Quantitative Deliverables for the California Water Plan 2009 Update

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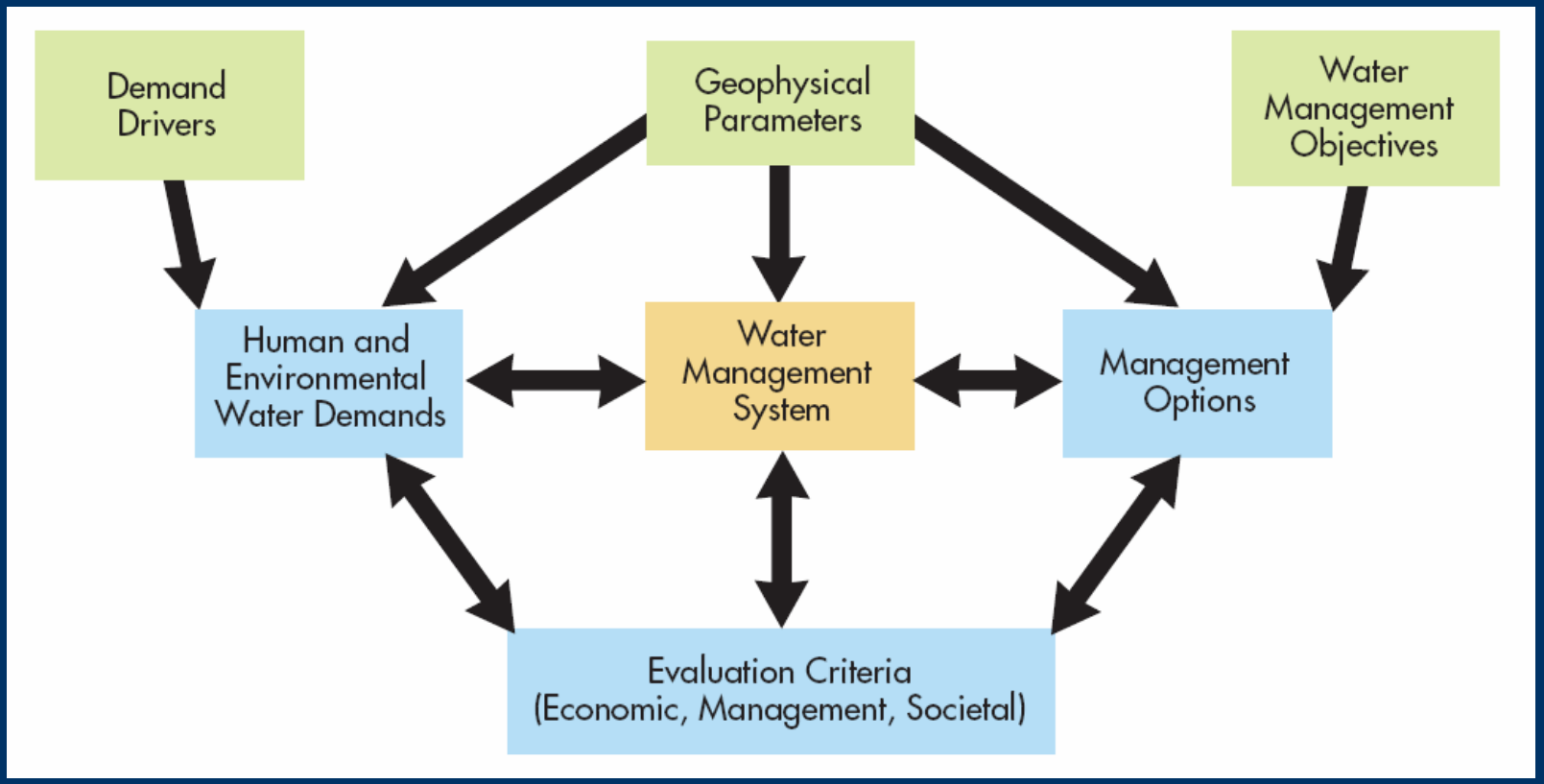
Water Plan 2005 Update Integrated Scenario Analysis Framework



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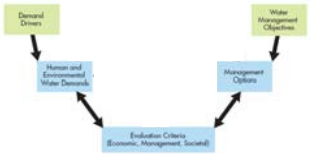
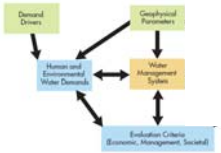
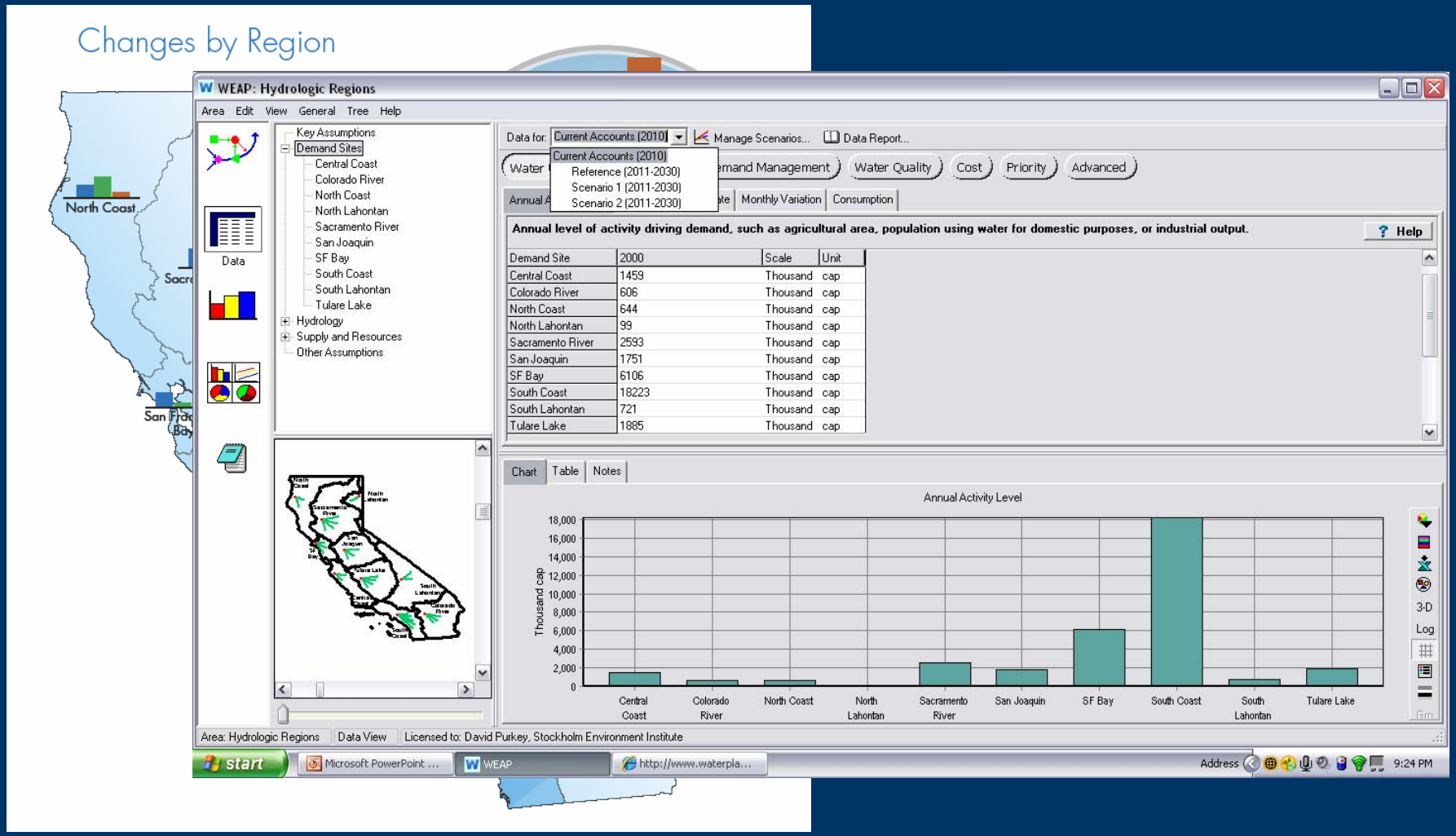
Progress with Respect to Scenario Framework Since the 2005 Update

	Scenario Framework	Geological domain	Level of integration	Level of System detail	Climate/hydrology
2005 CWP		Statewide, by Hydrologic Region	No integration between demand scenarios and management options	Coarse demand factor representation. Management options derived from other studies	Annual data for past hydrology (water portfolios), no climate or hydrologic signal in scenarios
Simple Scenarios for Southern California		Southern California. Demand by county, supply by region	Arithmetic combination of supply and demand. Factor changes to baseline estimates	Coarse demand factor representation. Management options derived from other studies and related to supply and demand projections	Annual projections of supply and demand. No interannual variability. No climate signal.
Sacramento WEAP application		Sacramento Basin, including Bay-Delta and Trinity Diversion	Full integration with demand and supply elements interacting dynamically during simulation	Full system detail with all critical system components represented explicitly	Monthly precipitation, temperature, RH and wind. Rainfall/snowmelt simulation->runoff. Water quality simulation.
Robust management strategies for IEUA		Inland Empire Utilities Agency service area.	Integrated supply and demand and long-term water management plans	Aggregated representation of large system components.	Monthly precipitation, temperature, RH and wind. Rainfall/snowmelt simulation->runoff. Parameterizations of effects on imports.
2009 CWP	**???**	**???**	**???**	**???**	**???**

Water Plan 2009 Update Deliverables

1. **New water portfolios**
2. **Inventory and synthesis of existing studies**
3. **High level integrated scenario analysis in the ten (10) Hydrologic Regions**
4. **Detailed Planning Area integrated scenario analysis in two (2) Hydrologic Regions**

Deliverable 3: High level integrated scenario analysis in the ten Hydrologic Regions



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Key Questions for Water Plan Analysis (From Update 2005)

- **How does water scarcity affect the economy and all beneficial uses?**
- **How does water quality affect water management and vice versa?**
- **How does land use affect water management?**
- **How should local, regional, and state agencies manage water during multiple year droughts?**
- **How will climate change affect water management?**
- **What are some of the costs, benefits, and tradeoffs between different water management strategies?**

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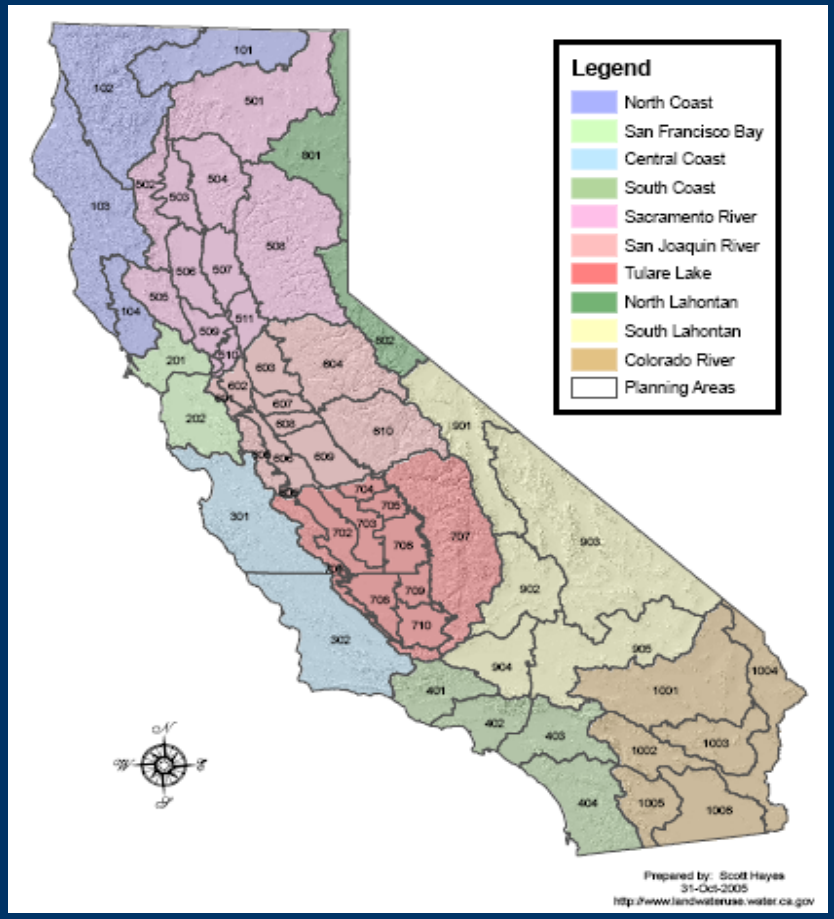
Deliverable 4: Detailed Planning Area integrated scenario analysis in two Hydrologic Regions



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Deliverable 4 Components

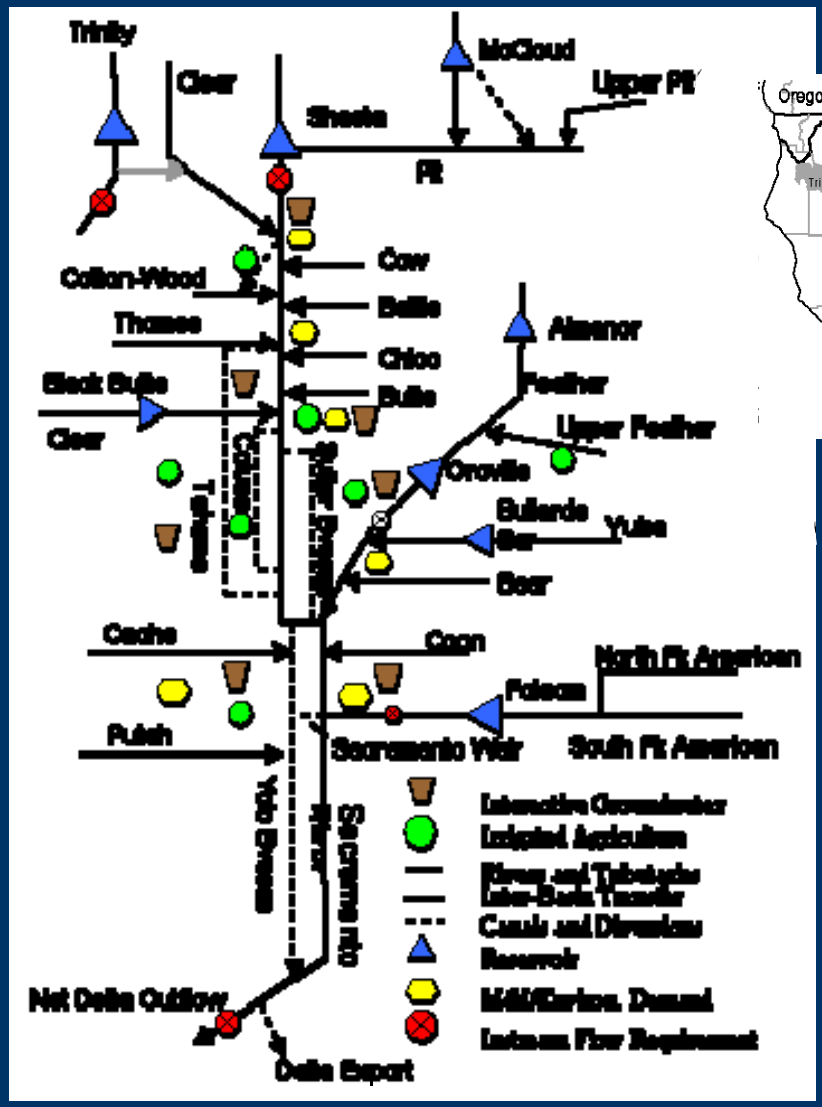
- **Expand SWAN pilot water management models (R in XLRM), to the Planning Area level, for two Hydrologic Regions:**
  - **Sacramento River Hydrologic Region**
  - **South Coast Hydrologic Region**

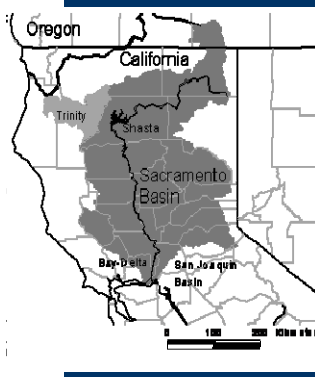
- **Construct large ensemble of quantitative water management scenarios (X in XLRM) consistent with:**
  - **New 2009 Water Plan narrative scenarios**
  - **CEC climate change scenarios**

- **Evaluate response packages (L of XLRM) against performance metrics (M of XLRM) at regional level**

SWAN Pilot 1: Sacramento River System

- Comprehensive Representation of Sacramento System
  - 71 Catchments
  - 32 Rivers
  - 7 Groundwater Basins
  - 8 Diversions (e.g. Yolo)
  - 30 Urban/Ag Demands
  - 6 Ag Crop types
  - Rice Ponding/Storage
  - Instream flow Requirements
  - Delta Salinity Dynamics





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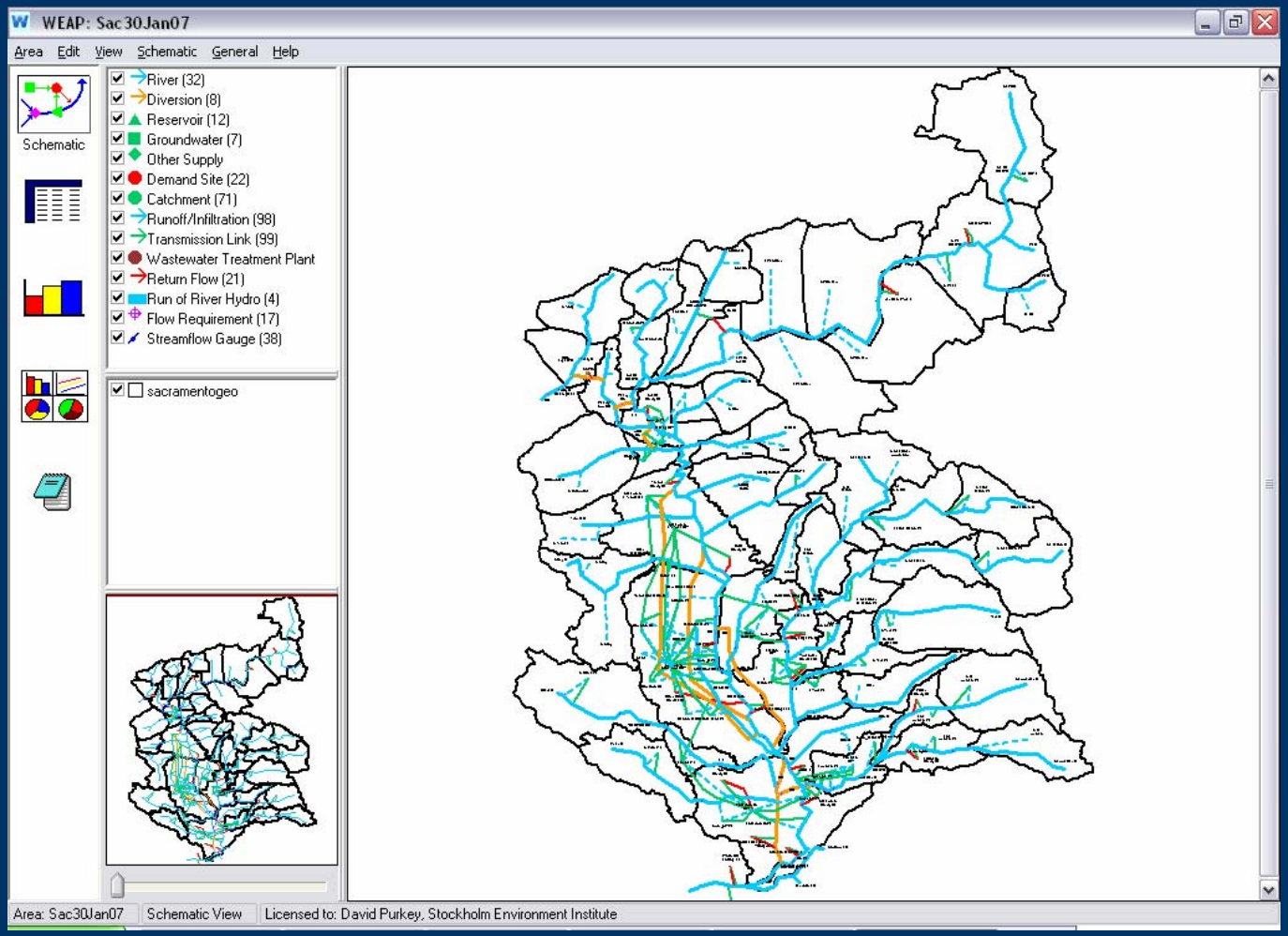
Sacramento River Model (R)



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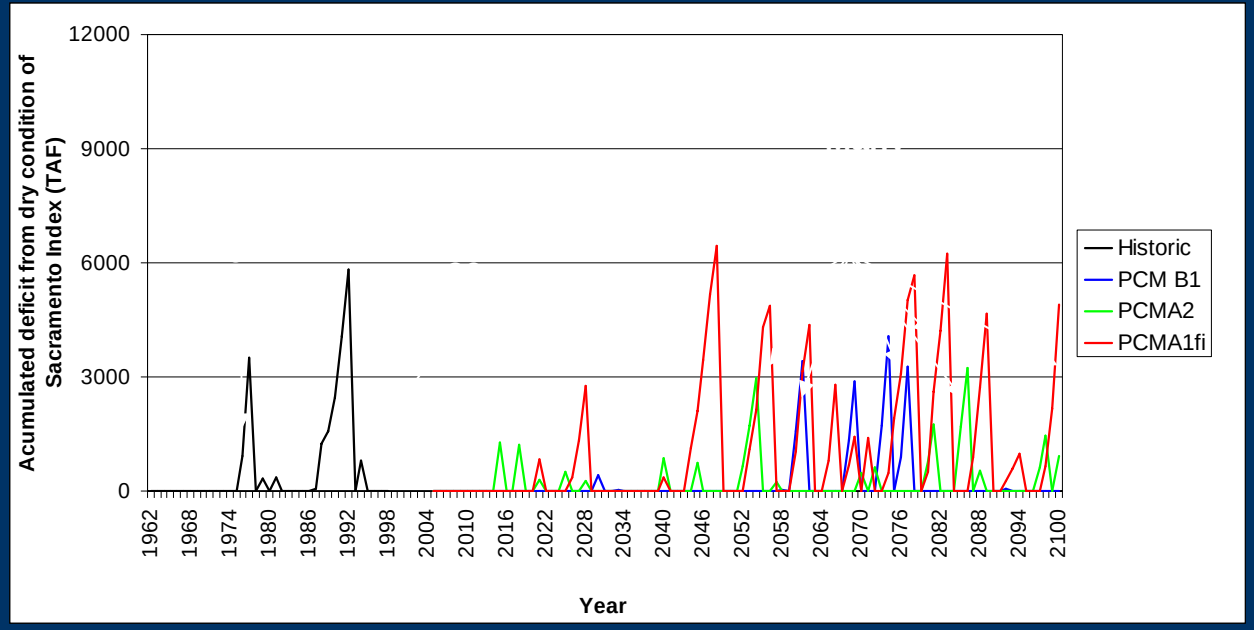
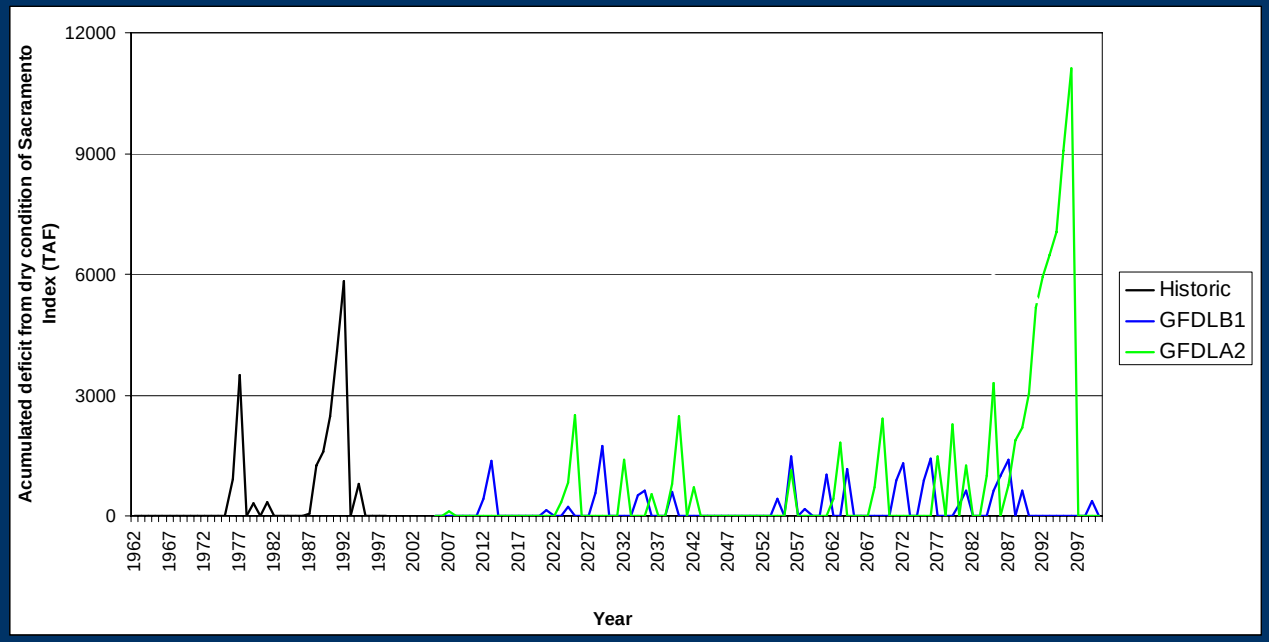
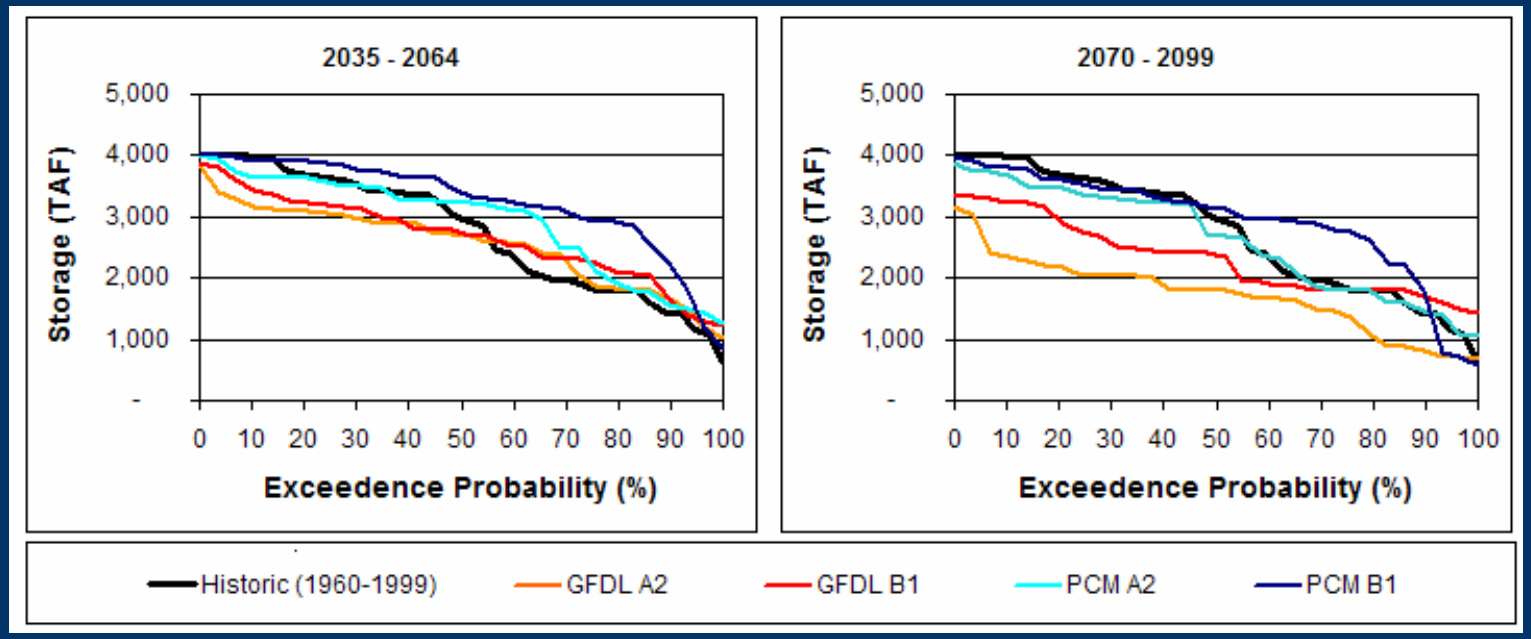
Drought Analysis for Future Climate Scenarios (X)

- Accumulated deficit from a dry condition based on Sacramento 40-30-30 index

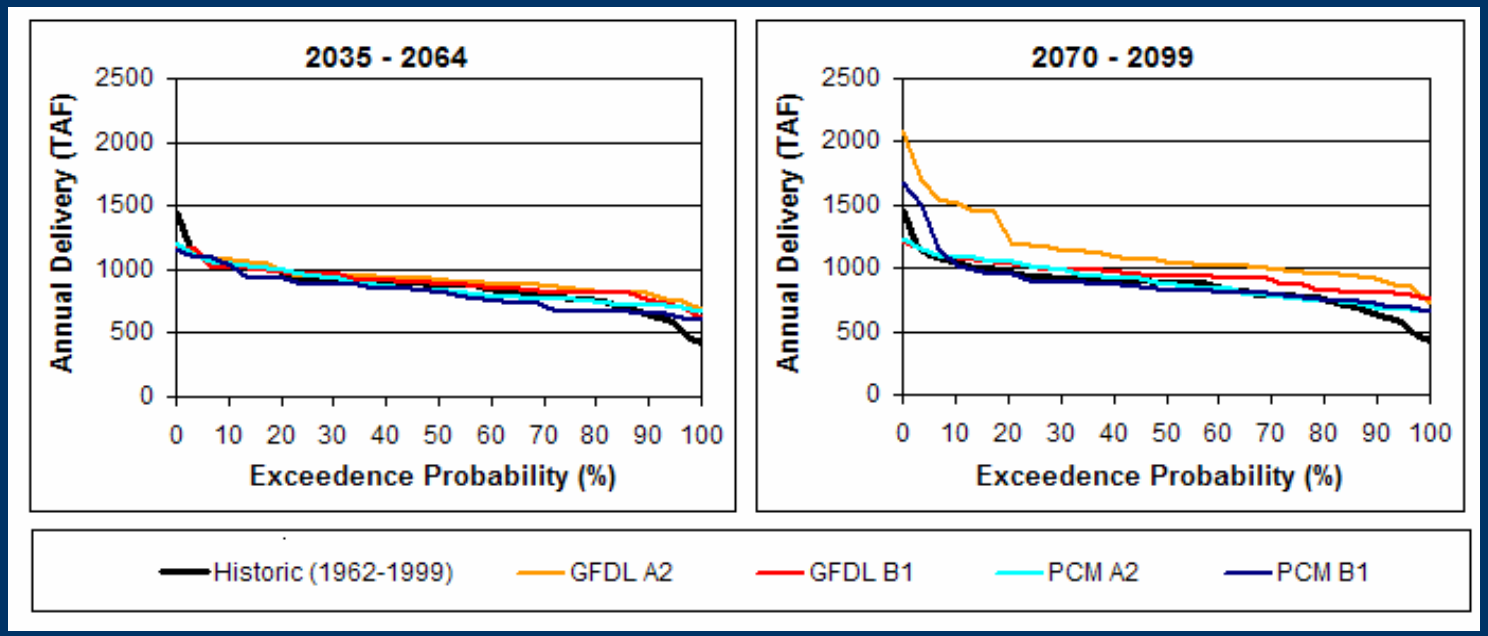




Lake Shasta
End-of-September Storage (M)



Sacramento River Agricultural Diverters Groundwater Pumping (M)



Key Activities in Sacramento River Hydrologic Region

- **Reformulate model (R) so that it is more consistent with the DWR Planning Areas.**
- **Develop a fuller range of scenarios (L) consistent with the key factors of the scenario narratives being developed for the 2009 Update.**
- **Describe a range of interesting management response (L) for the region and evaluate them against both physical and socio-economic metrics (M) by simulating them in the model (R).**

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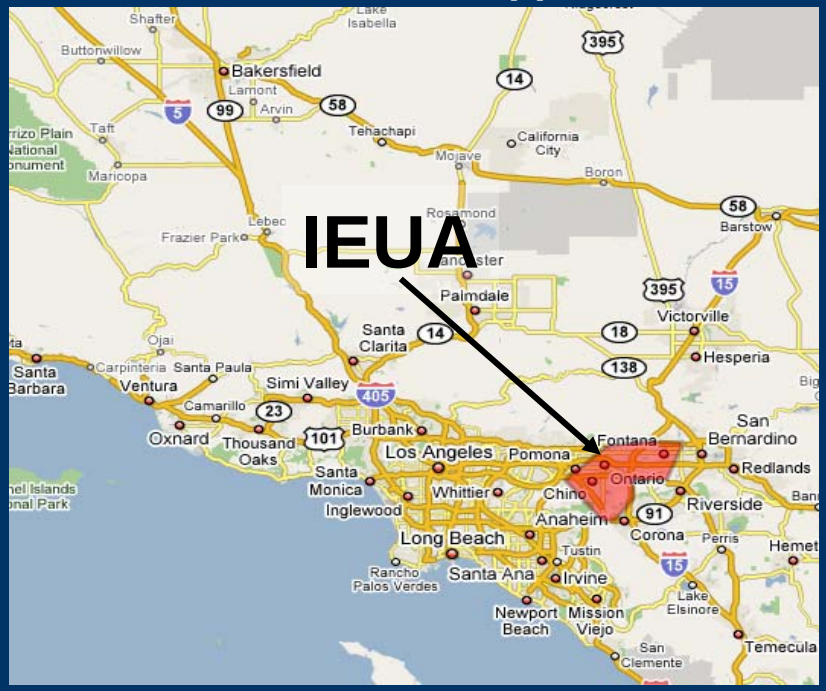
SWAN Pilot 2: IEUA (Inland Empire Utilities Agency) System

- **IEUA currently serves 800,000 people**
  - **May add 300,000 by 2025**
  - **Limited conventional sources of new water supplies**



- **Changes in climate may:**
  - **Increase irrigation demands**
  - **Change precipitation patterns**
  - **Diminish snow pack and reduce imports**
  - **Reduce groundwater recharge**

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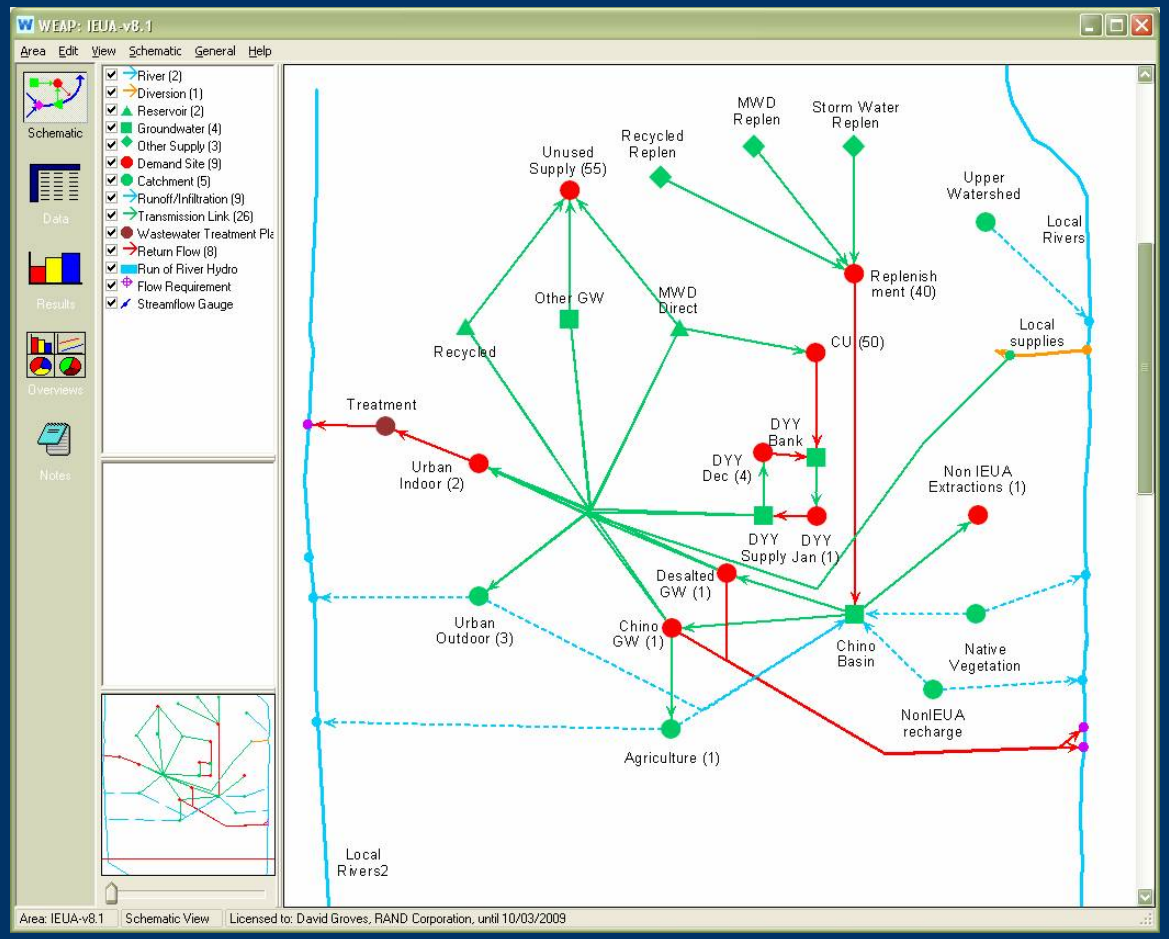
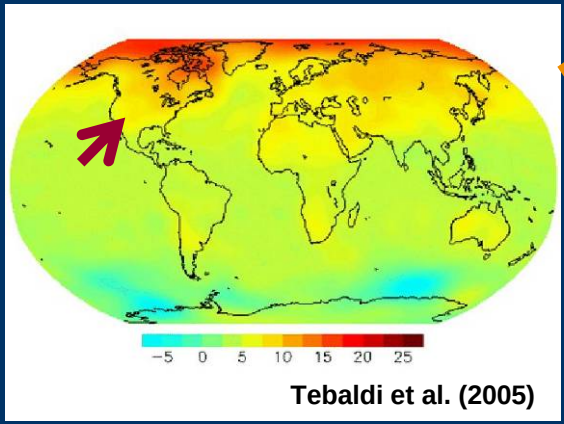
IEUA Model (R)

- **Sources**
  - Precipitation over catchments
  - Imports from MWD
  - Non-Chino Basin groundwater
- **Demands**
  - Urban indoor
  - Urban outdoor
  - Agricultural
- **Chino Basin groundwater**
  - Direct use
  - Desalted
  - Replenishment
  - Dry-year Yield program
- **Recycling**
  - Direct Use
  - Replenishment

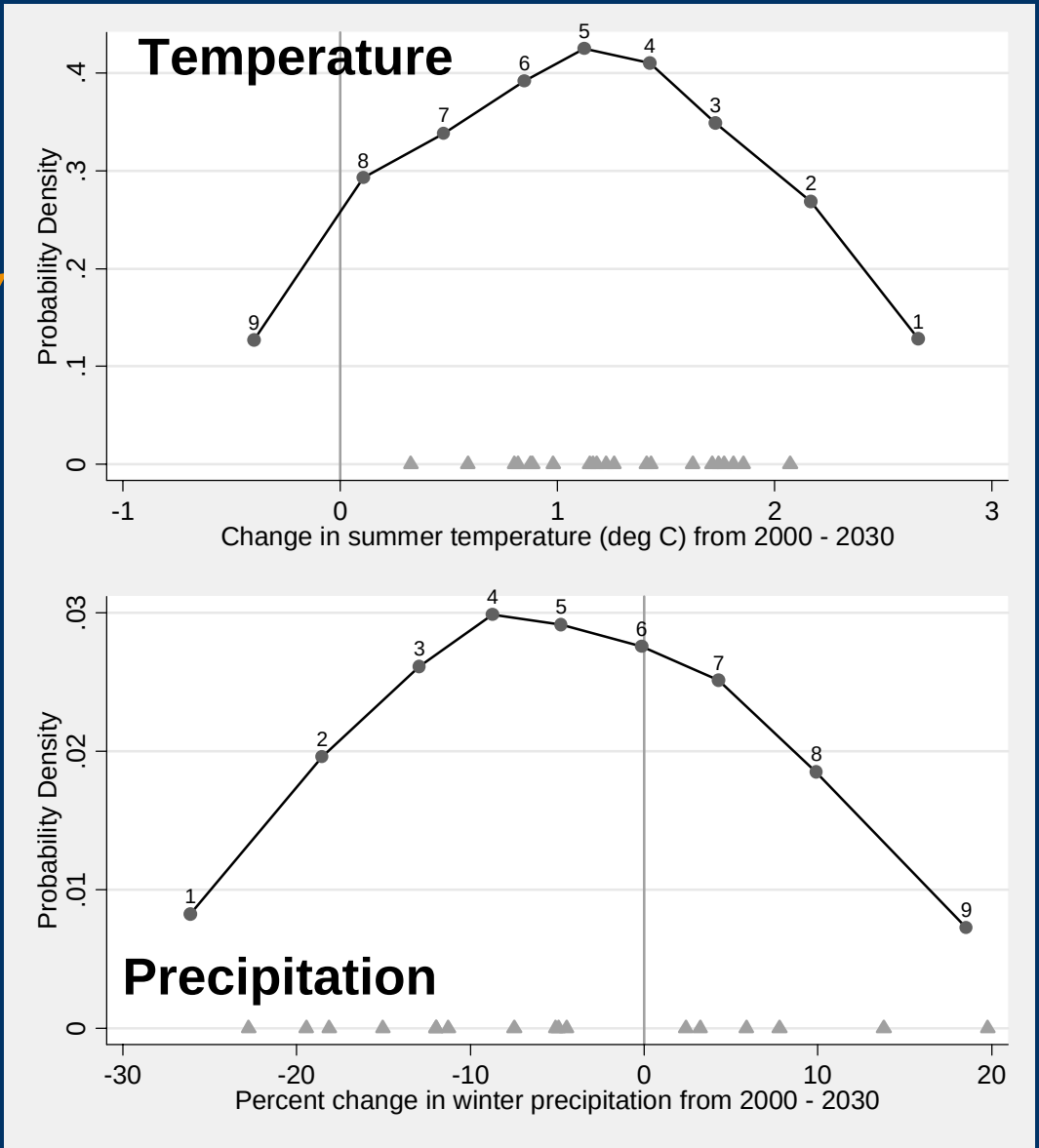


Future Climate Impacts Are Deeply Uncertain (X)

Twenty-one general circulation models suggest wide range of impacts to Southern California



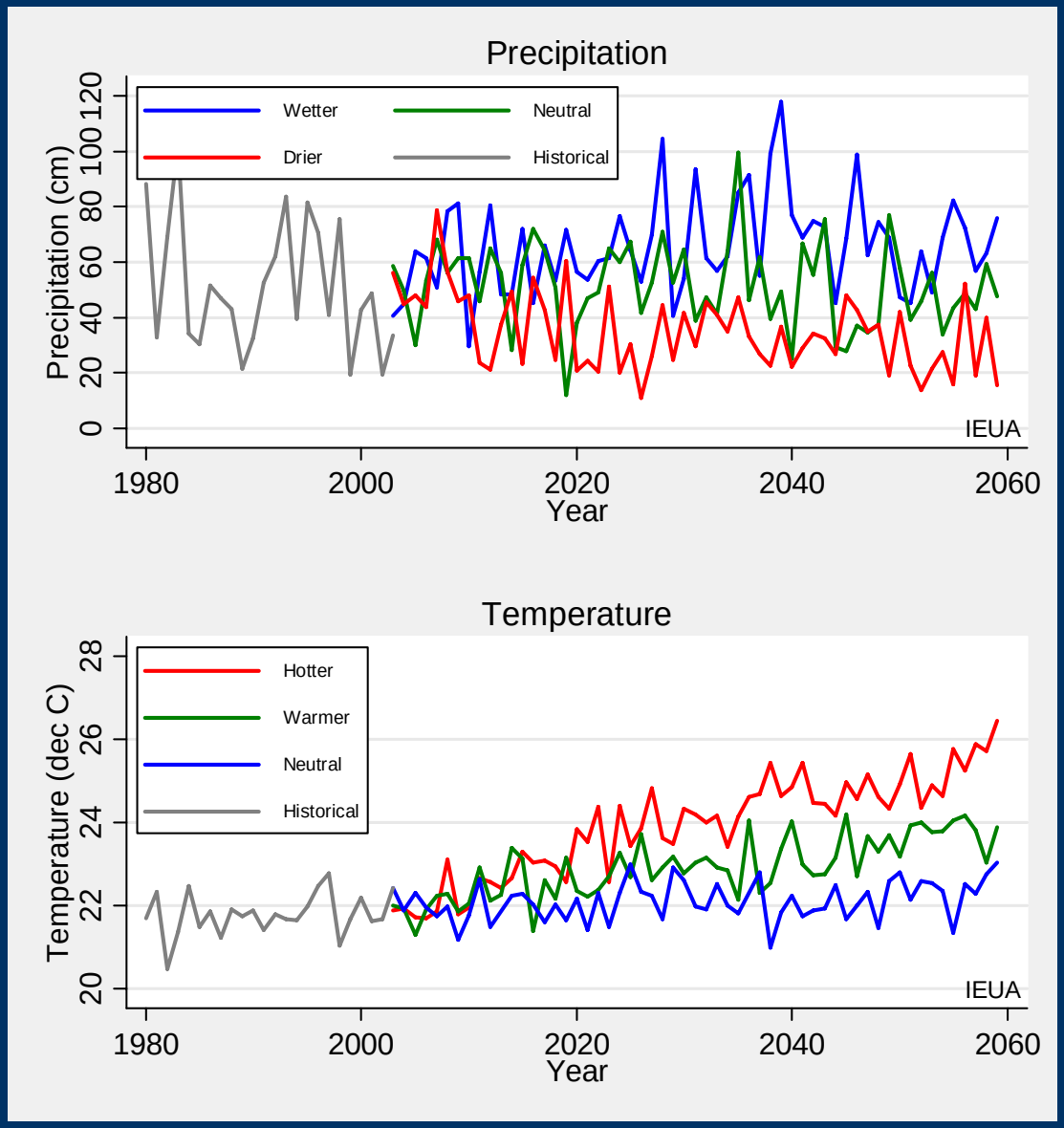
Tebaldi et al. (2005)



PDFs

- Show wide range
- Contingent on correct models and weightings

Plausible Climate Change Scenarios (X)



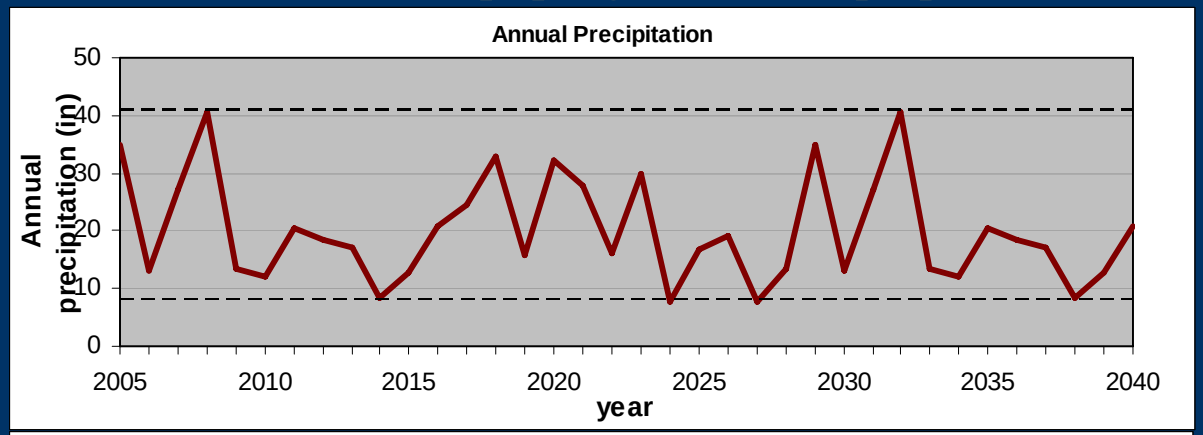
Hundreds of sequences generated using K-nn downscaling procedure

(Yates et al. 2003)

Scenarios (X) Reflect Uncertainty About Climate Change and Other Management Assumptions

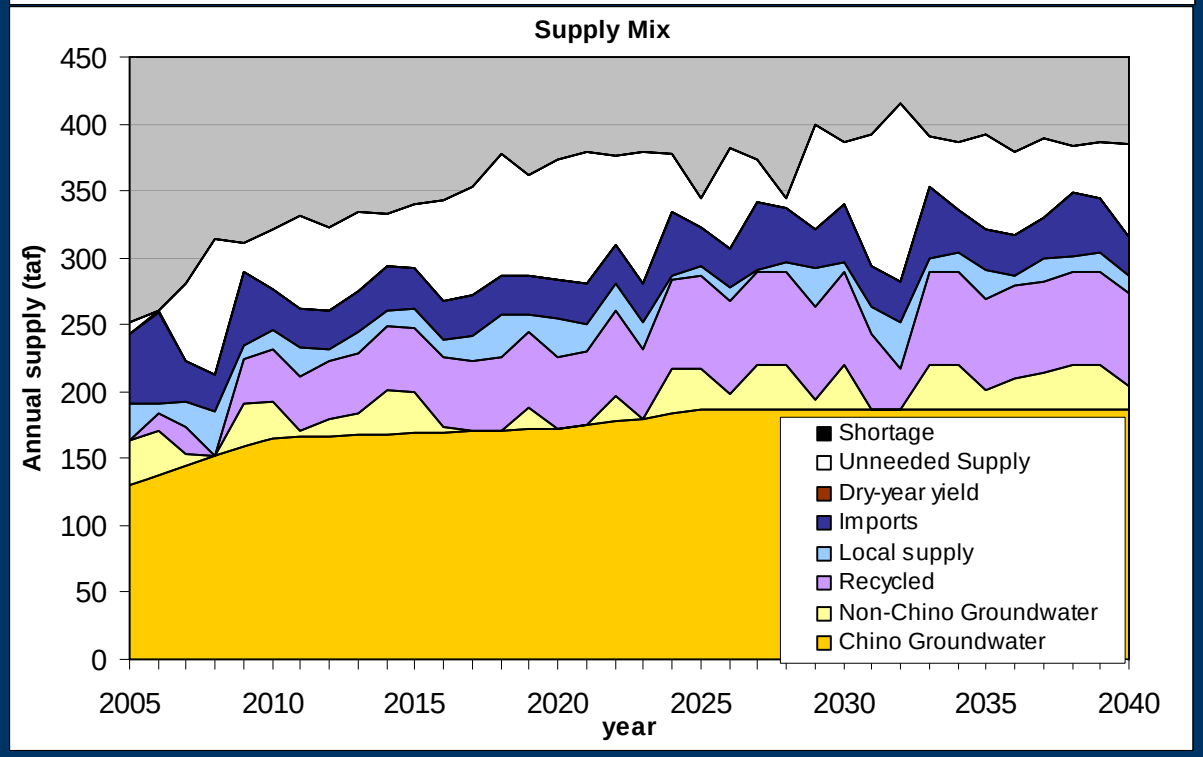
- Temperature and precipitation trends
- Hydrologic sequence
- Climate impact on imports
- Recycling system delay
- Water intensity of new development
- Groundwater replenishment achievement
- Basin-wide percolation changes
- Imported supply cost increases
- Efficiency cost increases

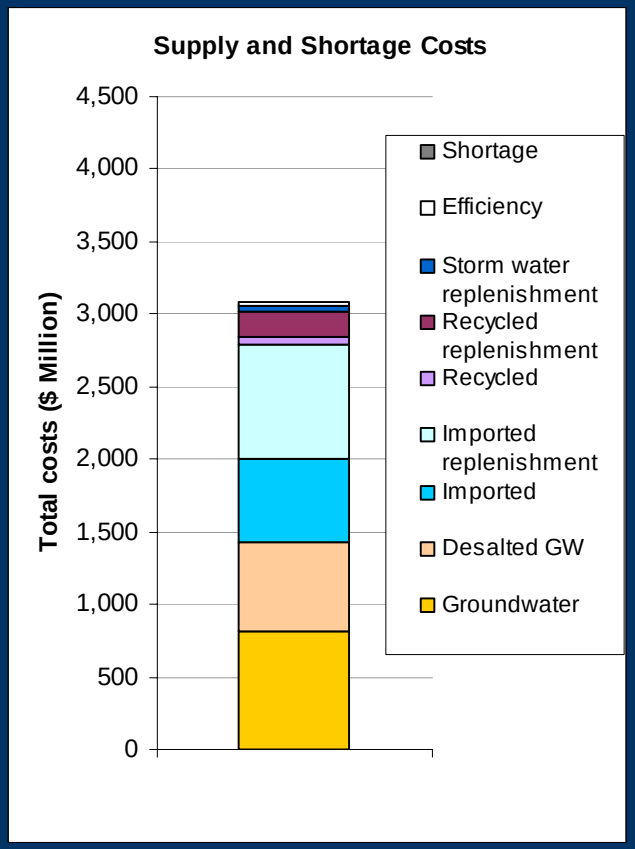
Annual Supply Mix (L) and Present Value of Costs (M)



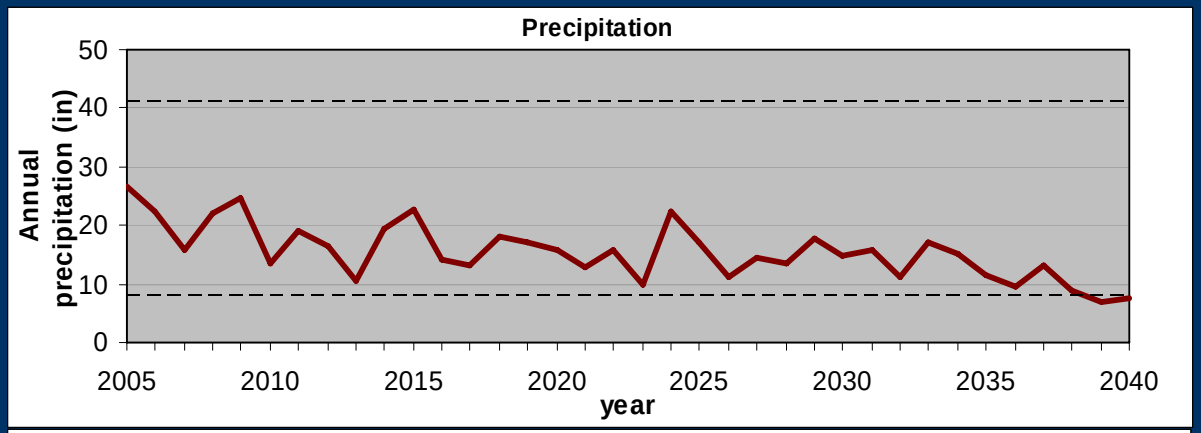
UWMP

Historical Climate



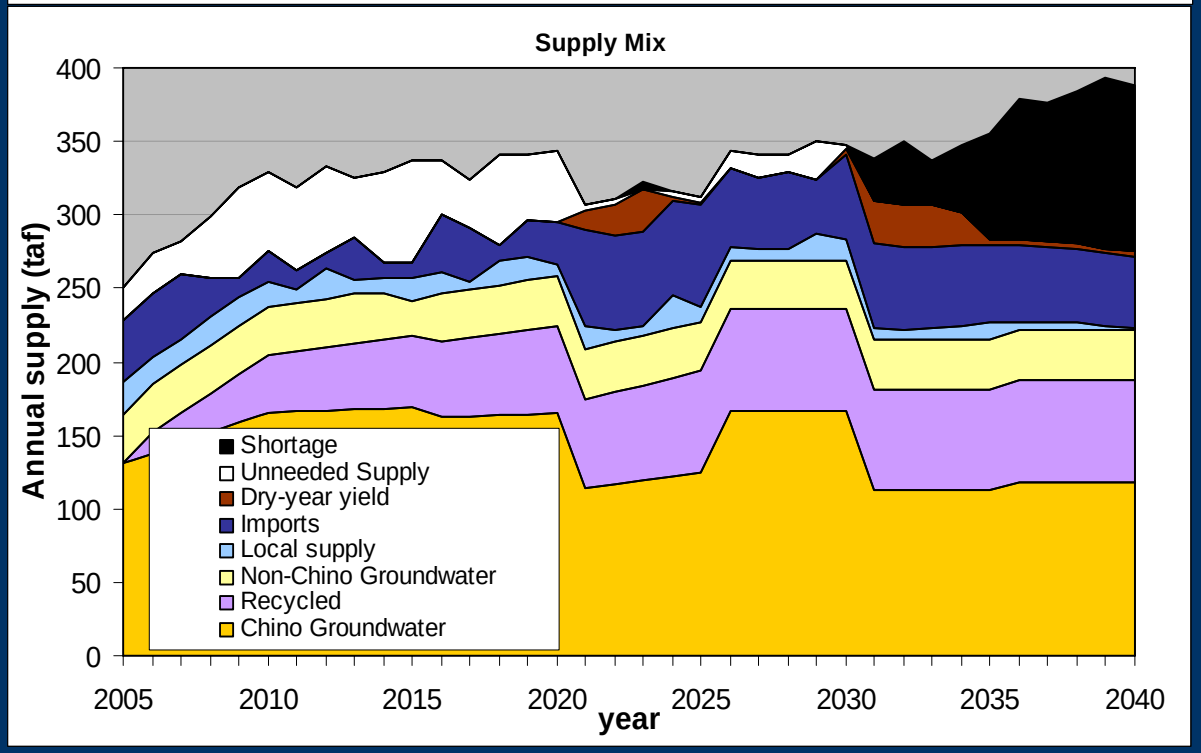


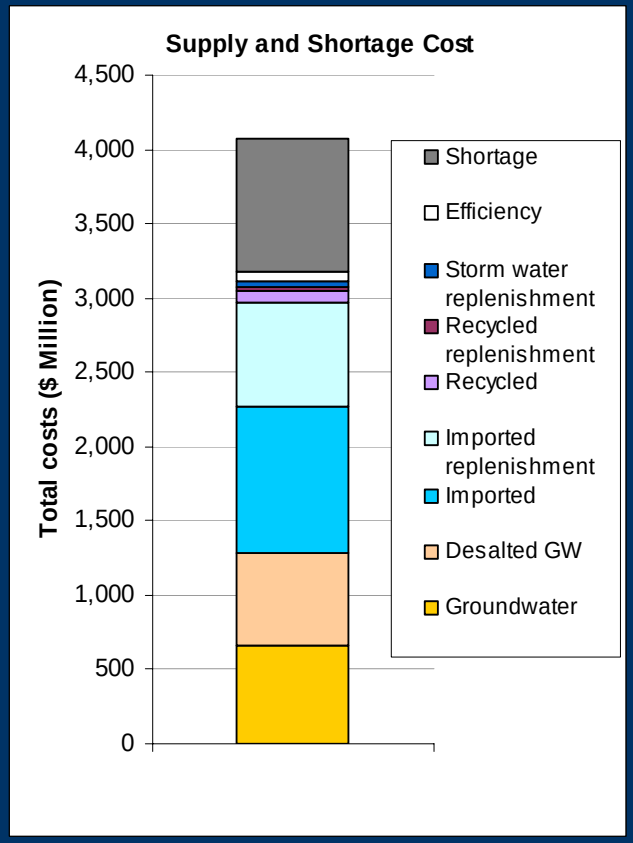
Annual Supply Mix (L) and Present Value of Costs (M)



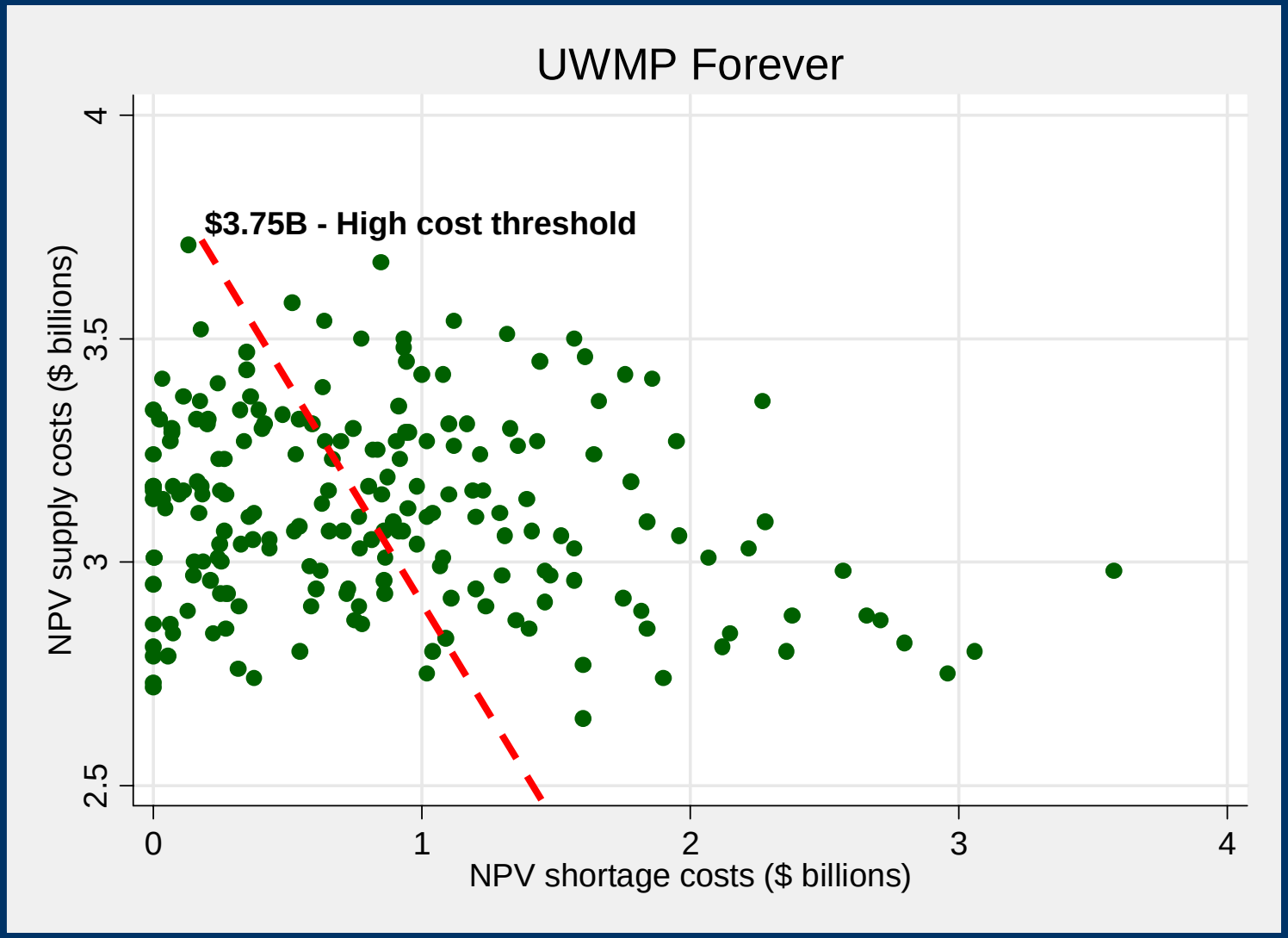
UWMP

Adverse Conditions

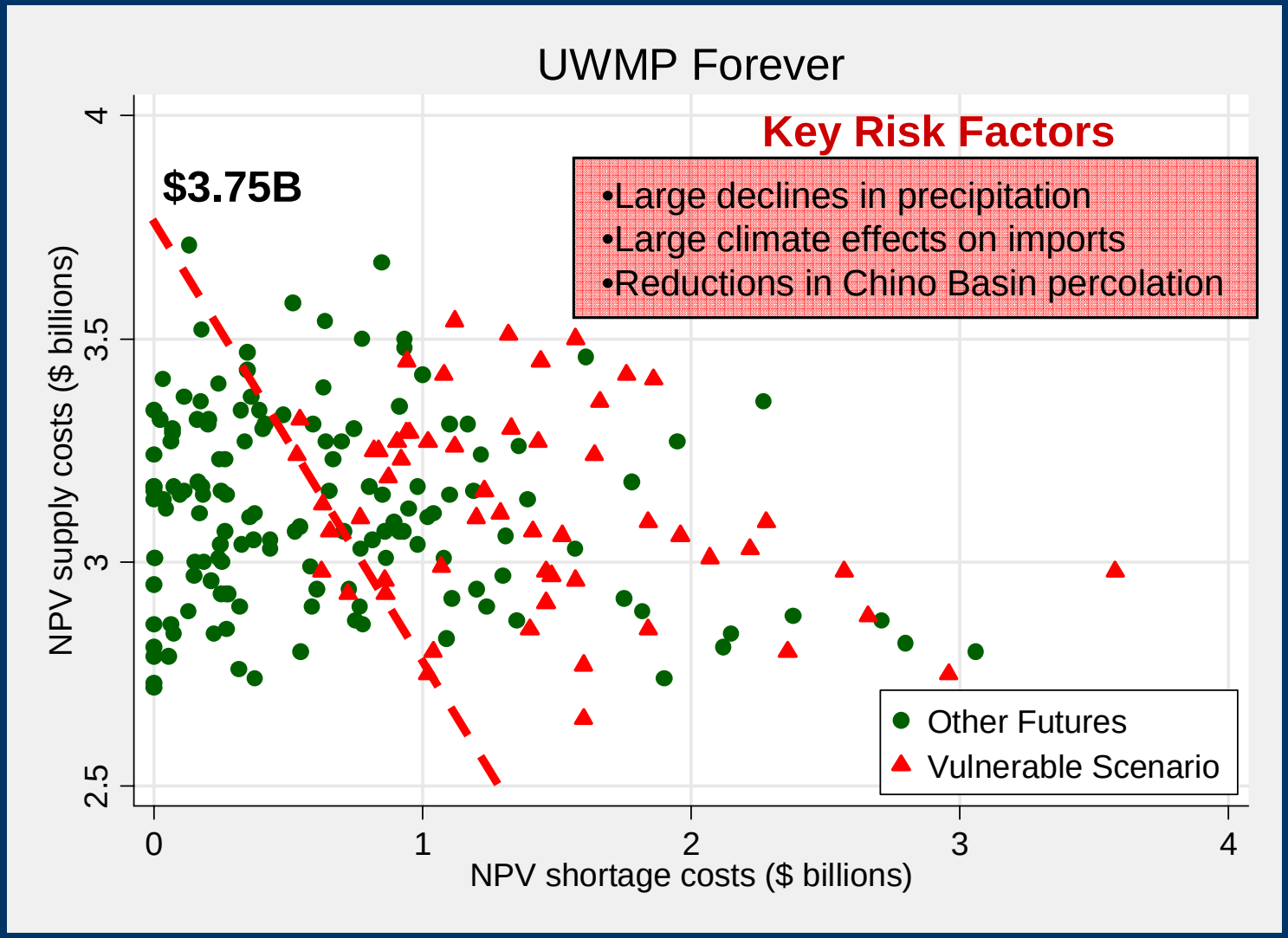




200 Different Scenarios (X), evaluated relative to Supply Costs (M) and Shortage Costs (M)



For a given set of UWMP actions (L), conditions (X) that resulted in high cost (M) outputs from the model (R)



Key Activities in South Coast Hydrologic Region

- **Expand model (R) so that it covers all South Coast Planning Areas.**
- **Develop a fuller range of scenarios (L) consistent with the key factors of the scenario narratives being developed for the 2009 Update.**
- **Describe a range of interesting management response (L) for the region and evaluate them against both physical and socio-economic metrics (M) by simulating them in the model (R).**

CWP 2009 Update XLRM Scenario Framework

Exogenous Factors (X)	Management Levers (L)
Economic and Financial Institutional and Political Natural System Technological Cultural Practices	Reduce Water Demand Improve Operational Efficiency & Transfers Increase Water Supply Improve Water Quality Practice Resource Stewardship
Relationships (R)	**Performance Measures (M)**
{Under development}	Performance during average conditions and extreme events – Demand – Reliability – Quality – Flood performance

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Proposed Schedule of Activity

	2008												2009					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Task 0: Project Management																		
Project Adminstration																		
Periodic Interaction																		
Task 1: Scenario Elements																		
Task 2: Regional Analysis																		
Task 3: Enhnace WEAP																		
Task 4: Sacramento River Analysis																		
Task 5: South Coast Analysis																		
Task 6: Climate Scenarios																		
Task 7: Evaluate Scenarios																		
Task 8: Statewide Integration																		
Task 9: Training																		
Task 10: Documentation																		