



Using Future Climate Projections to Support Water Resources Decision Making in California

DWR/UC Workshop
January 26, 2009

Jamie Anderson, Ph.D., P.E.



Department of Water Resources
Modeling Support Branch
Bay-Delta Office

Acknowledgements

- Francis Chung
- Sushil Arora
- Messele Ejeta
- Jeff Galef
- Tariq Kadir
- Kevin Kao
- Al Olson
- Chris Quan
- Erik Reyes
- Maury Roos
- Sanjaya Seneviratne
- Jianzhong Wang
- Hongbing Yin
- Nikki Blomquist



I MUST SAY, THE FUTURE
IS QUITE A BIT DIFFERENT
THAN I EXPECTED.



THIS BREEZE IS SO HOT
AND MUGGY. I FIGURED
THEY'D BE ABLE TO CONTROL
THE WEATHER BY NOW.



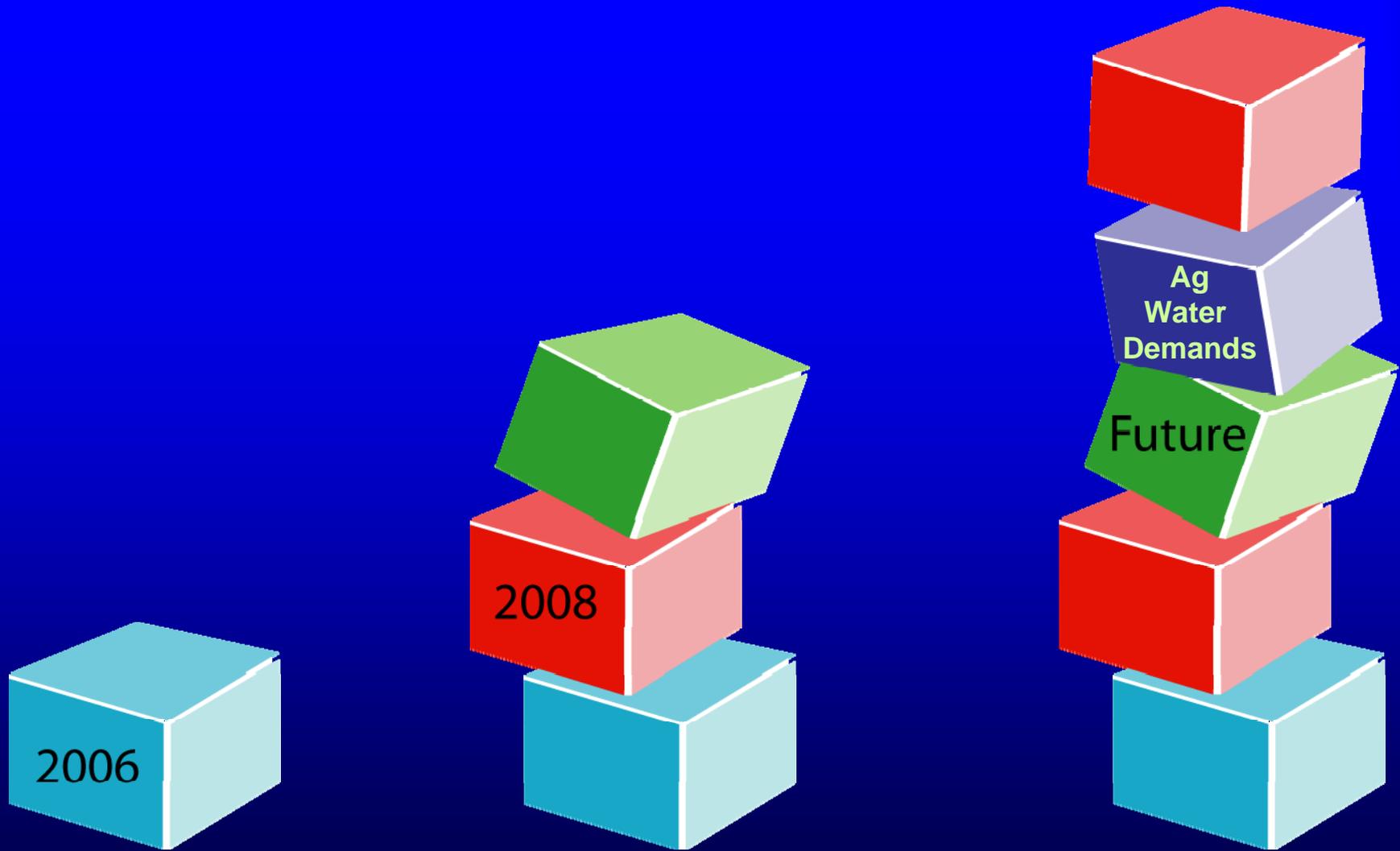
© 1967 Universal Press Syndicate

Governor's Executive Order S-3-05

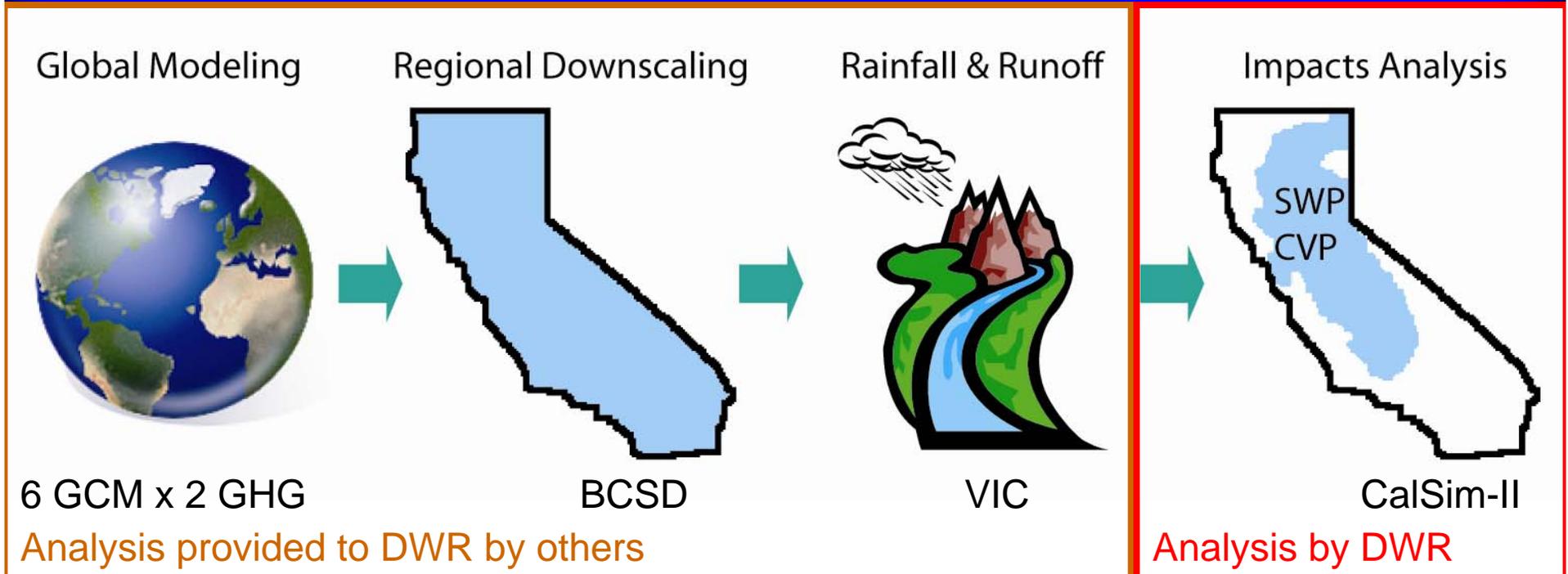


- Signed June 1, 2005
- Targets to reduce emission levels of greenhouse gases
- Required biennial reports starting January 2006
 - Water supply
 - Public health
 - Agriculture
 - CA coastline
 - Forestry
- Formed Climate Action Team

Building Blocks for Climate Change Analysis



GCM Scenario-based Impact Assessment Methodology



↓ Delta exports
↓ Carryover storage

↑ Groundwater pumping
→ X2 location

SWP and CVP Impacts Analysis

- 12 climate change (CC) scenarios
- Parameters adjusted to reflect CC
 - Streamflow / Reservoir inflows
 - Water Demands
- SWP and CVP operations using CalSim-II
 - Base case (2030 with no climate change)
 - Mid-century
 - End of Century

Agricultural Water Demand



Climate Change



Crop Type / Land Use



Plant Response



Study Assumptions

Assumption	Base scenario	Mid-century (12 Projections)	End of century (12 Projections)
Regulations and operating rules	Current regulations, no Environmental Water Account or CVPIA b2	Current regulations, no Environmental Water Account or CVPIA b2	Current regulations, no Environmental Water Account or CVPIA b2
SWP-CVP infrastructure	Current	Current	Current
Land use	Estimates for 2030	Estimates for 2030	Estimates for 2030
Reservoir inflows	Historical	Adjusted for future air temperature and precipitation	Adjusted for future air temperature and precipitation
Water year types	Historical	Adjusted for streamflow changes	Adjusted for streamflow changes
Agricultural crop and urban outdoor water demands	Based on 2030 land use estimates	In the Sacramento Valley, demands were adjusted for changes in precipitation	In the Sacramento Valley, demands were adjusted for changes in precipitation
Sea levels	No sea level rise	1 ft sea level rise	2 ft sea level rise



Take Home Message

Improved estimates of agricultural water demands under climate change are needed

- Evapotranspiration rates
- Plant adaptations
- Land use changes
- Associated costs

What are the relative certainties of these responses to climate change?



www.climatechange.ca.gov
www.water.ca.gov/climatechange/
jamiea@water.ca.gov

Take Home Message



- Advances in using future climate projections for decision making
- Sea level rise
 - Amount, probability, Delta salinity ANNs
- Effects of increasing air temp on Feather basin
 - ↓ April snowpack, ↓ runoff in April-July
 - ← 50% inflow to Oroville up to a month earlier
- Effects of climate change on SWP and CVP
 - ↓ annual Delta exports, ↓ reservoir carryover storage
 - ↑ annual groundwater pumping
 - → X2 range moves upstream, standard still met

2008 CAT Team Scenarios

6 Global Climate Models

- GFDL-CM2.1 (USA)
- NCAR-PCM1 (USA)
- CNRM-CM3 (France)
- MPI-ECHAM5 (Germany)
- MIROC3.2med (Japan)
- NCAR-CCSM3 (USA)

2 GHG Emissions Scenarios

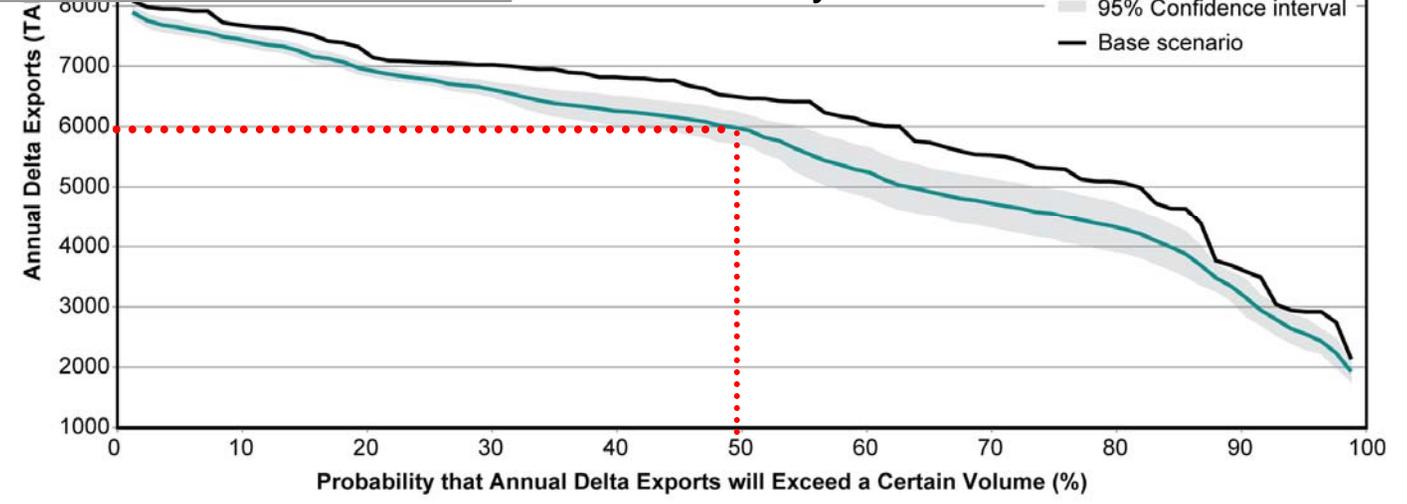
- A2
 - high population growth
 - regional economic growth
 - fragmented technological changes
- B1
 - low population growth
 - rapid economic growth
 - sustainable technology

12 Total Scenarios = 6 GCM x 2 Emissions Scenarios

50% Exceedence	Average	95% interval
Mid-century	-8%	-5% to -12%
End of century	-15%	-11% to -20%

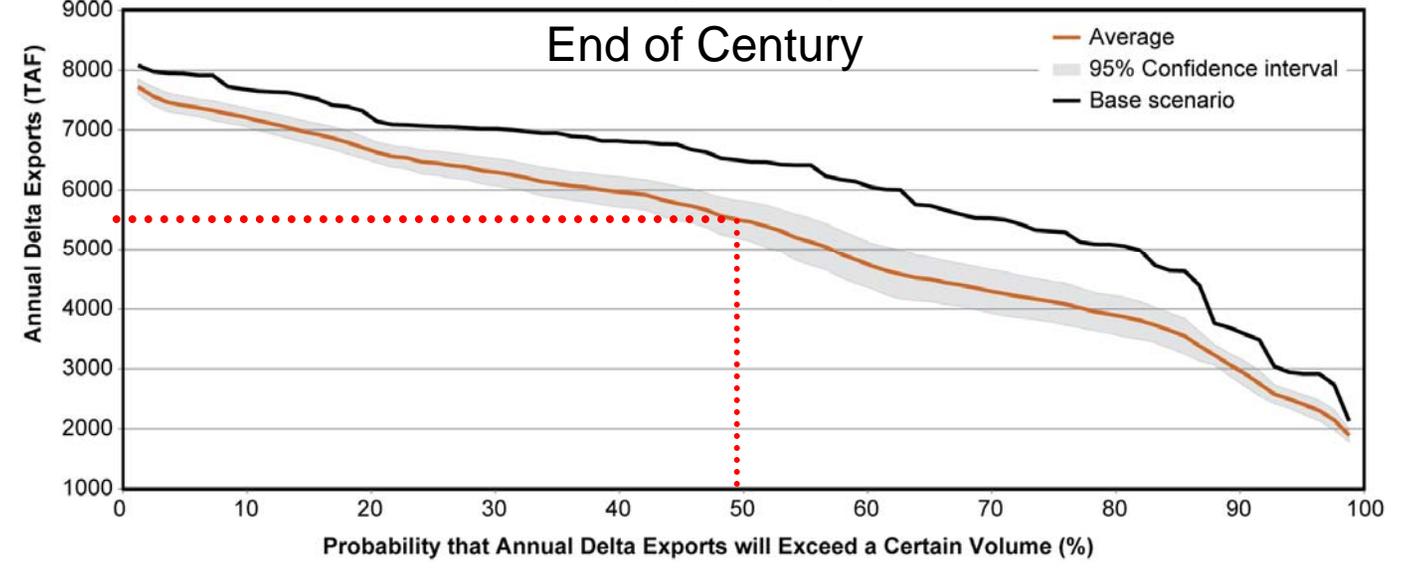
Mid-Century Climate Projections

Mid-Century



End-of-Century Climate Projections

End of Century

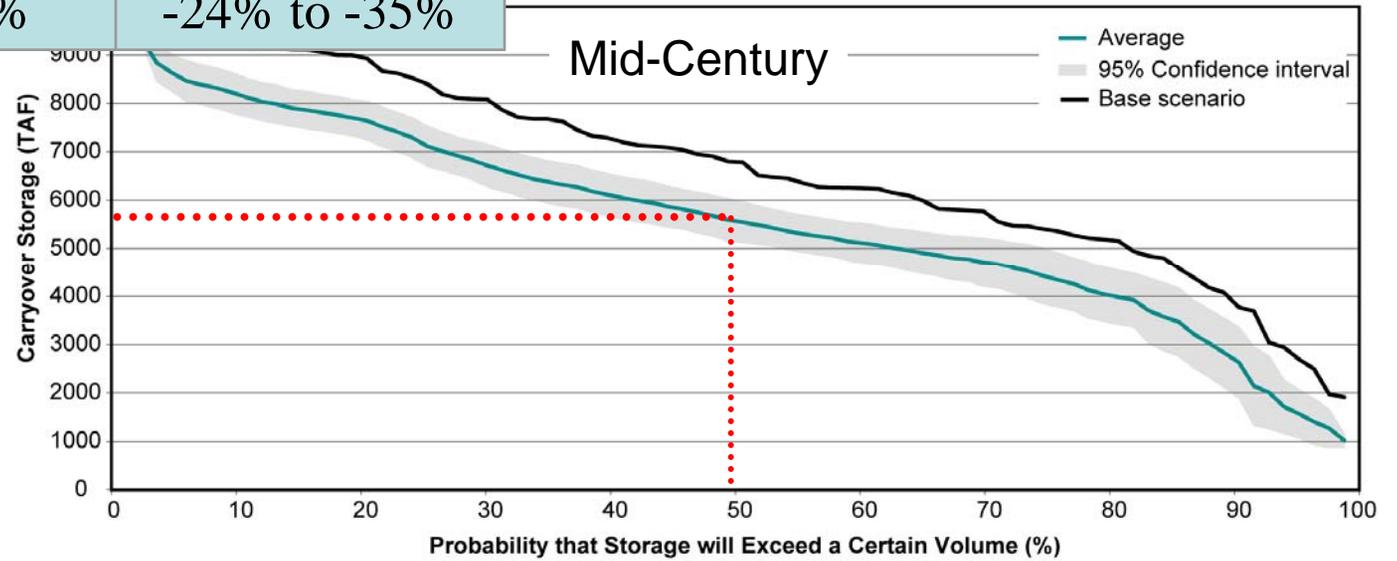


Annual Delta Exports

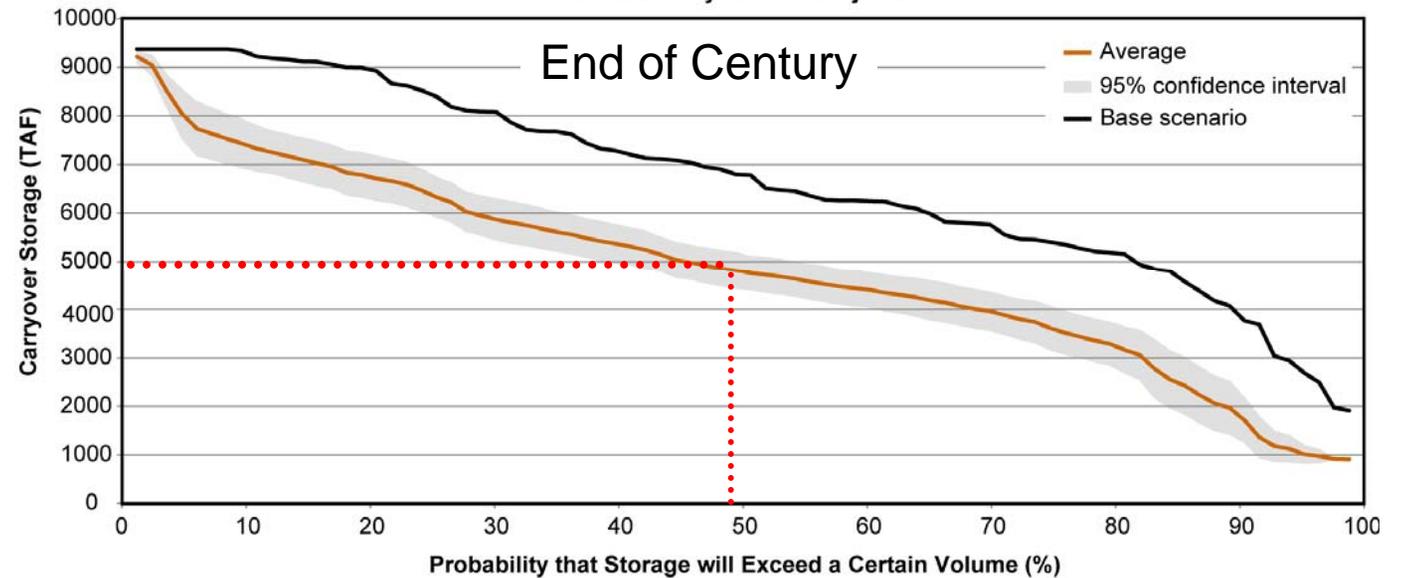
50% Exceedence	Average	95% interval
Mid-century	-18%	-12% to -25%
End of century	-29%	-24% to -35%

Reservoir Carryover Storage

Mid-Century Climate Projections

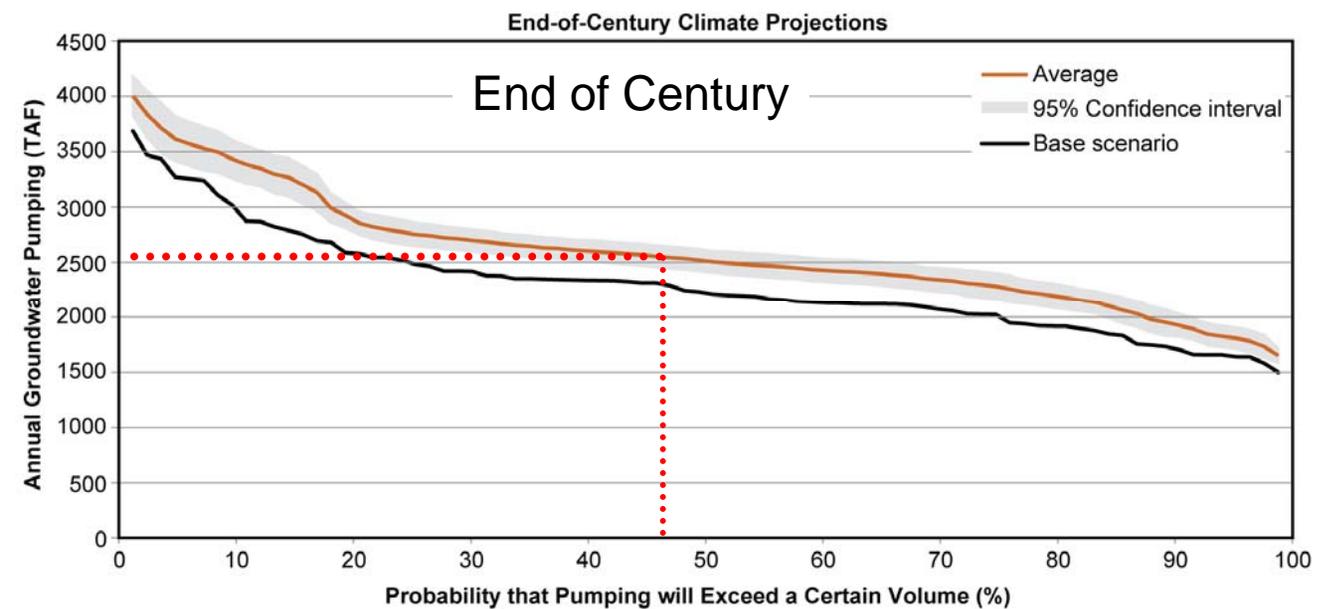
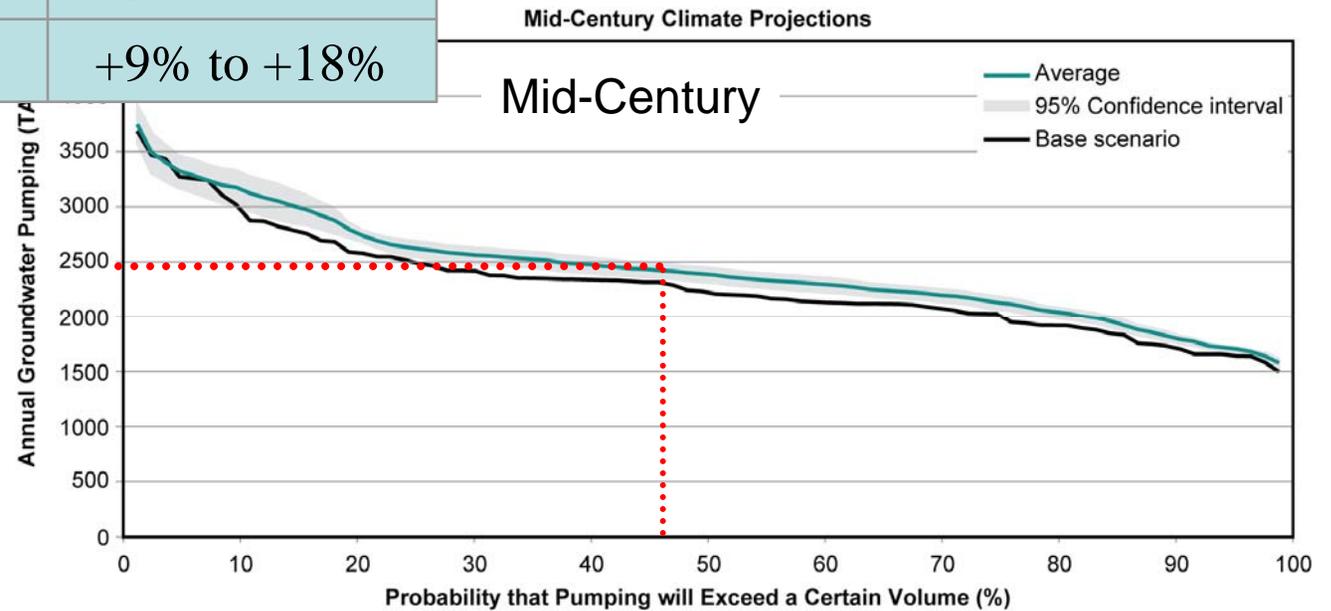


End-of-Century Climate Projections



50% Exceedence	Average	95% interval
Mid-century	+9%	+5% to +14%
End of century	+14%	+9% to +18%

Annual Groundwater Pumping



X2 Position



-  Range of estimated X2 values from 1997-2007
-  Range of estimated X2 values from 12 climate projections
-  Number of kilometers from Golden Gate Bridge

