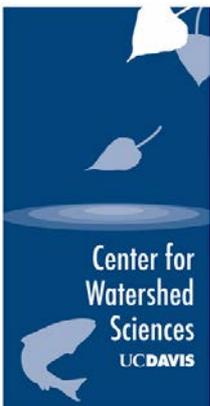


# Building Models from the Data Up: From Calvin to Hobbes

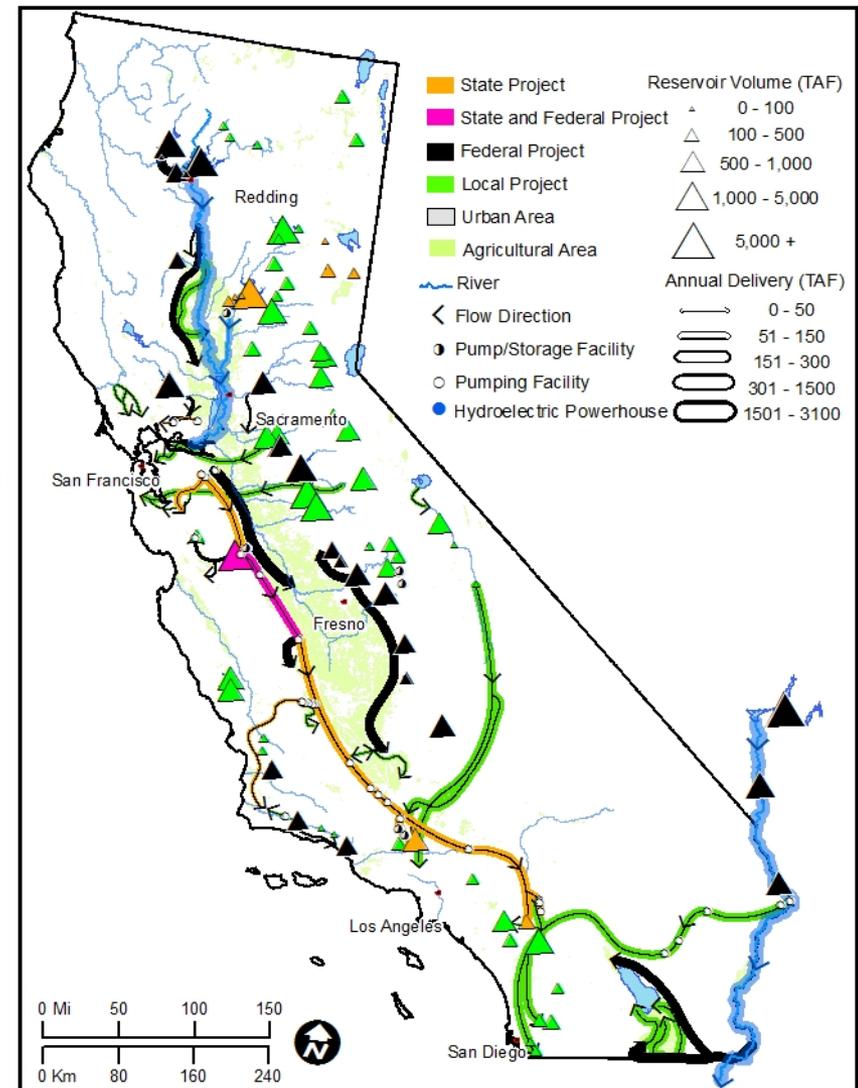
Jay Lund, Josué Medellín, Samuel Sandoval, Wei Chu,  
Alvar Escriva, Ashley Vincent, Erik Porse, Prudentia  
Zhinkalala, Timothy Nelson, Rui Hui

April 5, 2012



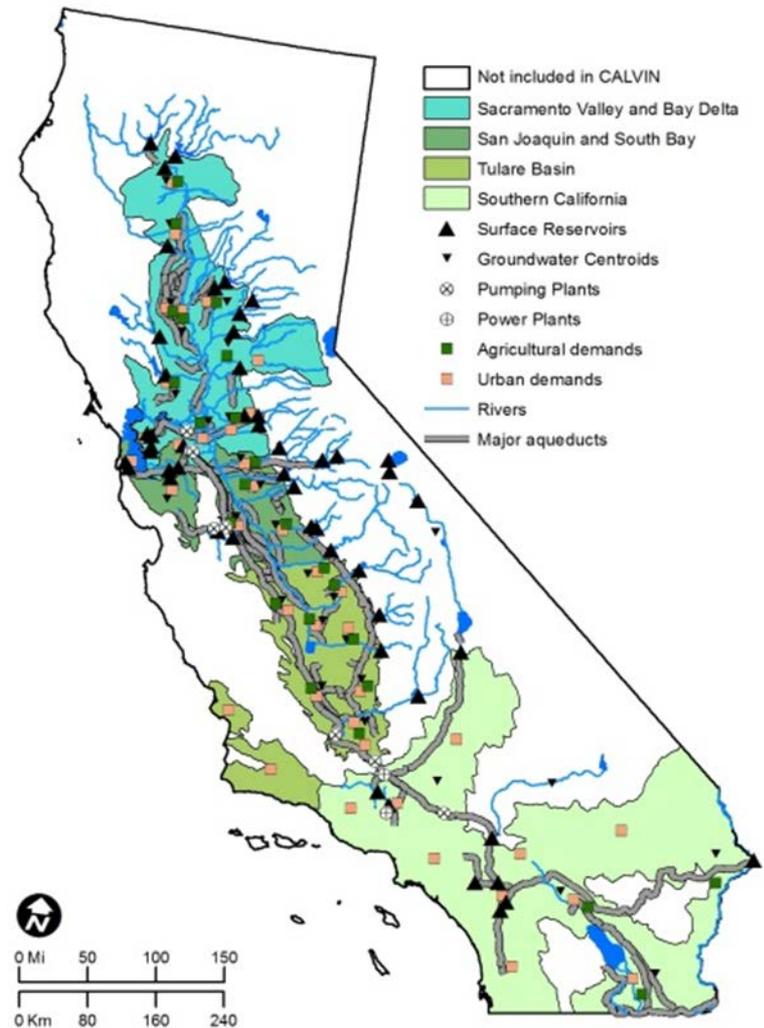
# California Water Problems

- Asynchrony in supply and demand
- Droughts & climate change
- Water quality
- The Sacramento-San Joaquin Delta
- Groundwater
- Flood management
- Ecosystem services
- Quantitative understanding



# The (12 Year Old) CALVIN Model

- Entire inter-tied water system
- Hydro-economic model
- Prescribes 72 year of operations
- Surface and Groundwater infrastructure
- Quantitative understanding of the system



# Applications and Insights

Topics	Citation
Integrated water management, water markets, capacity expansion, at regional and statewide scales	Draper et al. (2003); Jenkins et al. (2001; 2004); Newlin et al. (2002)
Conjunctive use and southern California	Pulido et al.(2004)
Hetch Hetchy restoration	Null (2004); Null and Lund (2006)
Perfect and limited foresight	Draper (2001)
Climate warming, wet and dry	Lund et al. (2003); Tanaka et al.(2006; 2008)
Climate warming, dry	Medellín-Azuara et al.(2008a; 2009)
Climate warming, dry and warm-only	Medellín-Azuara et al.(2008a; 2009); Connell (2009)
Severe sustained drought adaptation (paleodrought)	Harou et al. (2010)
Increasing Sacramento River outflows	Tanaka and Lund (2003)
Reducing Delta exports and increasing Delta outflows	Tanaka et al.(2006; 2008; 2011); Lund et al.(2007; 2008)
Colorado River delta and Baja California water management	Medellín-Azuara et al.(2006; 2007; 2008b)
Cosumnes River and Sacramento area water management	Hersh-Burdick (2008)
Bay Area adaptation to severe climate changes	Sicke (2011)
Responses to Water Scarcity in Southern California	Bartolomeo (2011)
Ending overdraft in the Tulare Basin	Harou and Lund (2008); Chou (2012), Zikalala (2013)
Urban water conservation with climate change and reduced Delta pumping	Ragatz (2013)

# What we have learned

- Need integrated and workable technical plan
- Organize model data into databases
- Document data in databases
- Modeling capabilities for water issues
- Don't wait for perfect data
- Quantify, document, improve cycle

# Hobbes: Building Models from Data Up

- Need a new approach
- Models are too big and detailed to build around solution algorithms
- Need to build models on top of data to allow flexibility with algorithms
- Problem determines algorithm and scenarios
- Reality determines the data

# New Directions: Data Management and Documentation System

- Standards for storing and sharing datasets and metadata
- A object-oriented geospatial database platform
- Automatic network generation
- User-friendly Graphical User Interface (GUI)
  - GUI for general users
  - GUI for DMDS managers

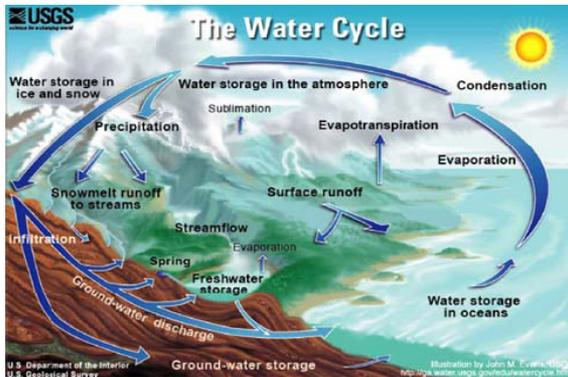
# What goes in the DMDS?



**Water infrastructure**



**Environmental Services**



**Hydrology**

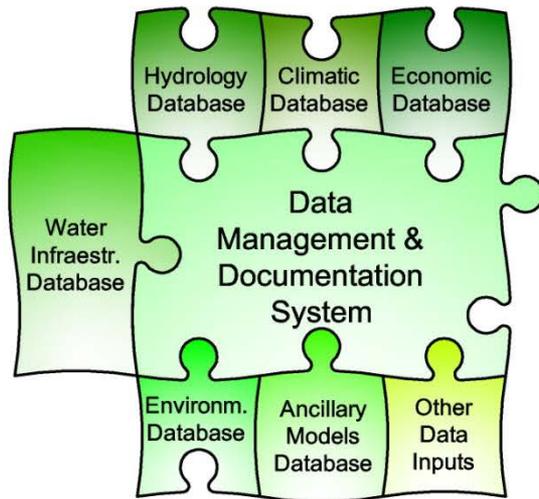


**Water Economics**

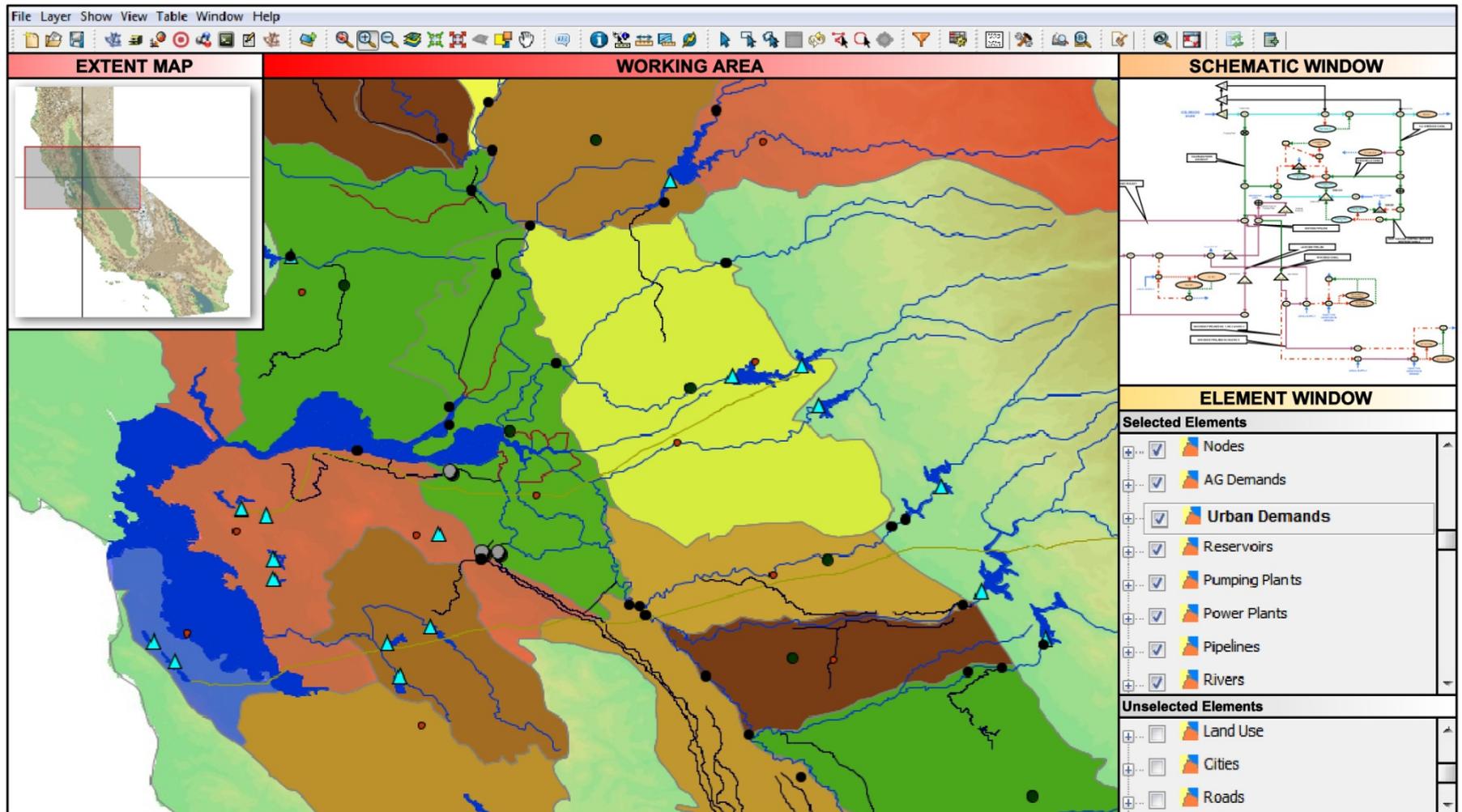
**+**

**Ancillary model specifications and connections**

# Hobbes: Assembling the puzzle



# Graphical User Interphase



**Synchronized network generator**

# The Hobbes Project is a Venue for:

- Database standardization and data documentation
- Geocoded data element representation
- Open platform with web access
- Transforming database elements into documented model inputs
- Focus on data and database structure, and documentation instead of specific models
- Framework for agencies and interests to largely agree and document fundamental data for long term modeling

# Acknowledgements

- Past graduate students and researchers
- Department of Water Resources
  - Jamie Anderson, Tariq Kadir, Rich Juricich, Mike Mierzwa, Kamyar Guivetchi, Erik Reyes, Tara Smith,
- State Water Resources Control Board
  - Les Groeber, Eleanor Bartolomeo, Rich Satkowski,
- Stacy Tanaka and Mike Deas, Watercourse Eng.
- Andy Draper, MWH
- Past and present funding from Bechtel Foundation and state and federal agencies.