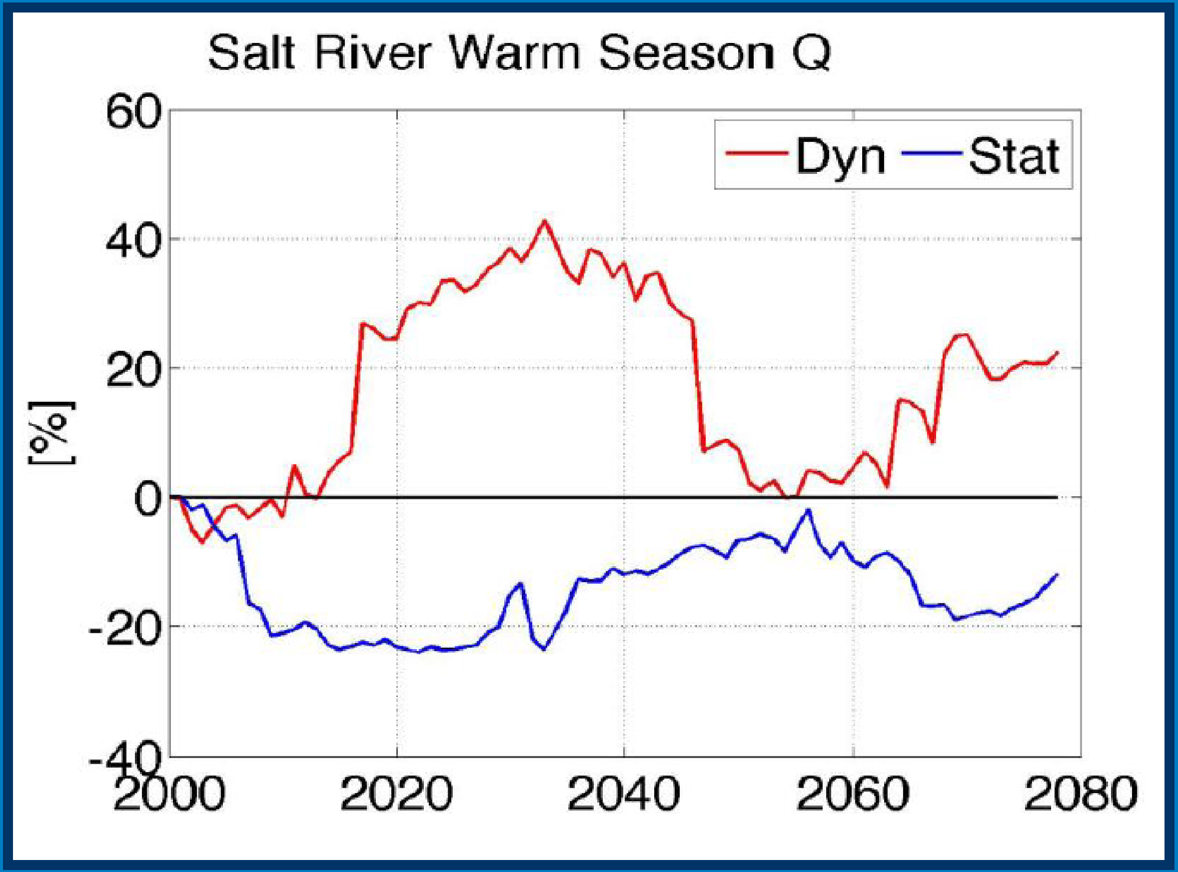
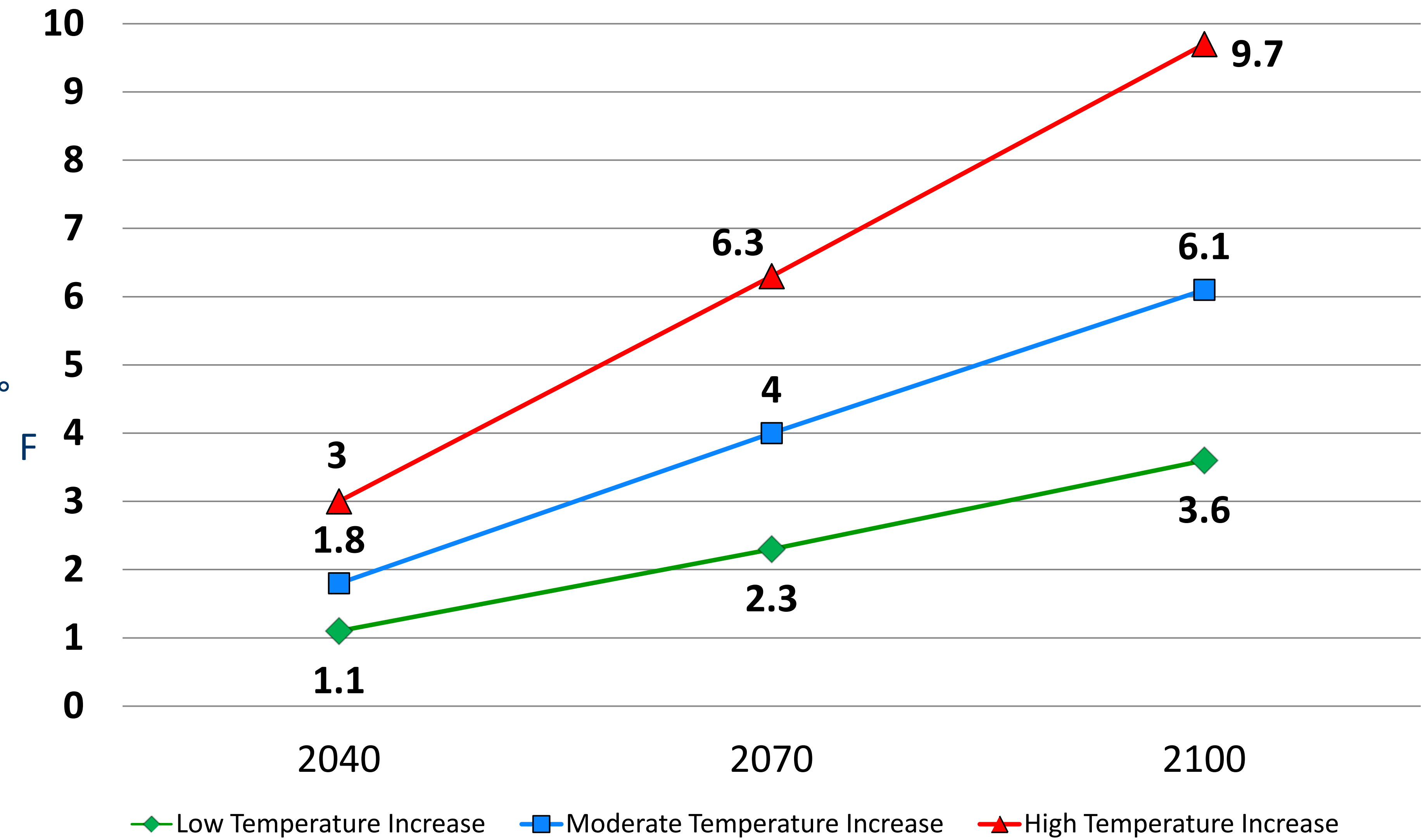
Southwestern United States: Salt River



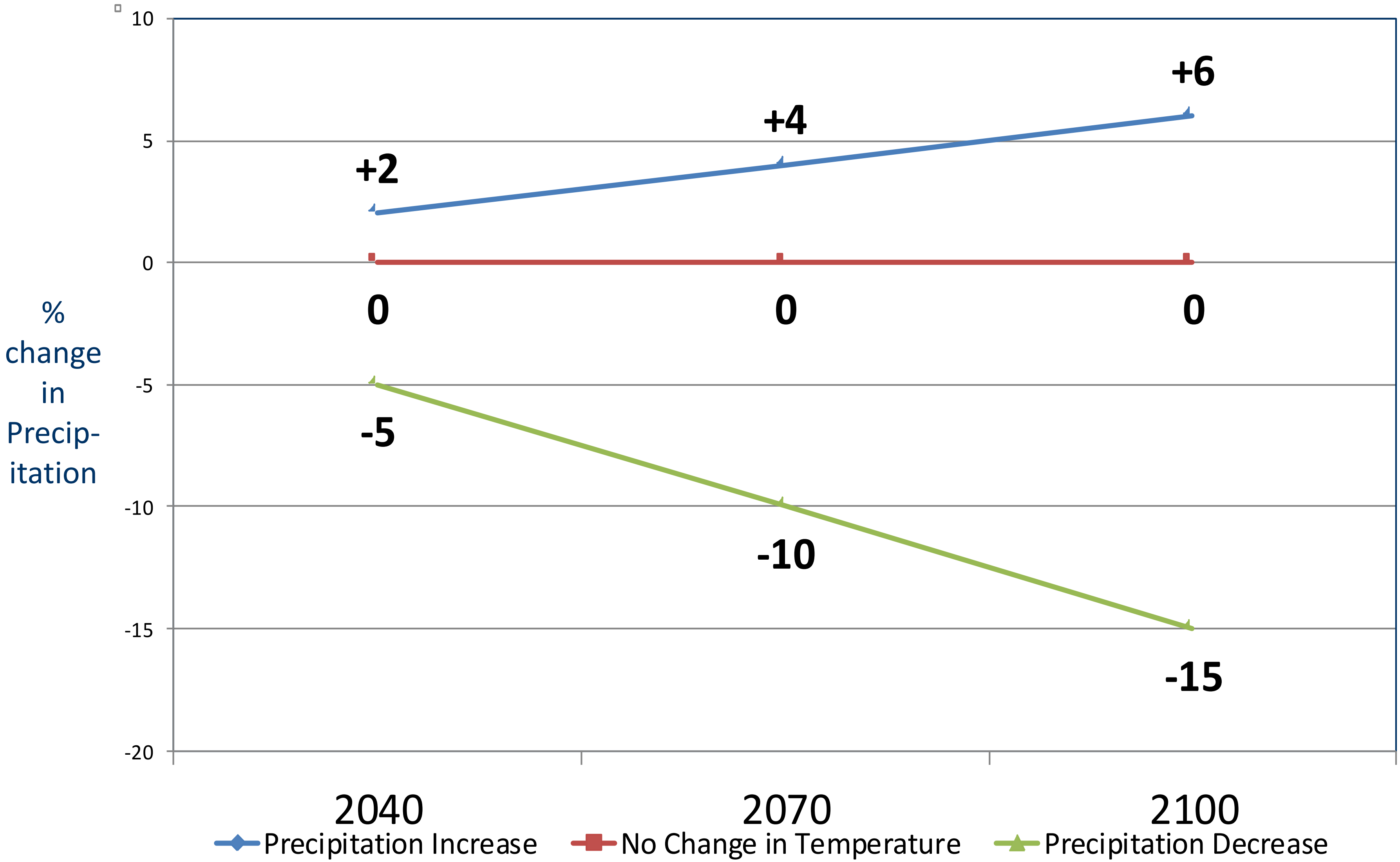
Boundary conditions from HadleyCM3.
Statistically DS data from Maurer et al; dynamically DS data generated using nested WRF

Dominguez, Rajagopal, Castro, Troch, Demaria, Gupta, Durcik, Chang, University of Arizona.
Slide courtesy Gregg Garfin, Institute of the Environment, University of Arizona

SFPUC Sensitivity Analysis: Temperature



SFPUC Sensitivity Analysis: Precipitation



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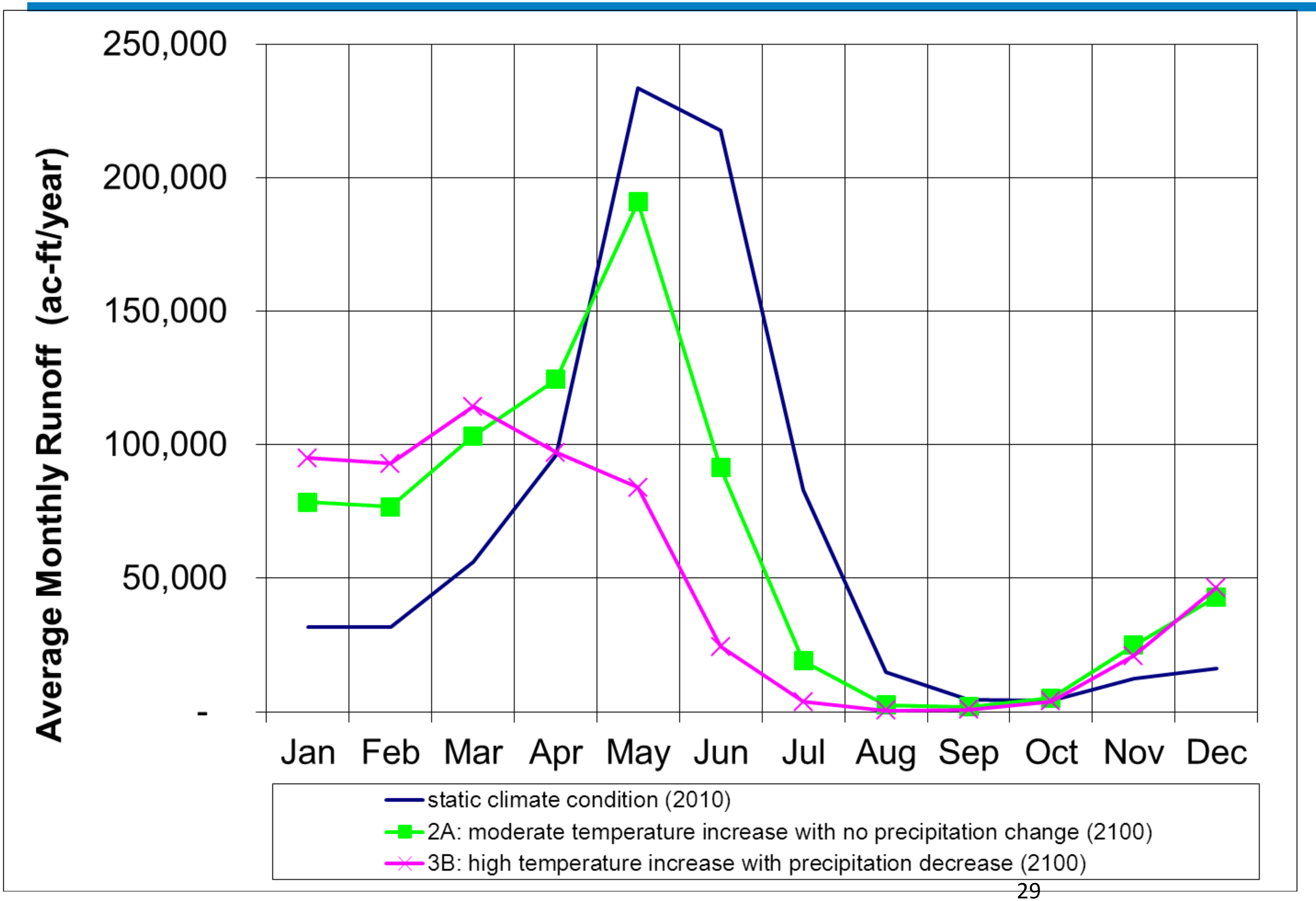
Monthly Runoff into Hetch Hetchy: Two Climate Scenarios for Yr 2100

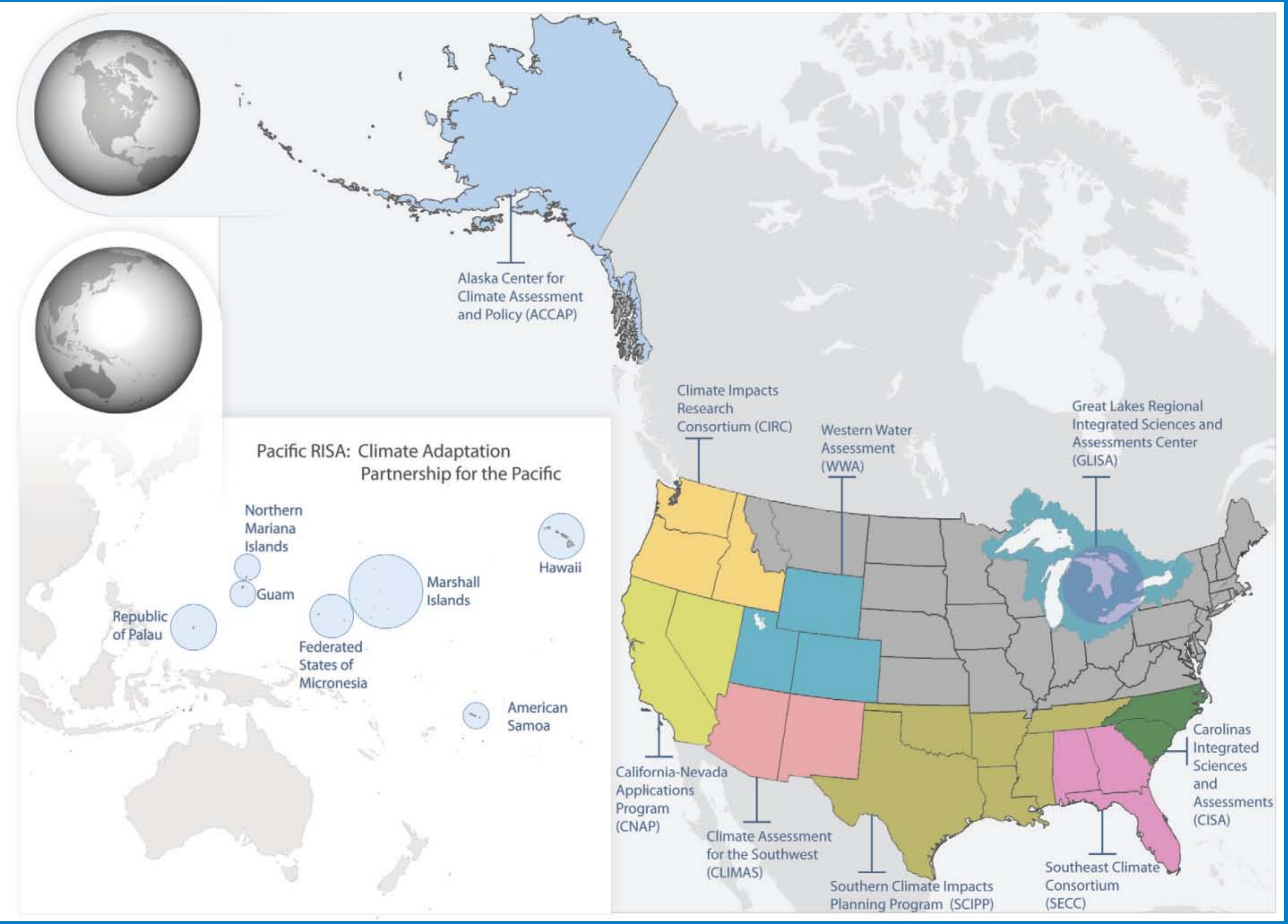


Building on this Study: Next Steps

Next Steps in Climate Change Evaluation:

- Operations/Planning Model runs
  - *The impact on water supply, levels of service, drought preparedness, operations, etc.*
- Climate Change "Assessment"
  - *The likelihood of one climate scenario over another*
  - *Parameters in addition to T and P*
  - *Seasonal or diurnal differences in the effects of climate change*
  - *Climate extremes (drought, storm intensity)*
  - *Characterization of uncertainty*

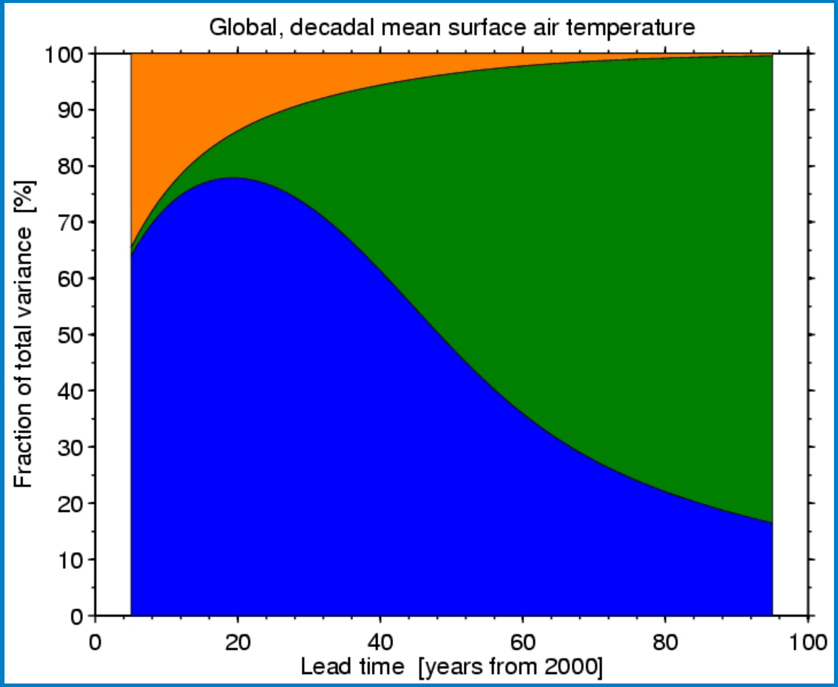
Regional Integrated Sciences and Assessments (RISA) Program

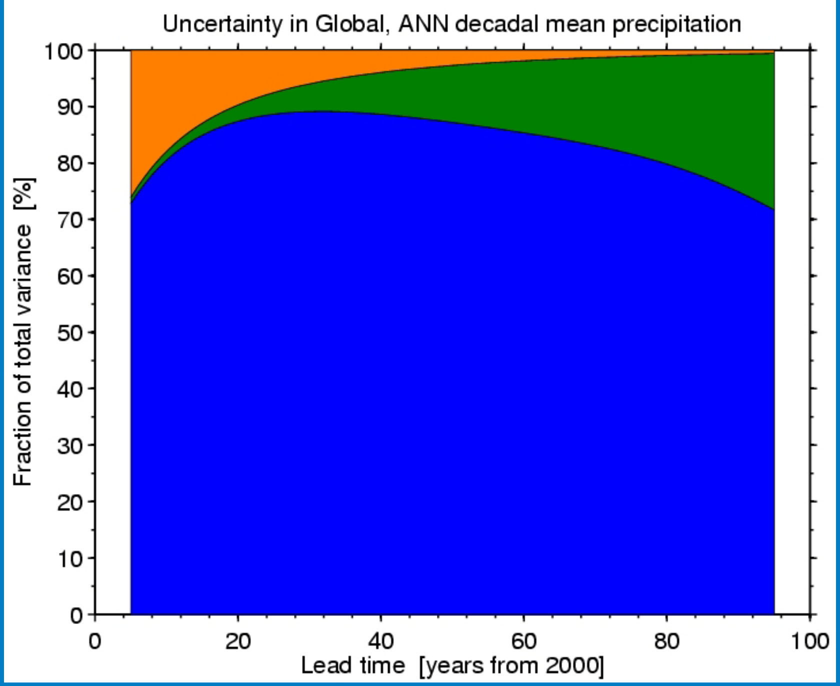


"supports research that addresses complex climate sensitive issues of concern to decision-makers and policy planners at a regional level."

Uncertainty: Natural variability/ Emissions scenario/Model uncertainty

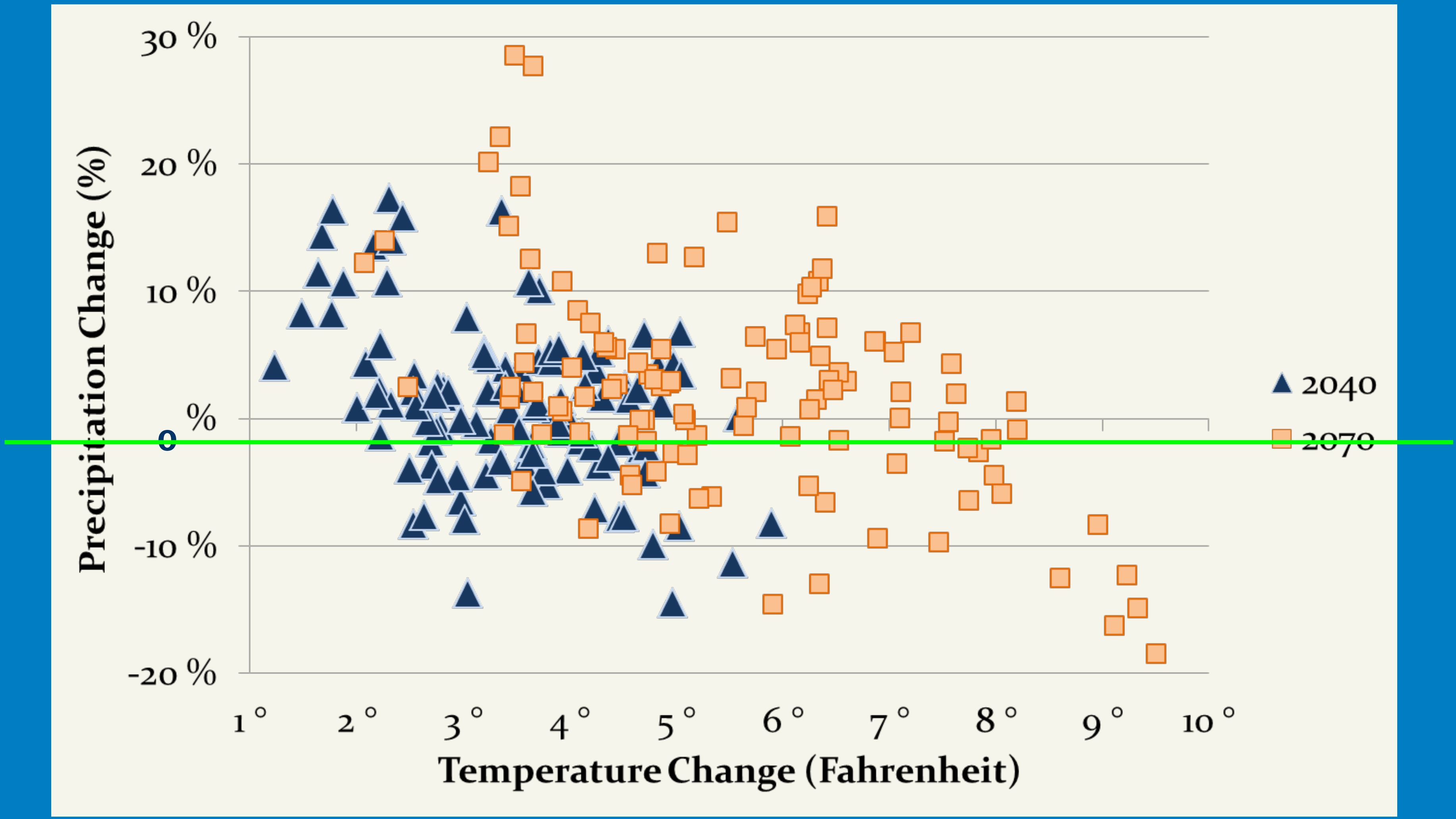
- Emissions uncertainty
- Internal variability
- Model uncertainty





From Hawkins & Sutton 2009 (BAMS) and 2010 (Climate Dynamics)

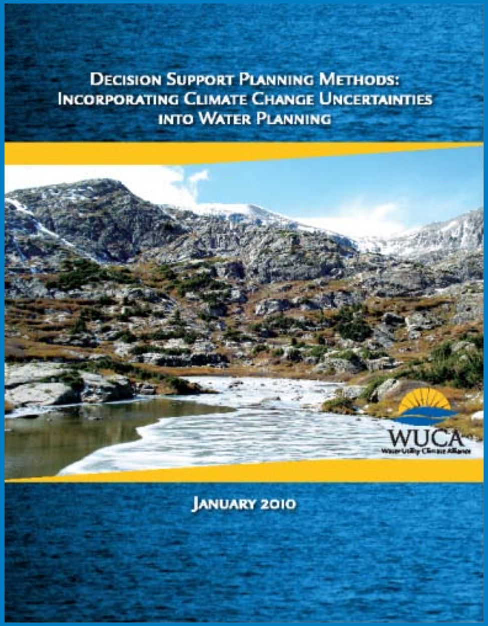
Projected Changes for Denver's Watershed



Slide courtesy Denver Water

Decision Support Planning Methods

- Classic decision analysis
- Traditional scenario planning
- Robust decision making
- Real options
- Portfolio planning



"Decision Support Planning Methods: Incorporating Climate Change Uncertainties into Water Planning," Means, Laurier, Kaatz, Waage, January 2010,

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Needed from Ratepayers through 2050:

$1.7 - 2.2 Trillion

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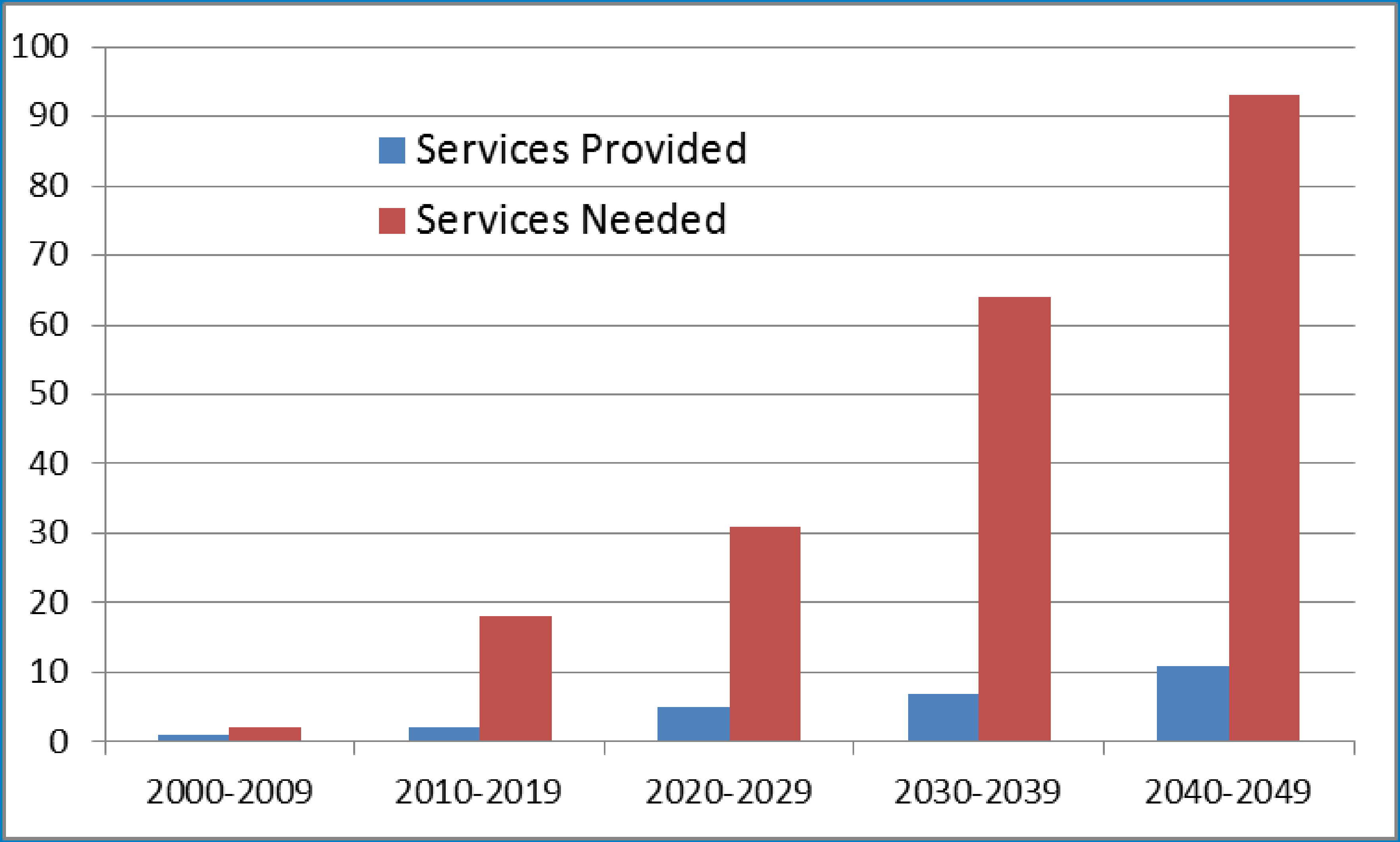
A Climate Services Scenario



Note: fake data – for illustration purposes only