

Climate Change in Long Term Water Resources Planning: California Case

ILSI-INDIA/CIMSANS
Bangalore, India

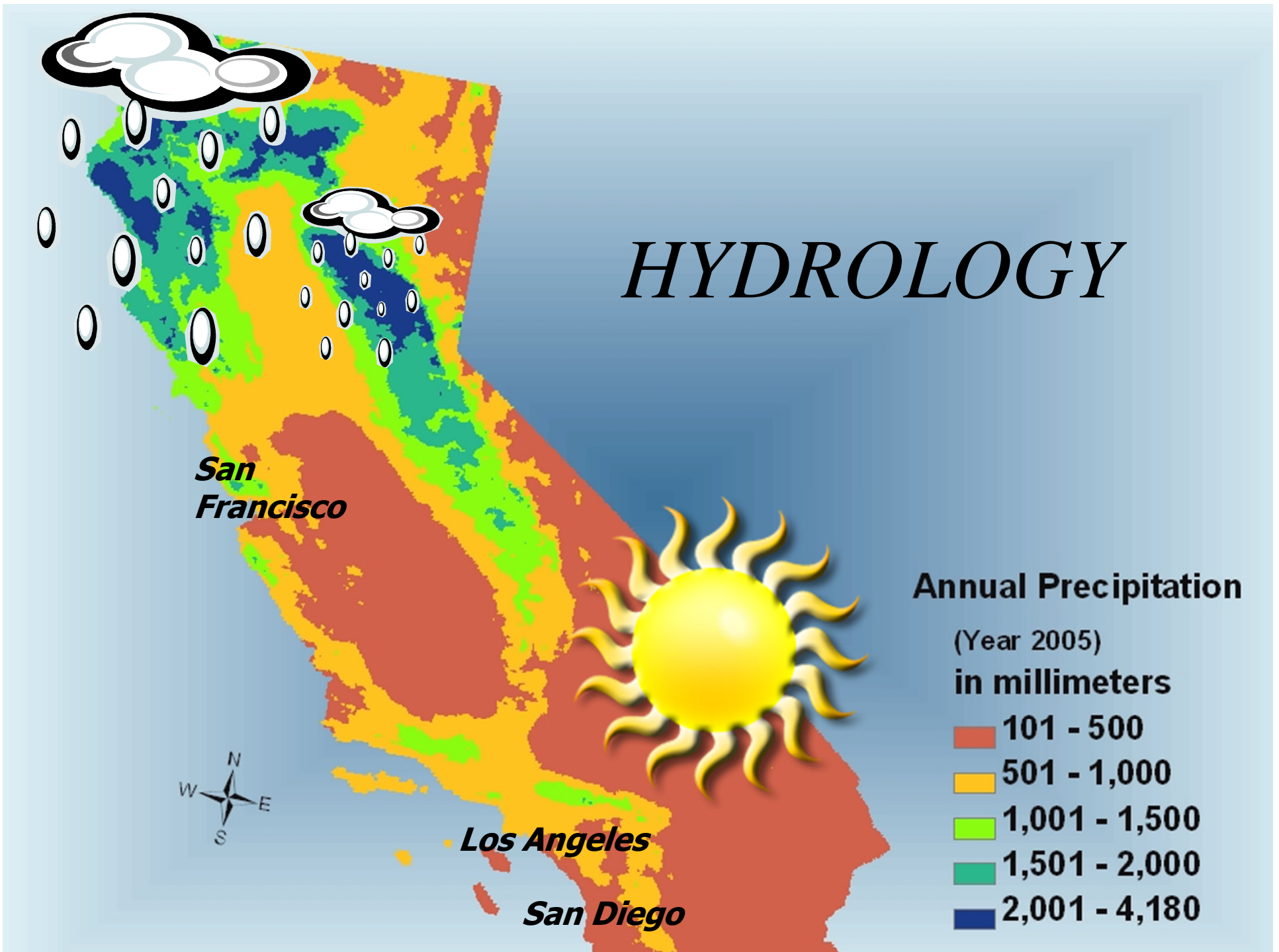
November 15, 2013
Francis Chung, Ph.D. ,P.E.
California Department of Water Resources

HYDROLOGY

Annual Precipitation

(Year 2005)

in millimeters



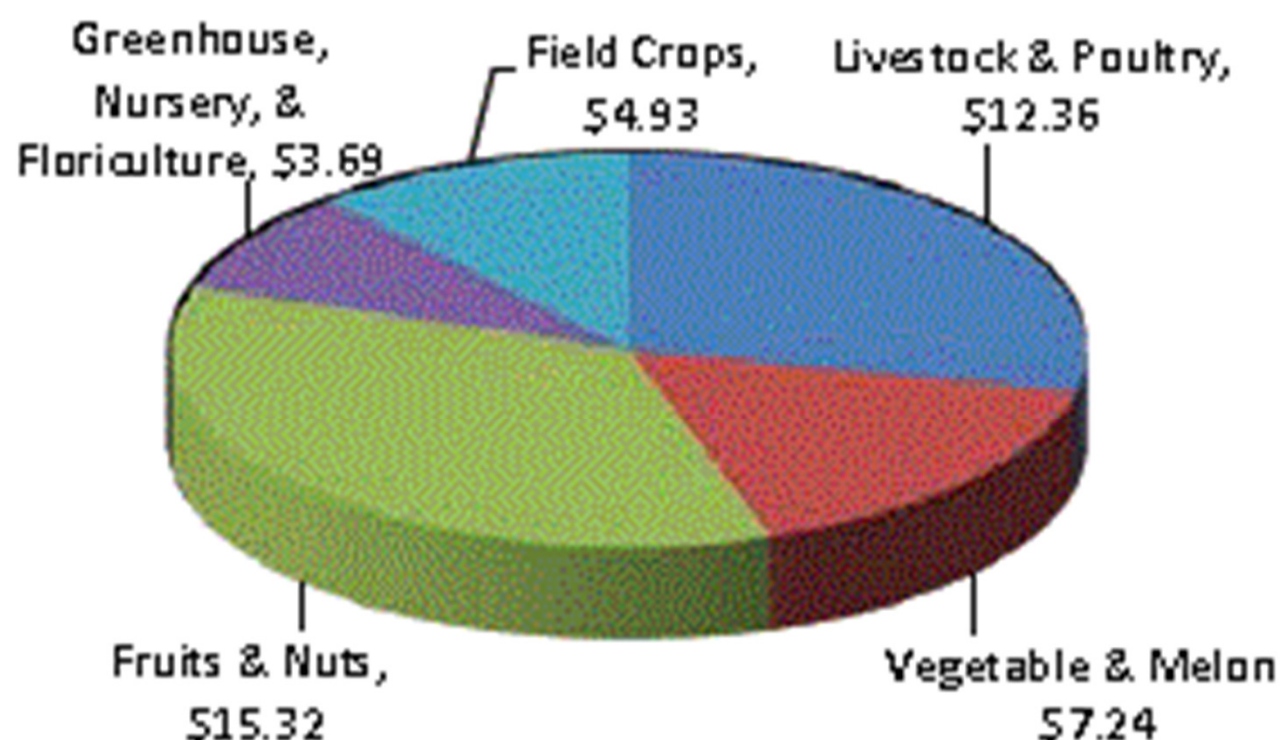
ECONOMY

\$1.8 Trillion in GDP makes **California** the 8th largest economy in the world



1. United States (14.2)
2. Japan (4.9)
3. China (3.8)
4. Germany (3.6)
5. France (2.8)
6. United Kingdom (2.6)
7. Italy (2.3)
- 8. California (1.8)**
9. Brazil (1.6)
10. Russia (1.6)

California's Gross Cash Receipts, 2011 \$43.5 Billion*



*Totals may not add due to rounding.

Top 5 Agricultural States in Cash Receipts, 2011

State	Rank	Total Value Billion Dollars
California	1	43.5
Iowa	2	29.9
Texas	3	22.7
Nebraska	4	21.8
Illinois	5	19.8

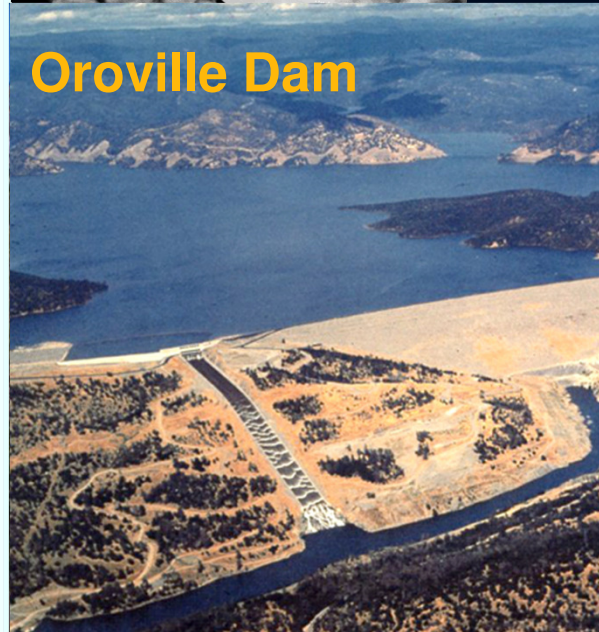
California's Top 10 Agricultural Export Markets, 2011

Rank	Country	Export Value Millions	Leading Exports
1	Canada	3,049	Wine, Lettuce, Strawberries
2	European Union	2,214	Almonds, Wine, Pistachios
3	China/Hong Kong	1,382	Almonds, Pistachios, Walnuts
4	Japan	1,415	Rice, Almonds, Beef and Products
5	Mexico	661	Dairy and Products, Processed Tomatoes, Table Grapes
6	South Korea	577	Oranges and Products, Rice, Beef and Products
7	India	360	Almonds, Cotton, Oranges and Products
8	United Arab Emirates	341	Almonds, Walnuts, Hay
9	Turkey	321	Walnuts, Almonds, Processed Tomatoes
10	Taiwan	249	Beef and Products, Almonds, Rice

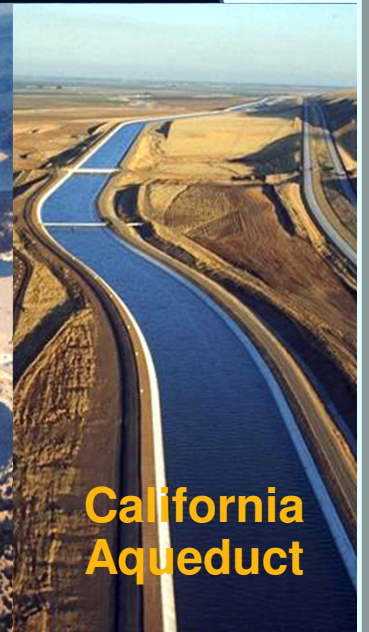
California Water Development



Oroville Dam



California Aqueduct



**CA Department of
Water Resources
State Water Project**
1960 - Burns Porter Act
1973 - 1st water to So.Cal.

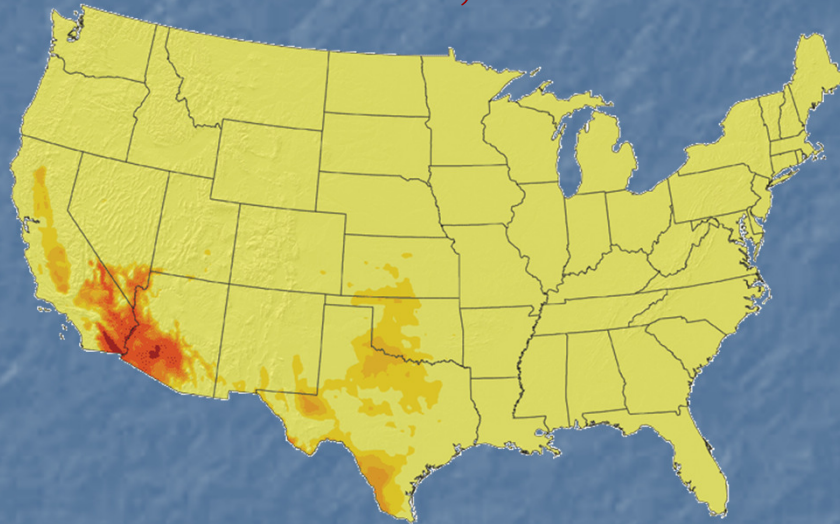
Potential Impacts of Climate Change



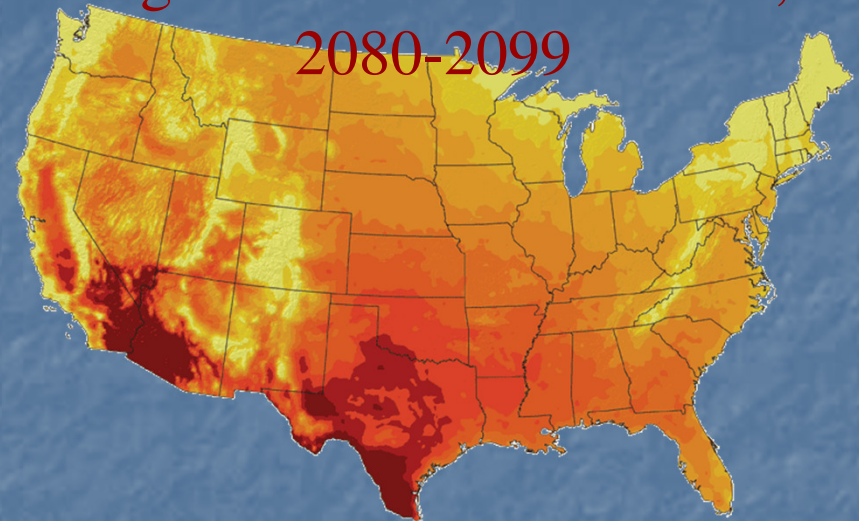
Increases in very high temperatures will have wide-ranging effects.

Number of Days Over 100°F

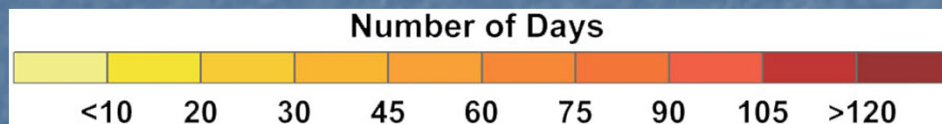
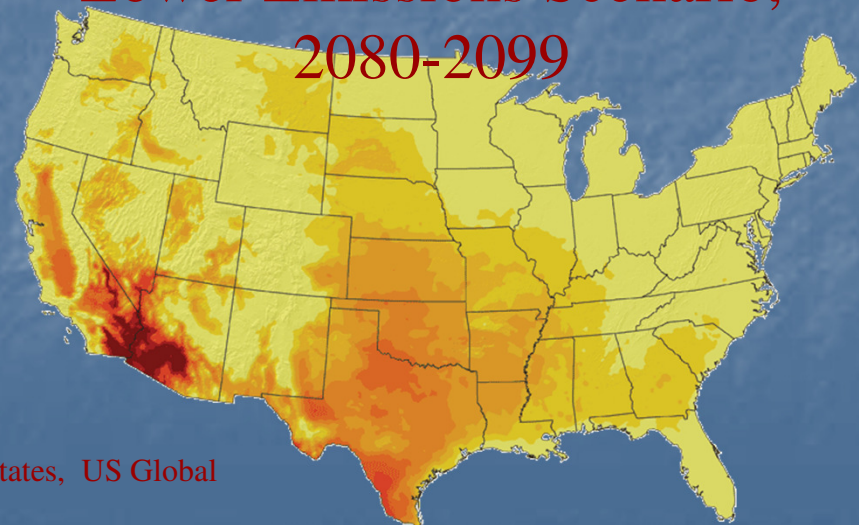
Recent Past, 1961-1979



Higher Emissions Scenario, 2080-2099



Lower Emissions Scenario, 2080-2099



From "Global Climate Change Impacts in the United States, US Global Change Research Program, June 2009"

Climate Change: Stressing Our Water System

What are the Expected Impacts from These Changes?

Climate change is already having a profound effect on California's water resources as evidenced by changes in snowpack, river flows, and sea levels. Scientific studies show these changes will increase stress on the water system in the future. Because some level of climate change is inevitable, the water system must be adaptable to change.

The impacts of these changes will gradually increase during this century and beyond. California needs to plan for water system modifications that adapt to the following impacts of climate change:

Water Supply

Changes in river flow impacts water supply, water quality, fisheries, and recreation activities.



A 25% reduction of snowpack will change water supply.



Ecosystem

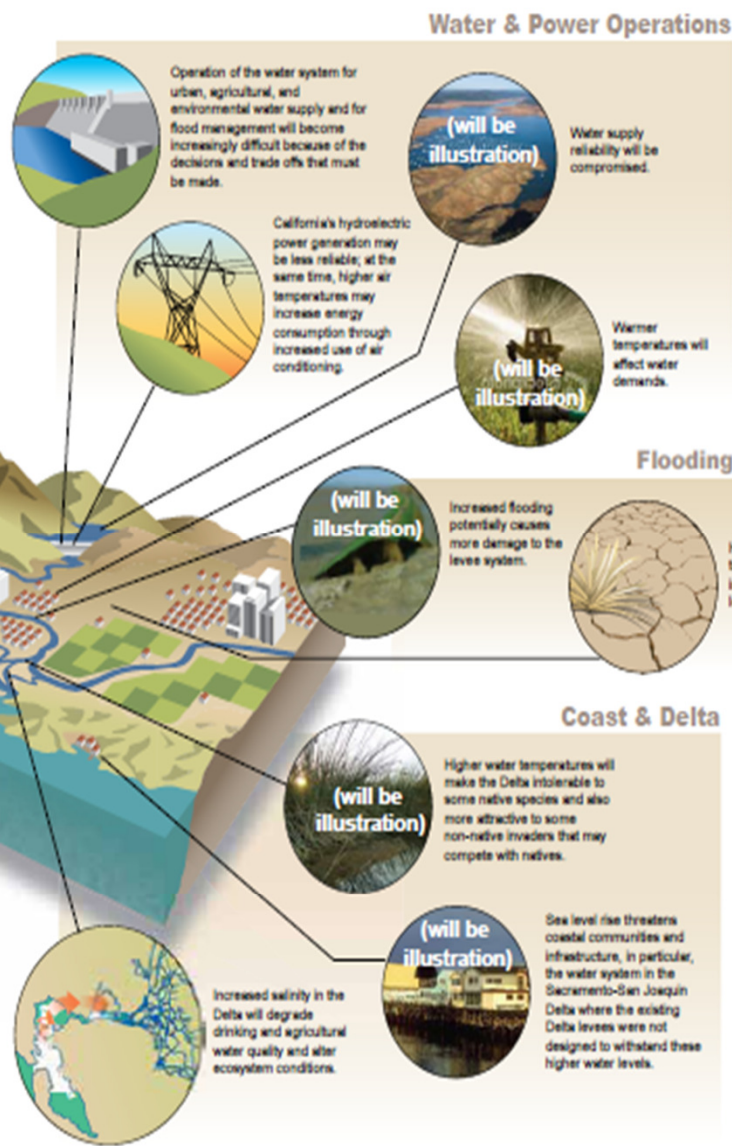
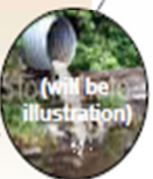
Forests, important contributors to water supply and quality, will be more vulnerable to pests, disease, changes in species composition, and fire.



Increases in water temperature and reductions in cold water in upstream reservoirs may hurt spawning and recruitment success of native fishes.



Lower streamflows will tend to concentrate urban and agricultural runoff, creating more water quality problems.

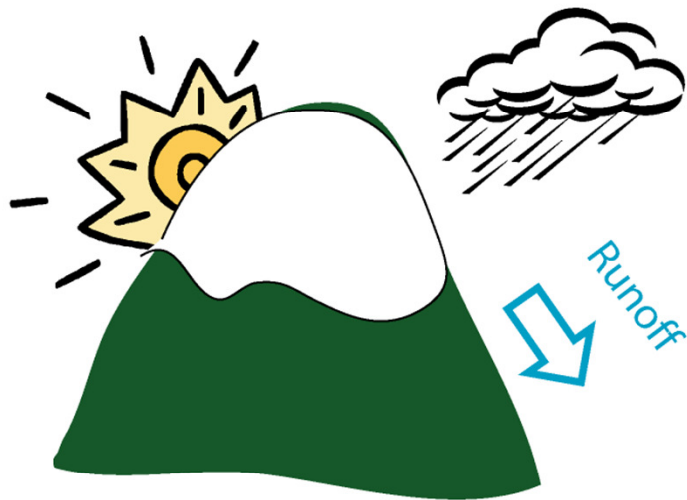


Climate Change Impacts on California's Water Resources

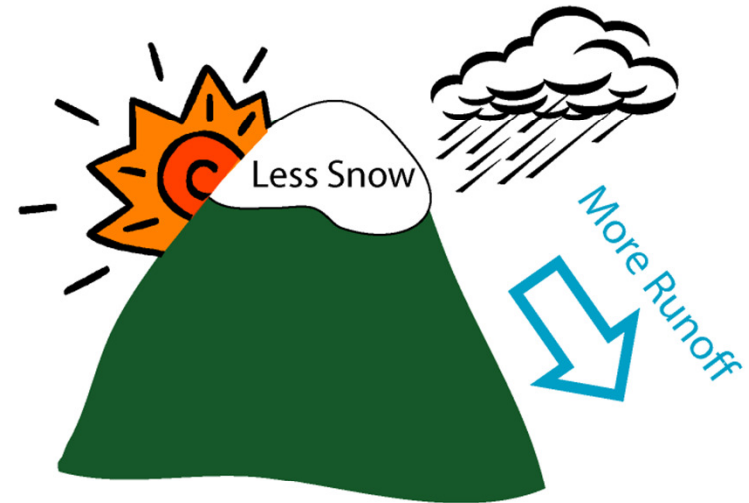


- Reduced snowpack
- Earlier snowmelt results in increased flood control demand on reservoir space
- Higher water temperatures impacts ecosystem
- Sea level rise impacts the Delta, threatens levees and increases salinity
- Increased demand in all sectors

Less Snow and Melts Sooner

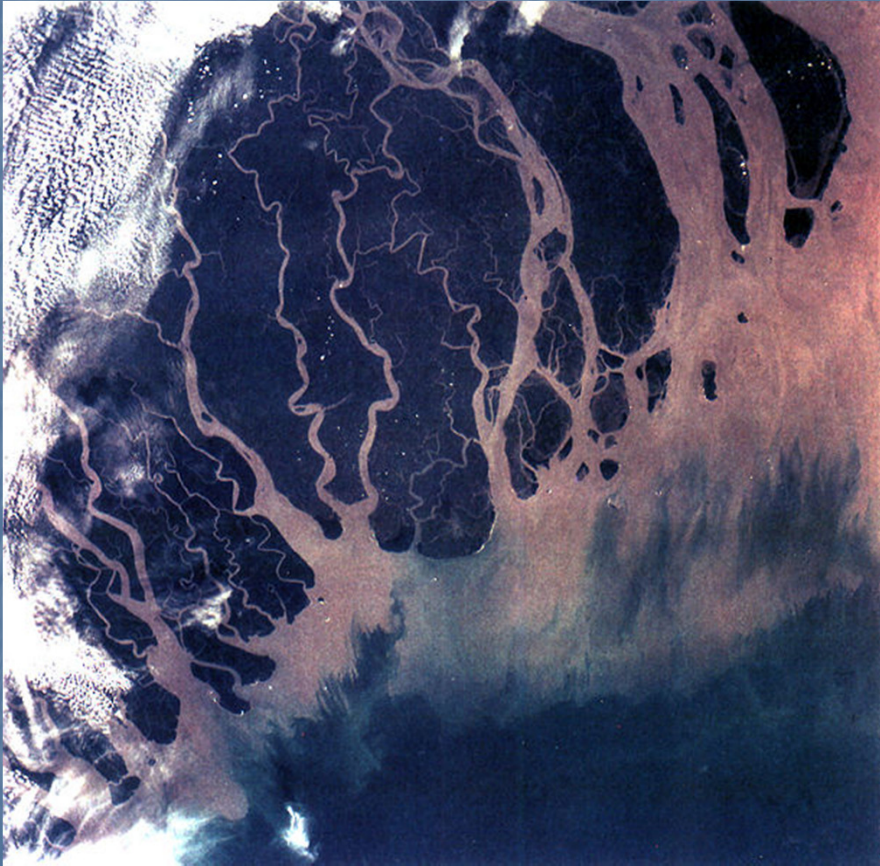


Present Conditions



Increased Air Temperature

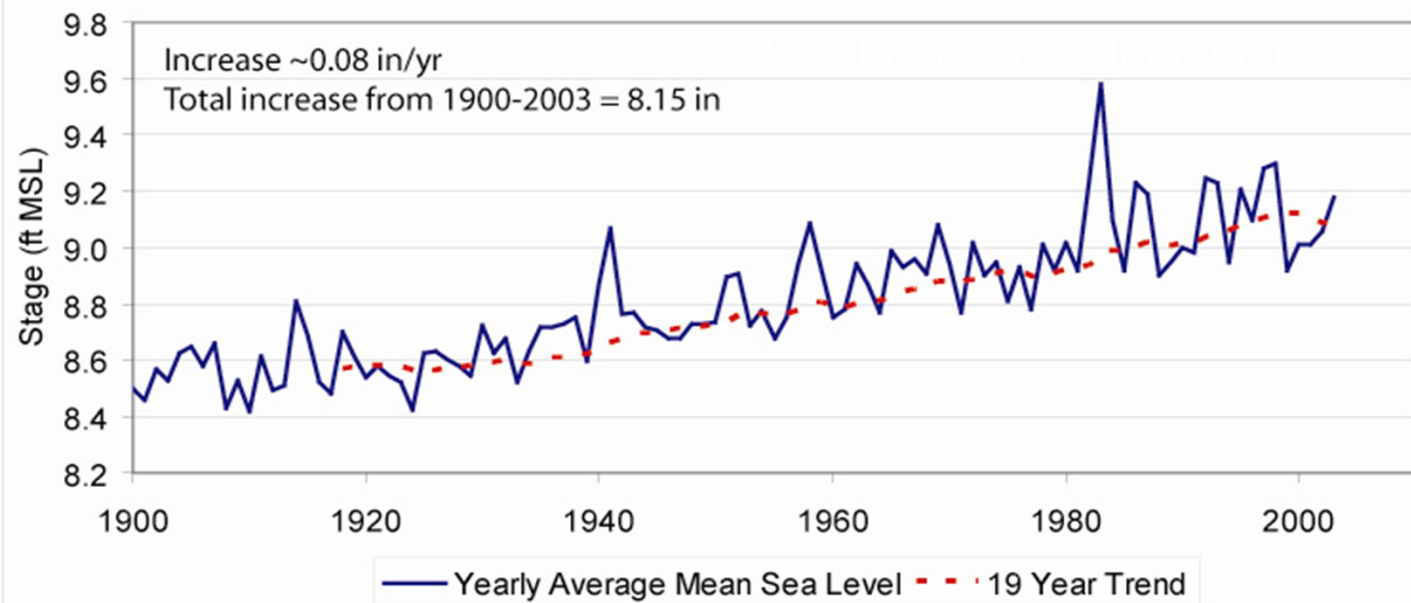
River Deltas and Sea Level Rise



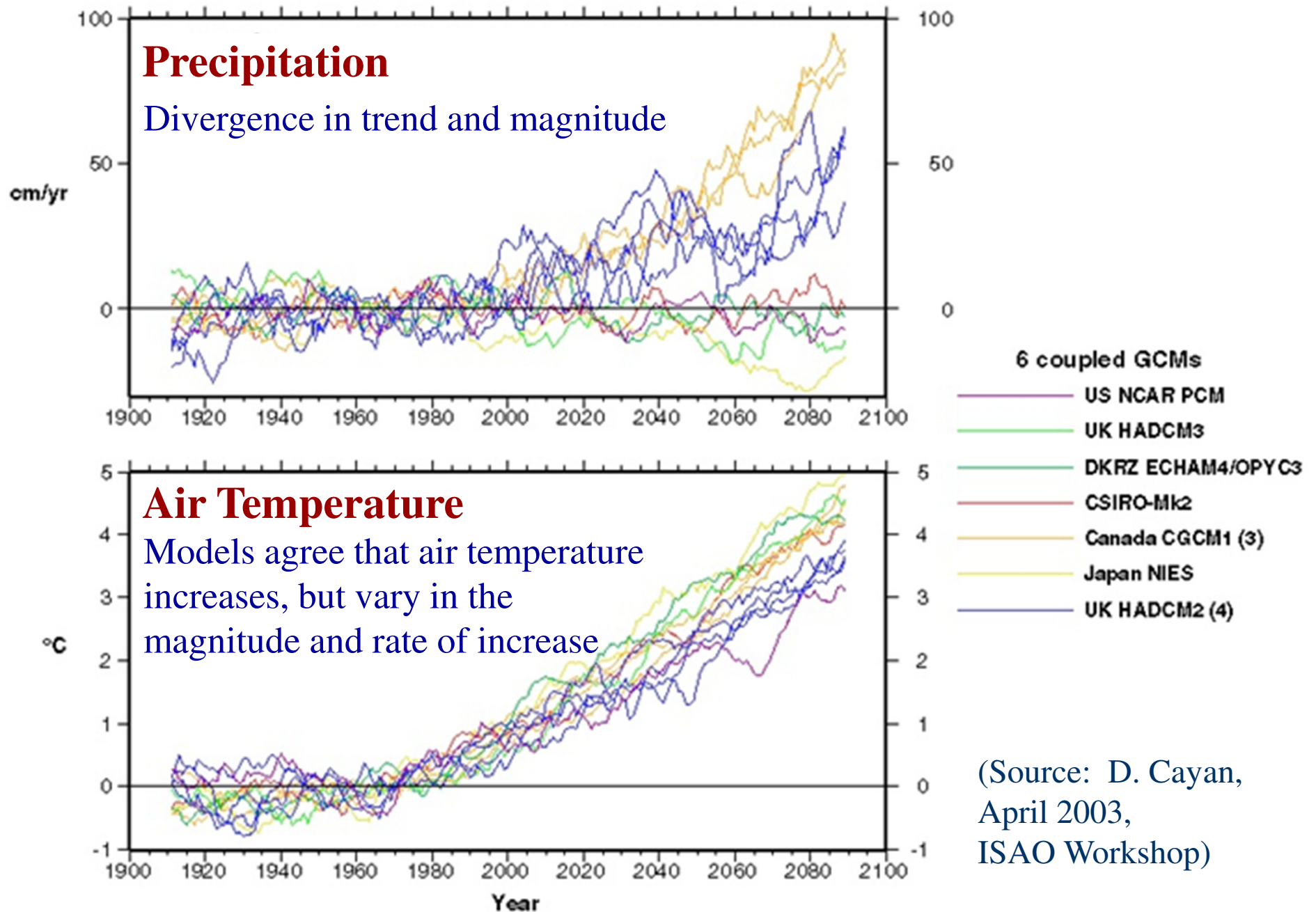
Ganges Delta, Bangladesh



Sacramento-San Joaquin Delta
California

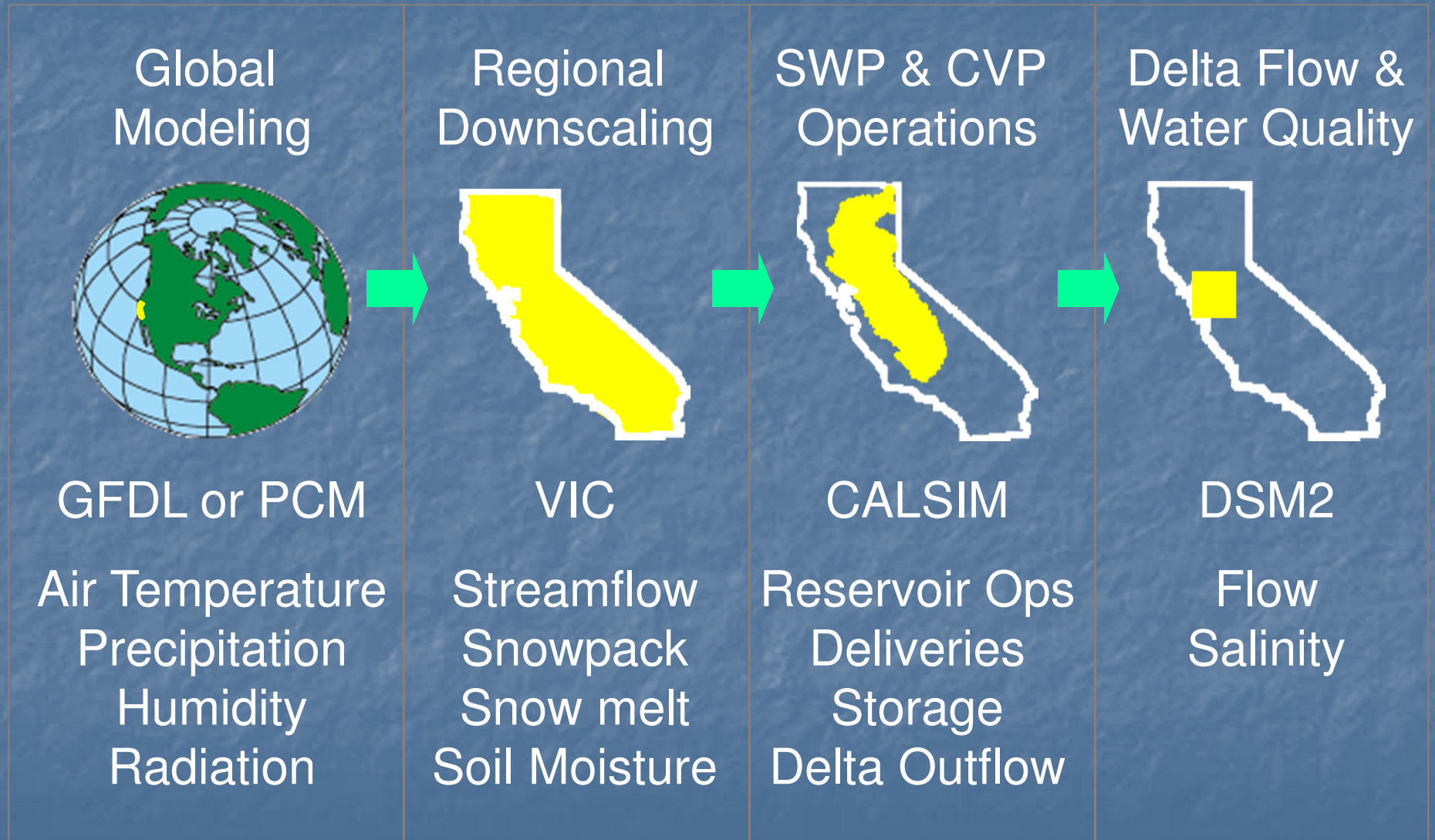


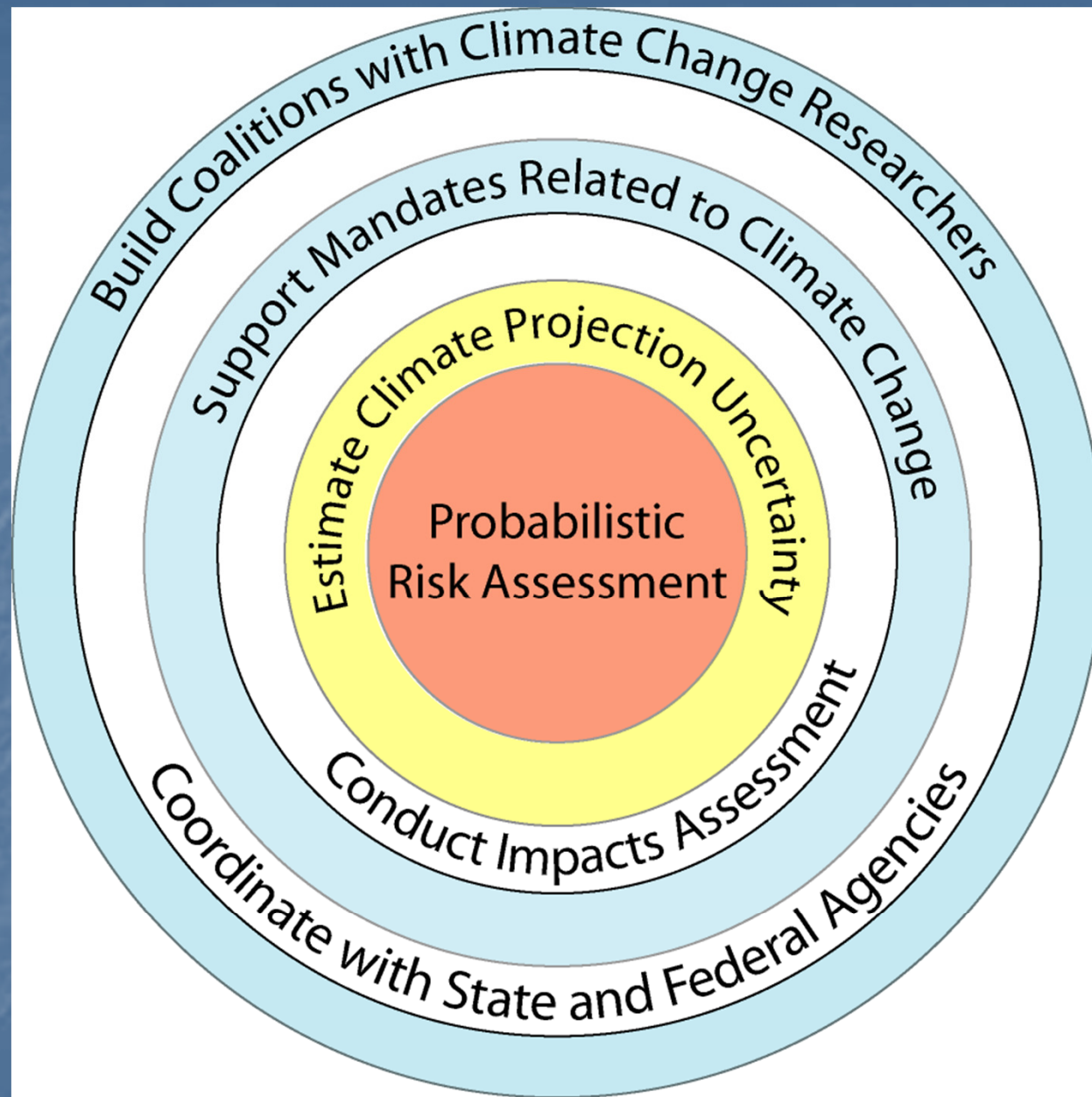
Climate Change Predictions for Northern California Differ



(Source: D. Cayan,
April 2003,
ISAO Workshop)

Operations Modeling



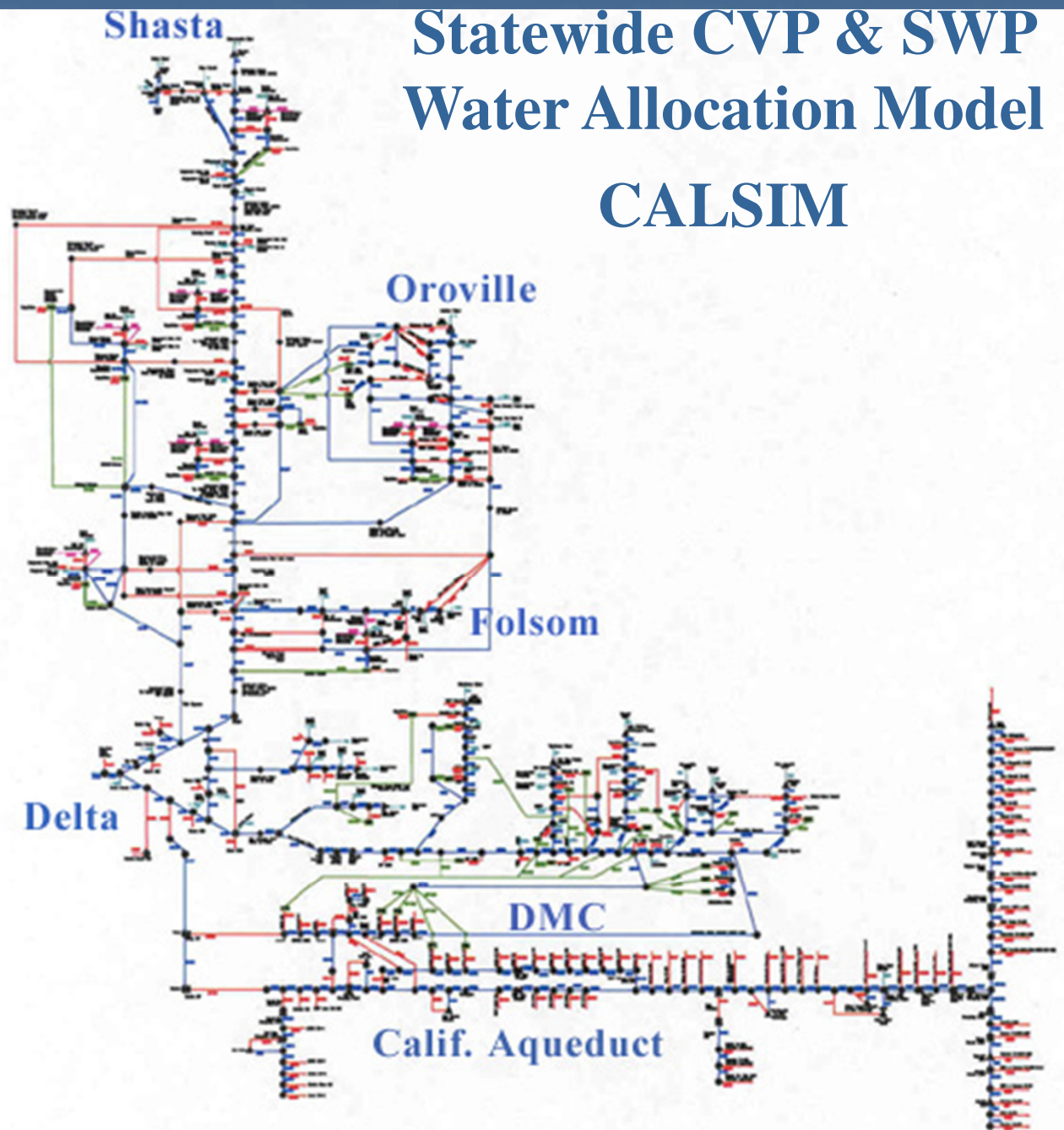


Climate Change Work Team Goals

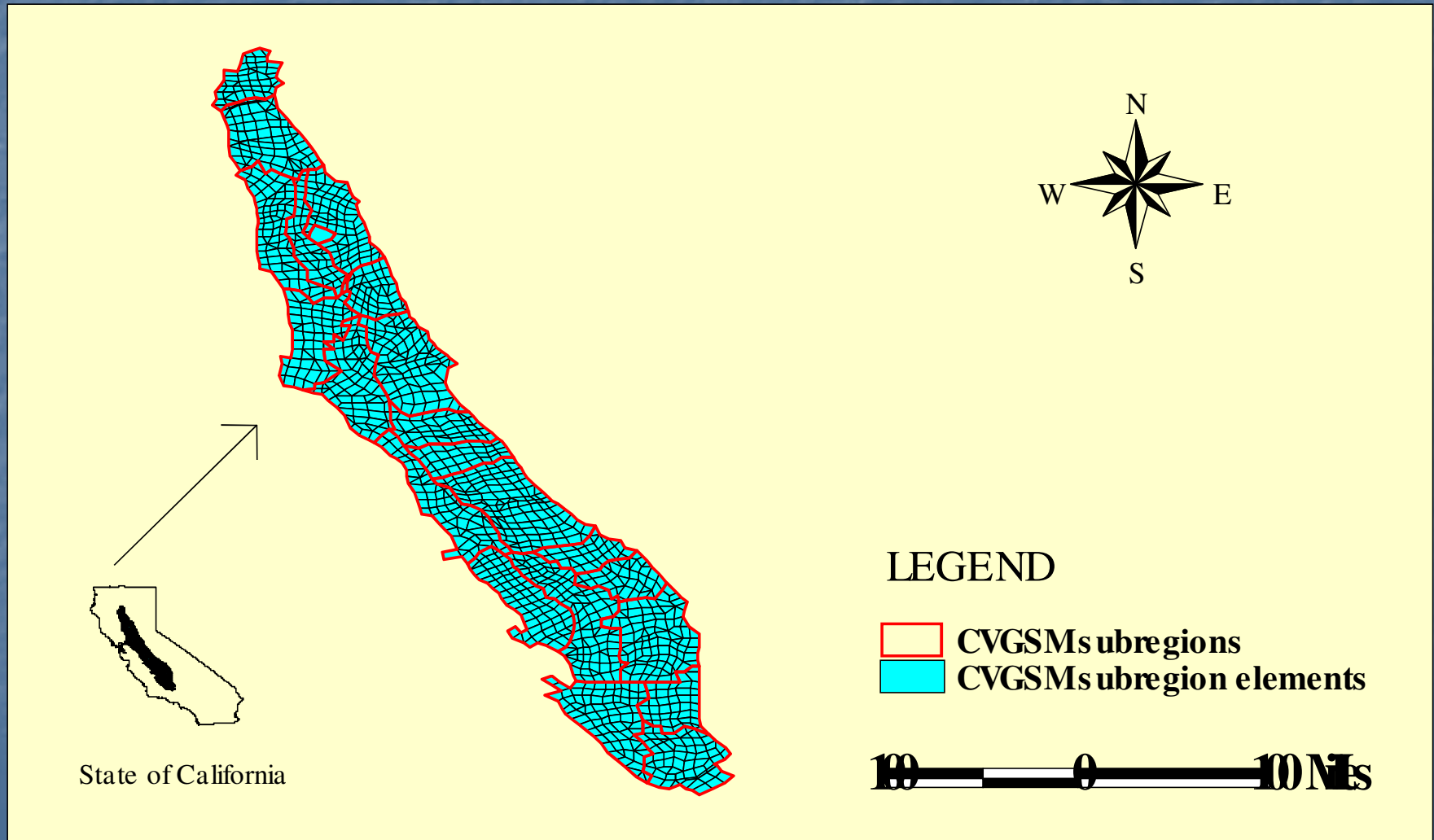
Statewide CVP & SWP Water Allocation Model CALSIM



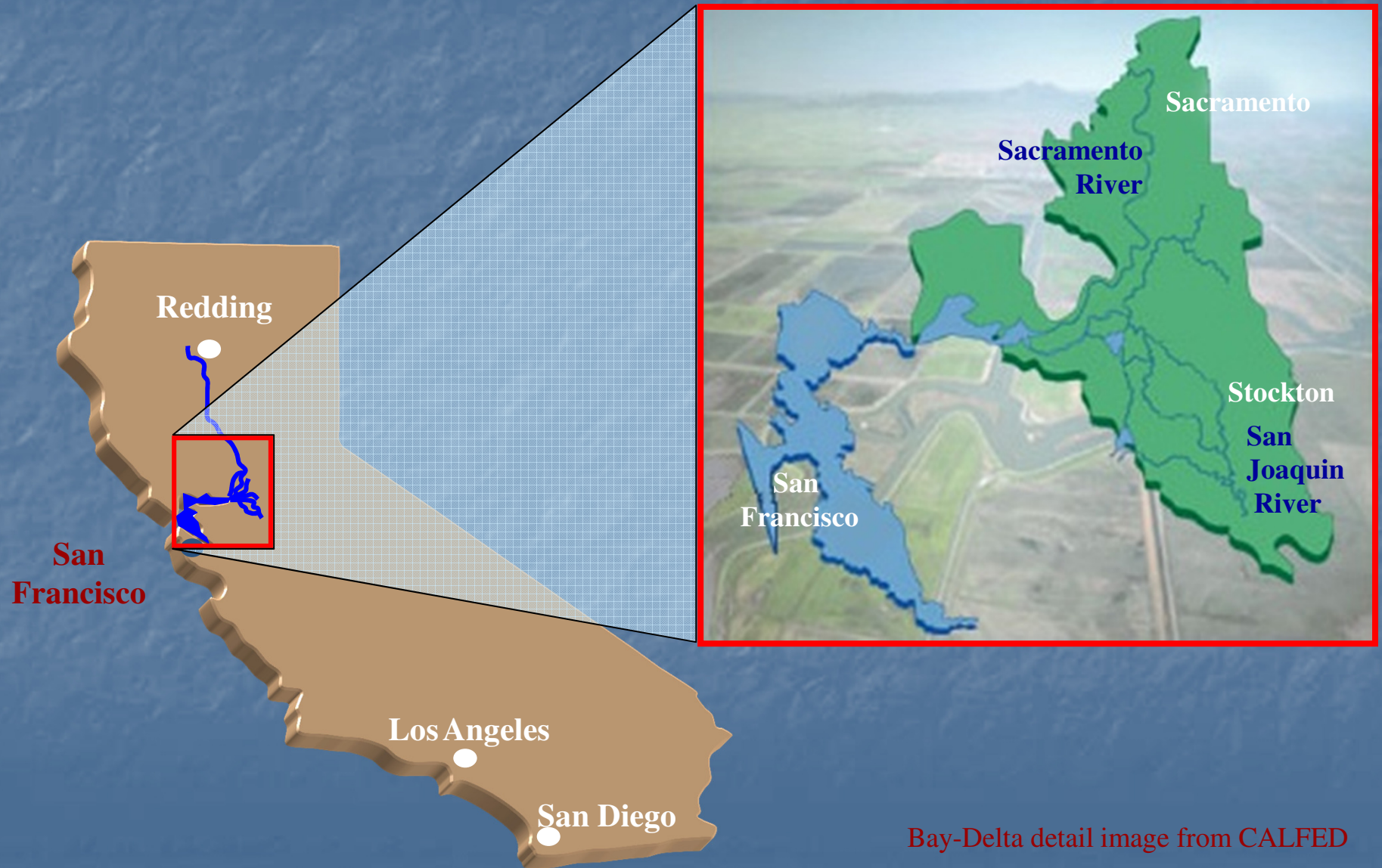
 Central Valley
 Project
(Federal)
 Local



CVGSM Subregions



Bay-Delta System



DSM2 Grid

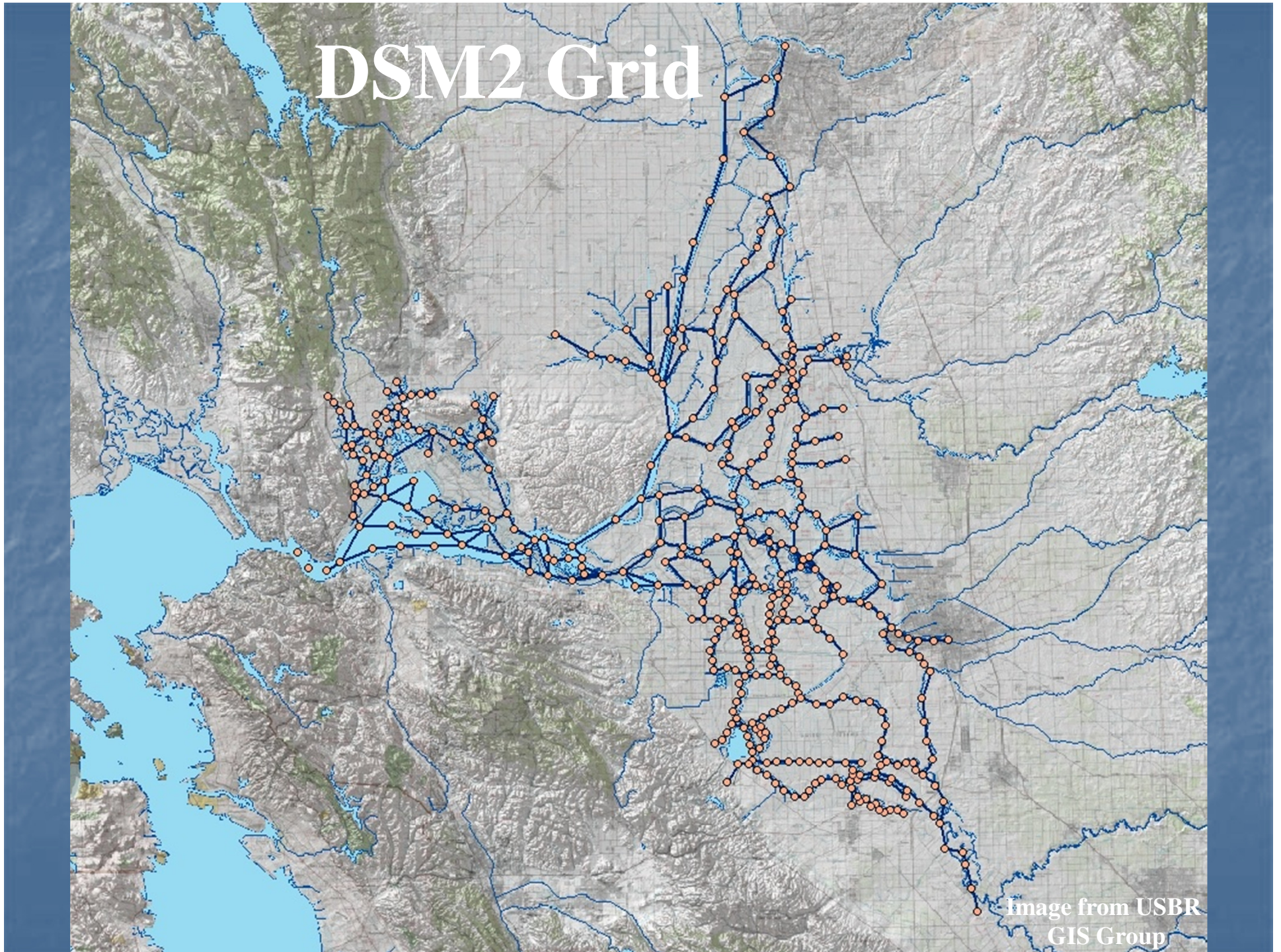


Image from USBR
GIS Group

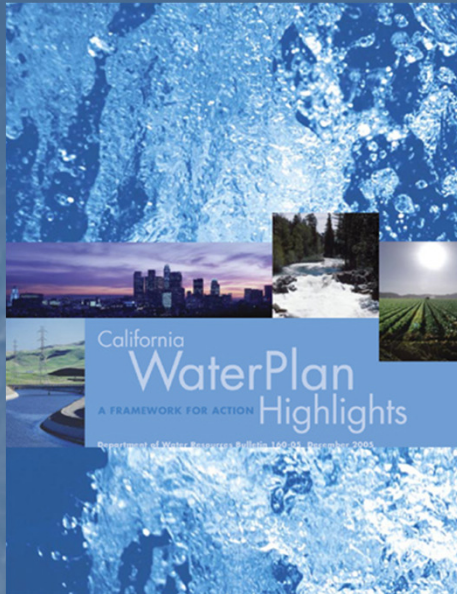
**Progress on Incorporating
Climate Change into Management
of California's Water Resources**



**July 2006
Technical Memorandum Report
California Department of Water Resources**

- CH1 Introduction
- CH2 Background
- CH3 DWR Studies
- CH4 SWP-CVP Impacts
- CH5 Delta Impacts
- CH6 Flood
Management
- CH7
Evapotranspiration
- CH8 Future Directions

Framework for Action Sustainable & Reliable Water in 2030



Vision



Initiatives
for
Reliability



Foundational
Actions for
Sustainability



**Vital Economy
Healthy Environment
High Standard
of Living**

**Implement
Integrated
Regional Water
Management**

**Improve Statewide
Water Management
Systems**

**Use
Water
Efficiently**

**Protect
Water
Quality**

**Support
Environmental
Stewardship**

Climate change is the sole focus of one of the 14 major recommendations

Crisis to Opportunity

- Credible Information: Science/Engineering
- Action Plan: Conserve, Recycle, Stop Overdraft, Build New Facilities
- Public Support: Vote and Funding