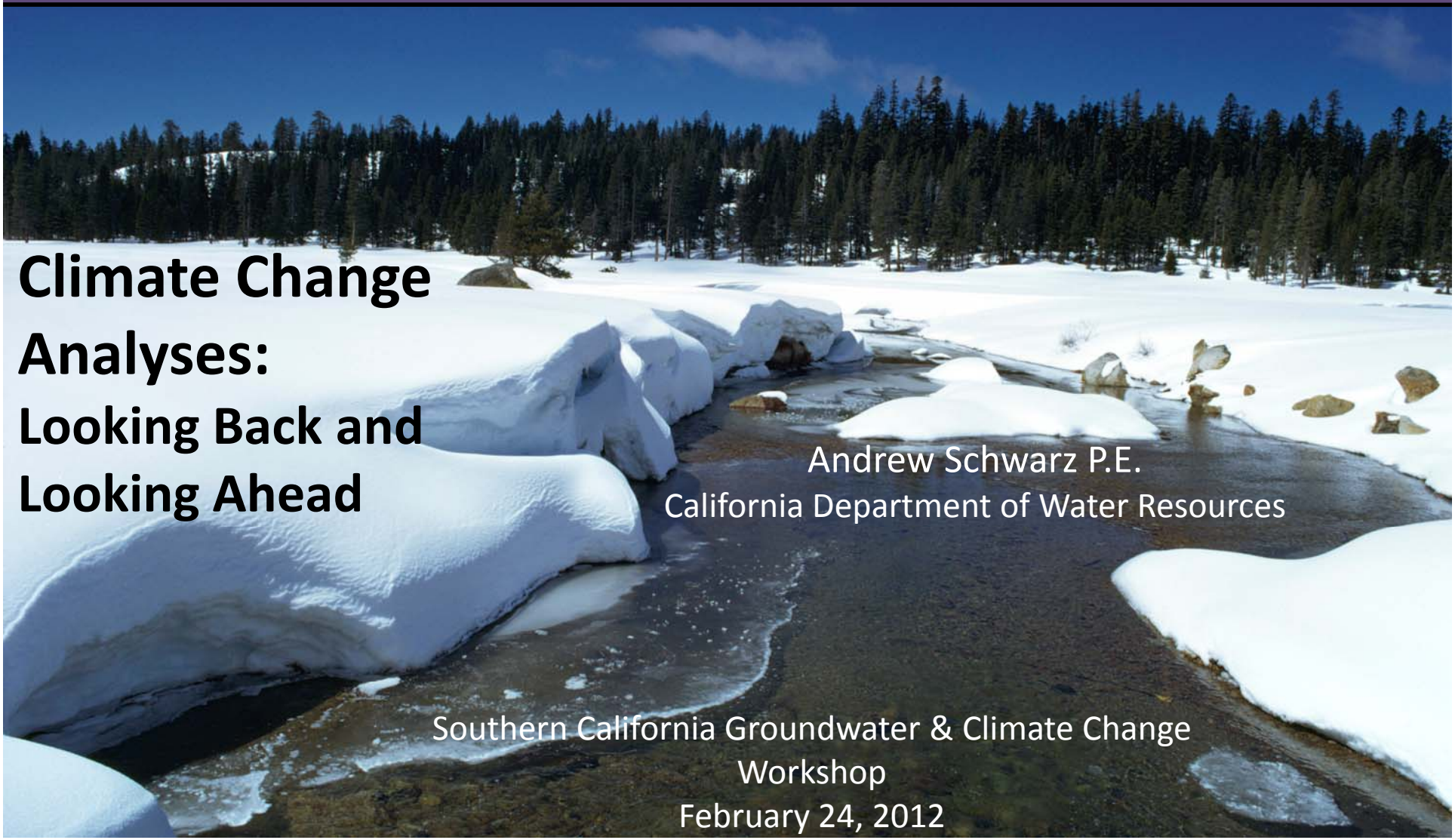
# CEQA and CLIMATE CHANGE

AT THE DEPARTMENT OF WATER RESOURCES



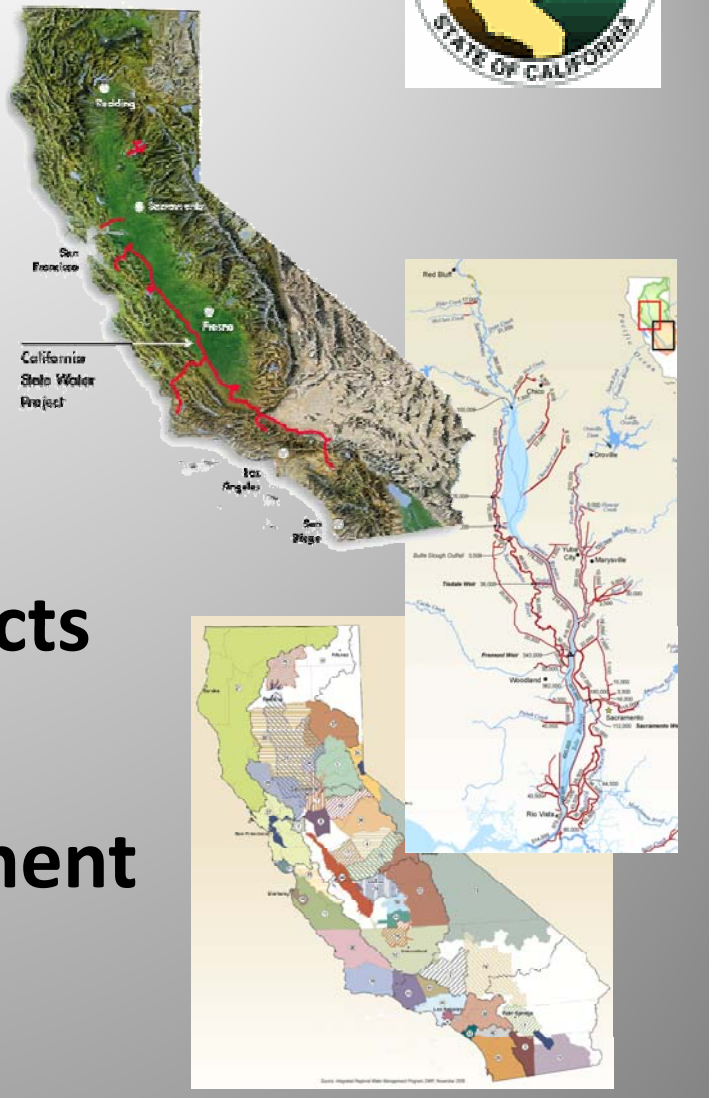
## Climate Change Analyses:
## Looking Back and Looking Ahead

Andrew Schwarz P.E.
California Department of Water Resources

Southern California Groundwater & Climate Change Workshop
February 24, 2012

# DWR

- State Water Project
- 1,600 miles of levees
- Planning, constructing, and managing water supply, flood control, and restoration projects
- Grant and local assistance programs  for water management
- Dam Safety



# Climate Quiz!

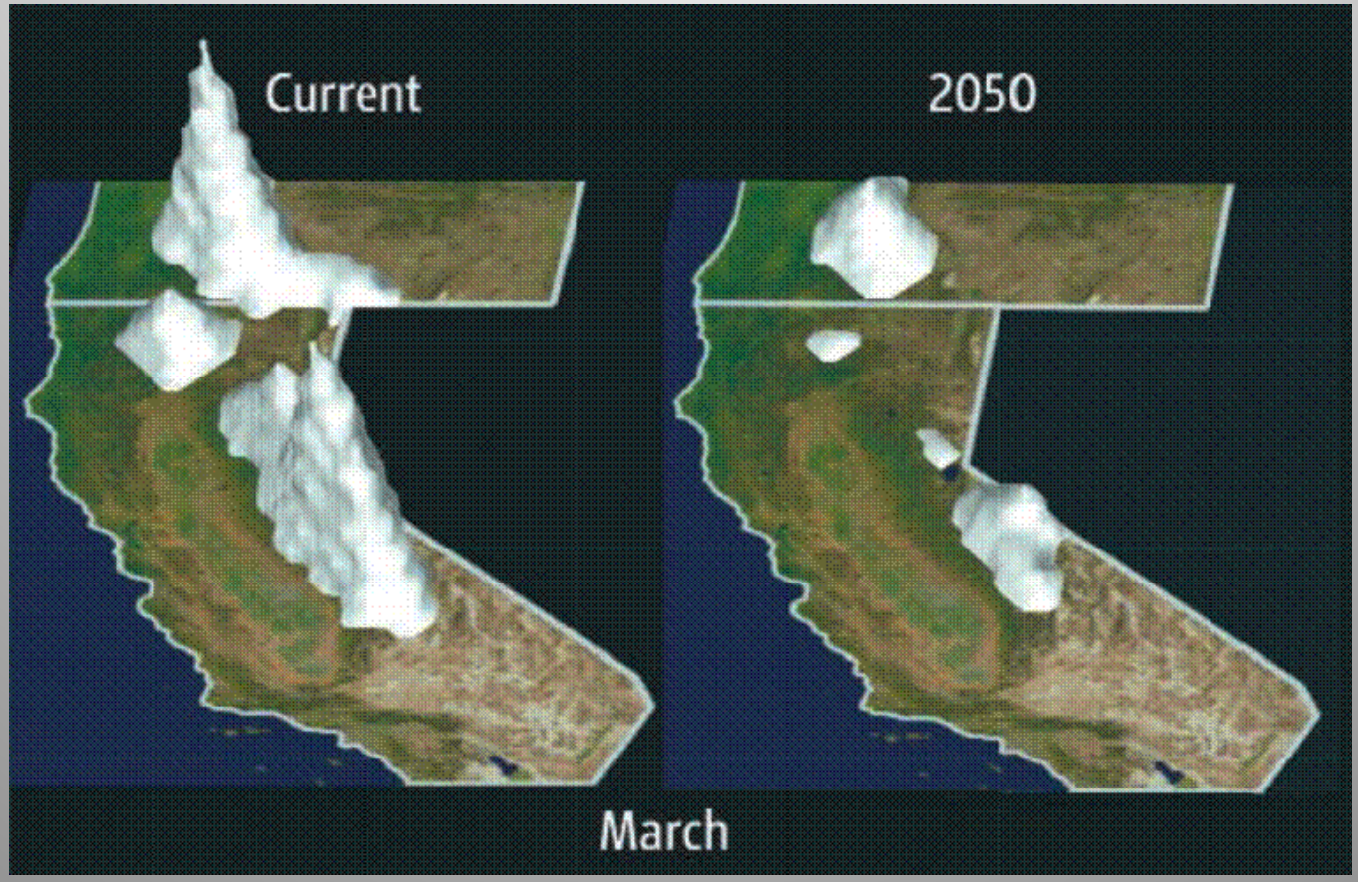
**How much of a reduction in Sierra Nevada snowpack has been measured by DWR in the past 100 years?**

**A. 1%**
**B. 5%**
**C. 10%**
**D. 15%**

***1.5 million acre-feet of lost storage***

# The Problem

## Snowpack Reduction

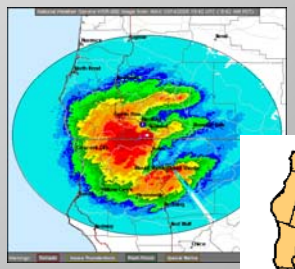


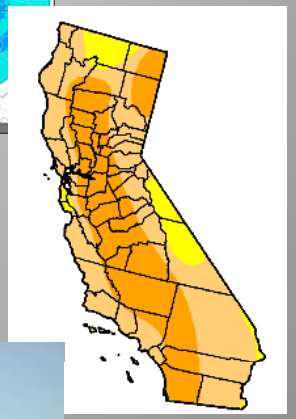

Scripps Institute of Oceanography

# The Problem

## In the next 40 years . . .

- 3.5 – 11º F temp rise (end of century)
- 25 - 40 % less snowpack
- More intense wet and dry periods
- Less summer runoff
- Higher flood peaks
- Sea Level rise: 4-16” (7-55” by 2100)
- Increased salinity in the Delta





# Climate Change Poses Significant Challenges for Water Resources Management in CA

2010 Report:

## "Climate Change Characterization and Analysis in California Water Resources Planning Studies"

Abdul Khan and Andrew Schwarz

http://www.water.ca.gov/climatechange/docs/DWR_CCCStudy_FinalReport_Dec23.pdf

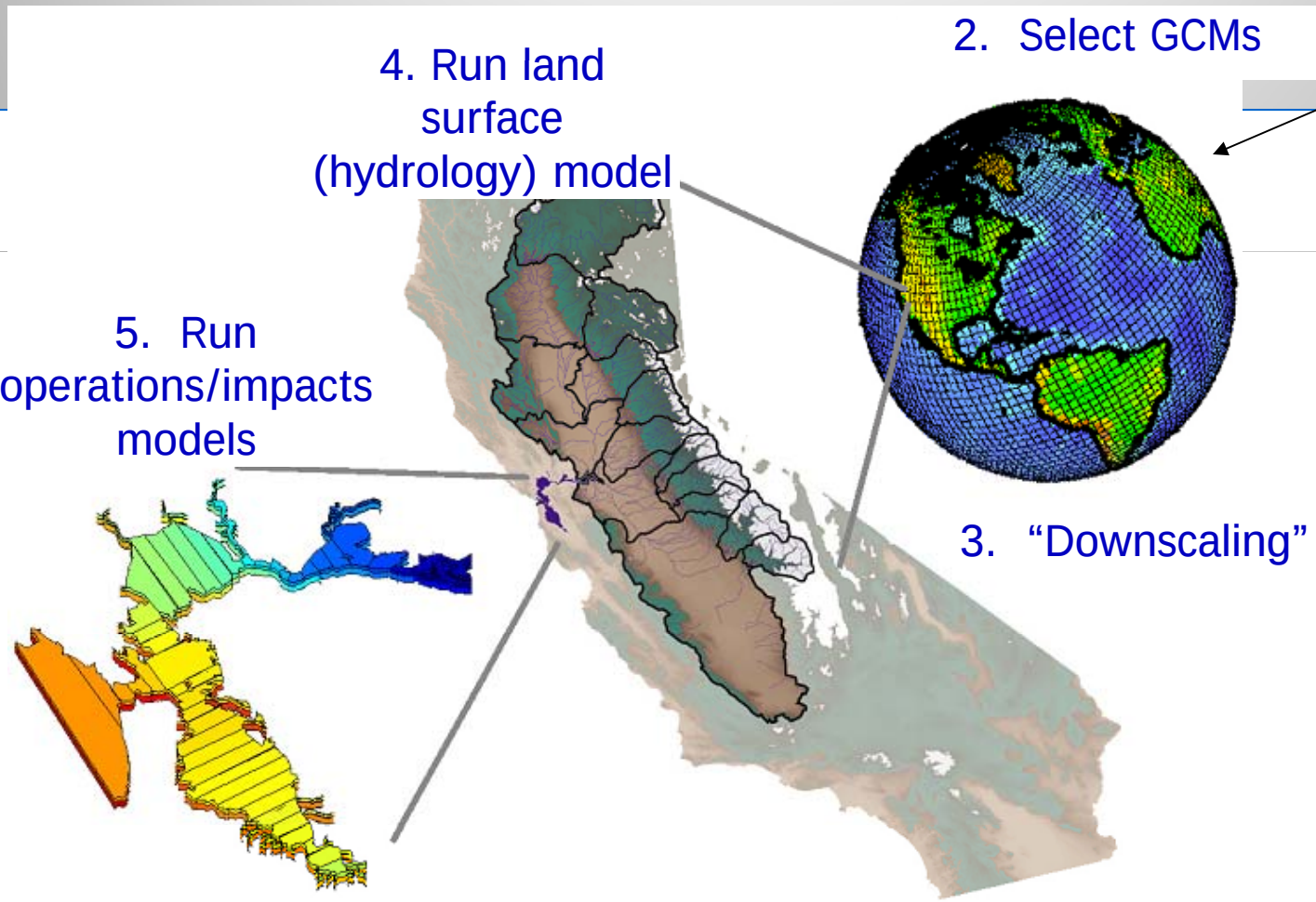
# Contemporary Approaches to Climate Change by DWR

- Scenario approach
- Ensemble informed approach
- Relative change approach
- Qualitative approach

Two supplementary analysis approaches:

  - Paleoclimate data
  - Sensitivity analysis

# All Approaches Follow Similar Steps

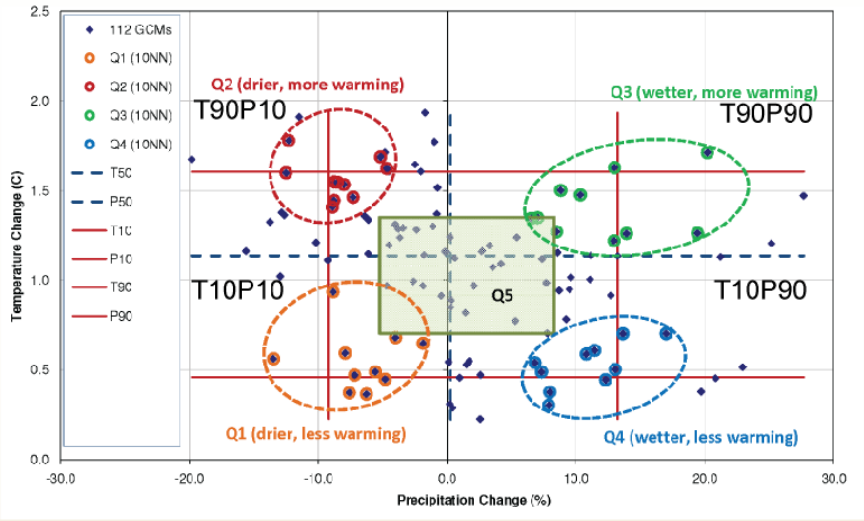



**Maurer, 2009 as Adapted from Cayan and Knowles, SCRIPPS/USGS, 2003**

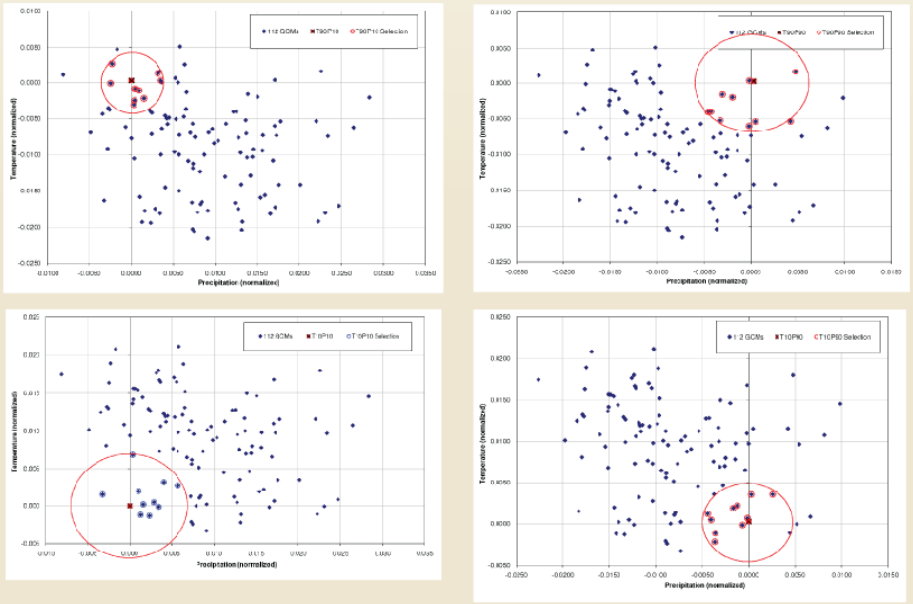
# Scenario Approach (CAT 2009 Approach)

- 2 SRES GHG emission scenarios – A2 and B1
- 6 GCMs
- 12 GCM Simulations (6X2)
- Downscaling: BCSD and CA

# Ensemble Informed Approach (BDCP)




(a) Scenario identification through relationship between changes in mean annual temperature and precipitation (Feather River Basin)



(b) 10 nearest neighbor GCM data mapping in normalized spaces: Feather River (63, 28)

# Findings

## General:

- A range of approaches used
- Approaches reveal an evolution in sophistication
- More advanced methods for longer planning horizon & larger spatial scales
- Trend: to use more quantitative & analytical approaches

# Findings

## Use of Global Climate Model Data:

- Reliance on data from 112 downscaled DOI/LLNL dataset
- Entire DOI/LNLL data set or a subset used
- GCM projections are used both directly & indirectly
- Regional downscaling of data mostly by BCSD
- Primary climate variables used are: temperature, precipitation, and humidity

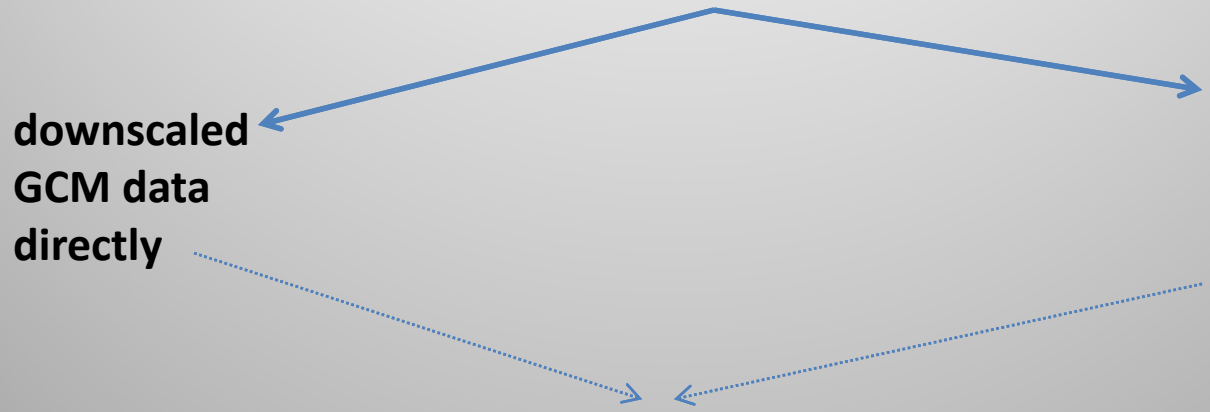
# Findings

**Planning Horizon:**

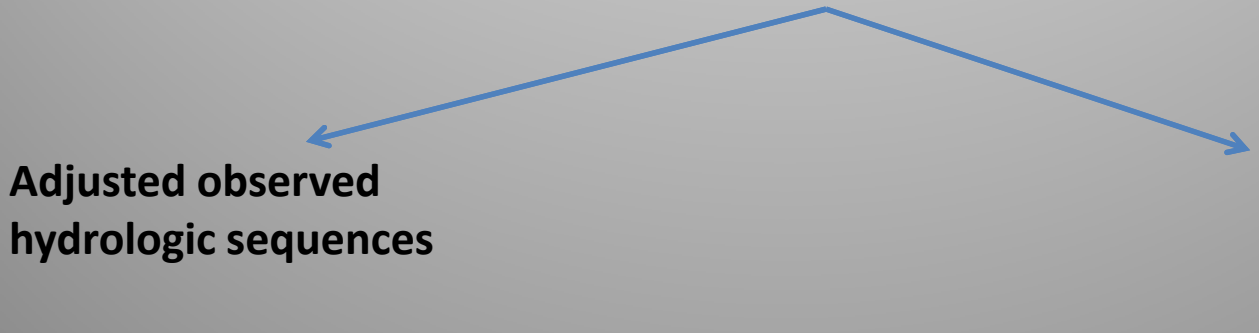
- **Studies reviewed: 15 - 70 years**
- **Studies with planning horizon greater than 15 years incorporates climate change analysis**

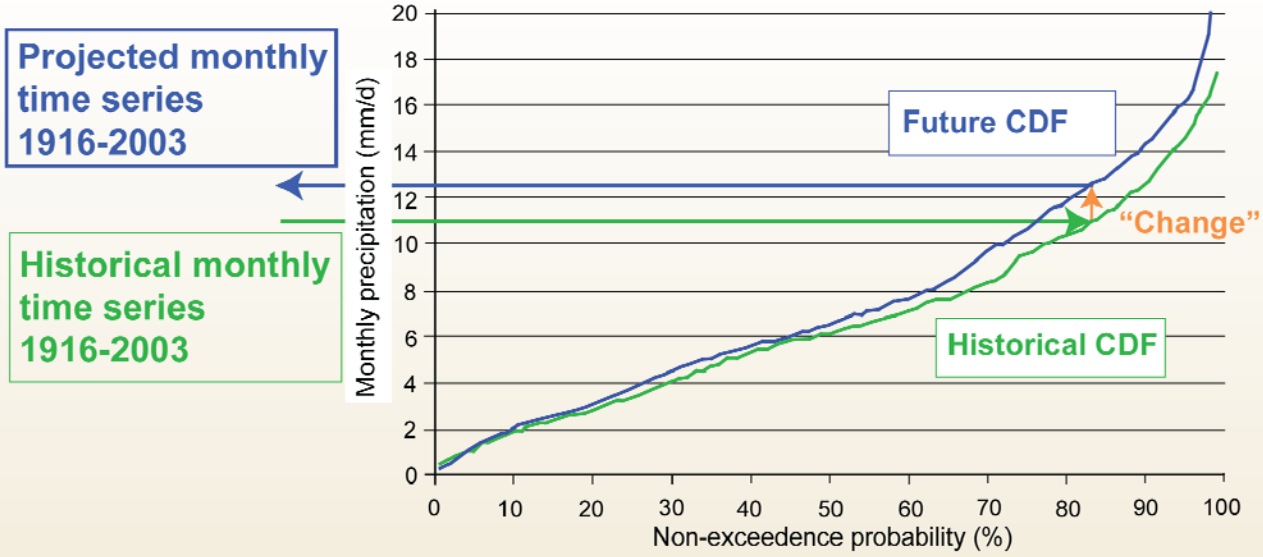
# Findings:
# Analytical Differences

## Characterization of Climate Variability:

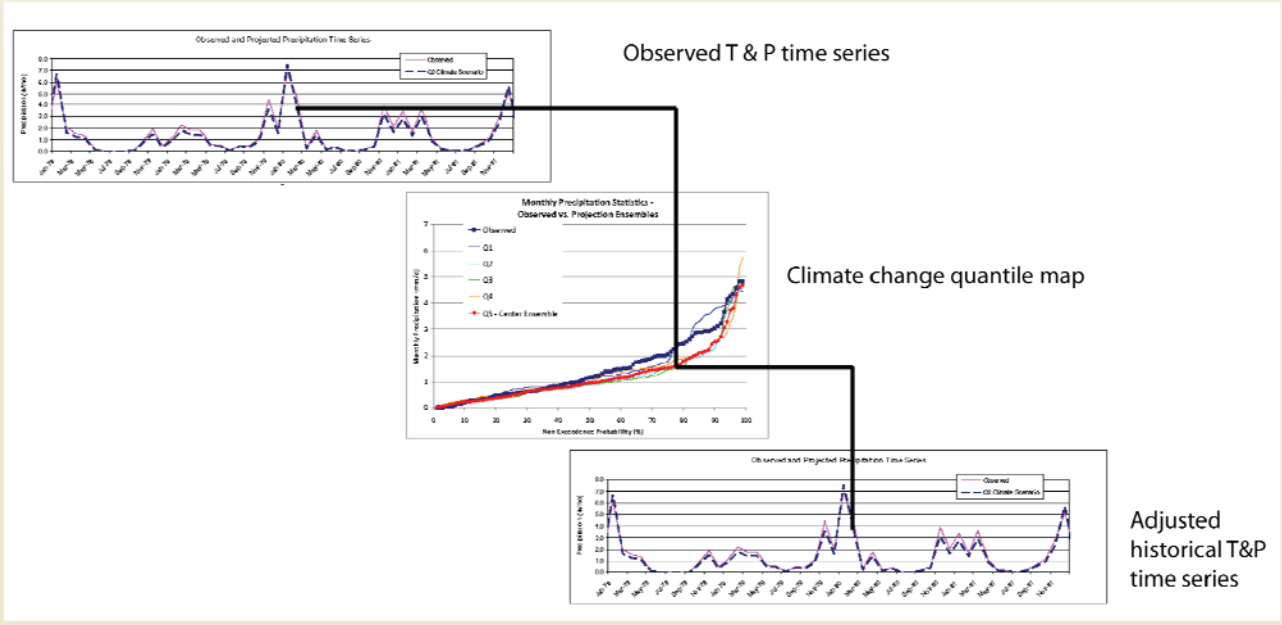



## Simulation of Future Hydrology:






(a) Monthly climate data statistics--historical vs. future



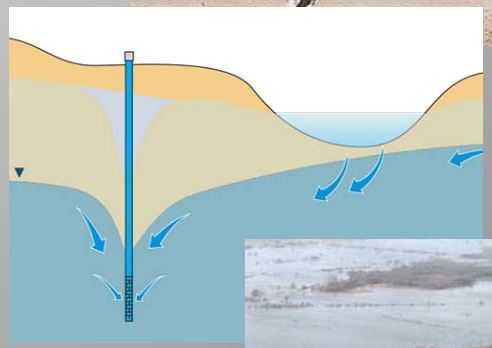

(b) Temperature and precipitation time series development

# Sea Level Rise:

- Not considered in several studies
- 1-foot sea level rise assumption for studies with a planning horizon: 2030 to 2050
- 2-feet sea level rise assumption for studies with a planning horizon: 2085 or longer
- Most estimates based on Rahmstorf ( 2007)

# Data Gaps & Needs Assessment

- No assessment of drought conditions that are more extreme than hydrologic records
- No analysis of groundwater impacts
- No analysis of surface water-groundwater interaction
- No analysis of flood protection projects



# Looking Forward


- DWR has put together a Climate Change Technical Advisory Committee
  - 15 members (climatologists, hydrologists, planners, lawyers)
  - Advise DWR on a myriad of climate change issues
- DWR has an internal workgroup developing guidance on the use of climate change simulations and analytical approaches
  - Internal guidance
  - Web portal development to share analysis and data sets

# Questions?

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