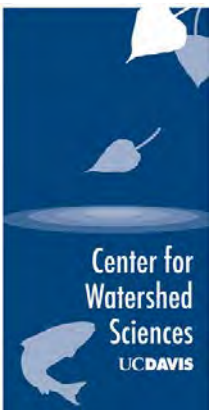# Building Models from the Data Up: From Calvin to Hobbes

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

April 5, 2012
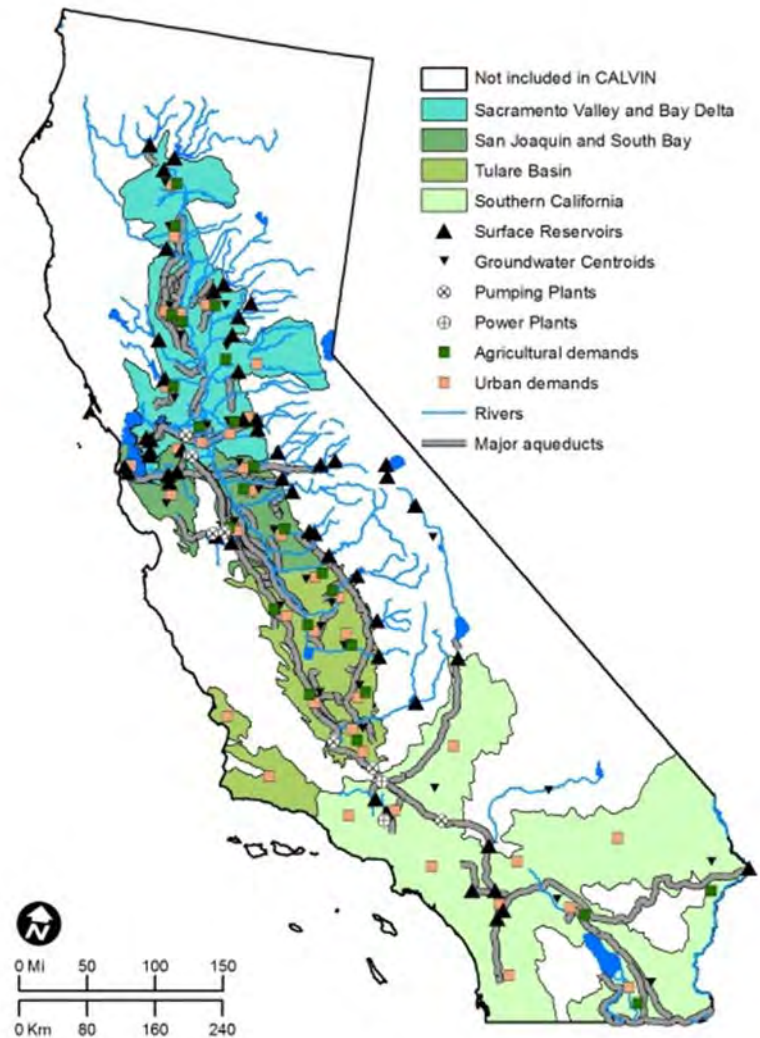
Center for Watershed Sciences
UCDAVIS

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

Managing California's Water from Conflict to Reconciliation

81

2
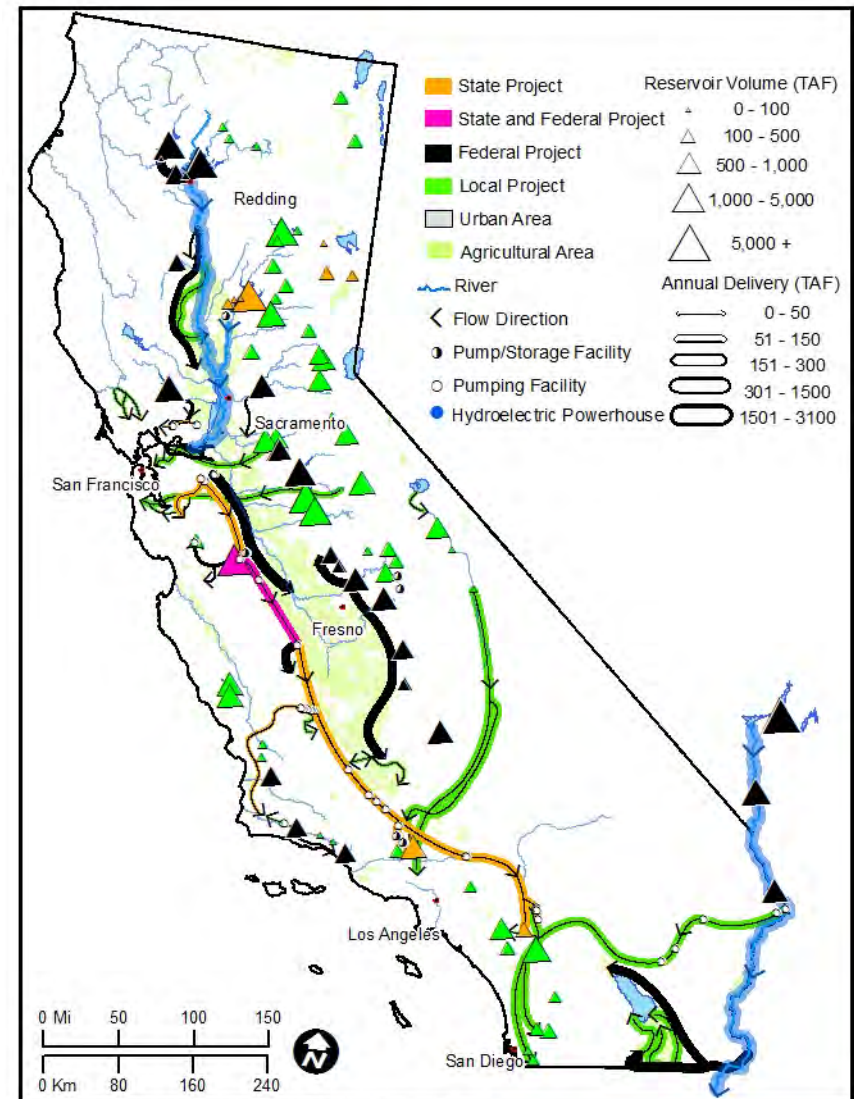
The (12 Year Old) CALVIN Model

- Entire inter-tied water system

- Hydro-economic model

- Prescribes 72 year of operations

- Surface and Groundwater infrastructure

- Quantitative understanding of the system

Not included in CALVIN
Sacramento Valley and Bay Delta
San Joaquin and South Bay
Tulare Basin
Southern California
▲ Surface Reservoirs
▼ Groundwater Centroids
⊗ Pumping Plants
⊕ Power Plants
■ Agricultural demands
■ Urban demands
— Rivers
═ Major aqueducts

0 Mi   50   100   150
0 Km   80   160   240

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)
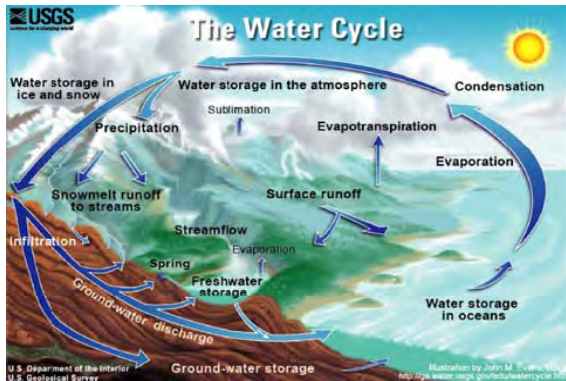 - GUI for general users
  - GUI for DMDS managers

What goes in the DMDS?
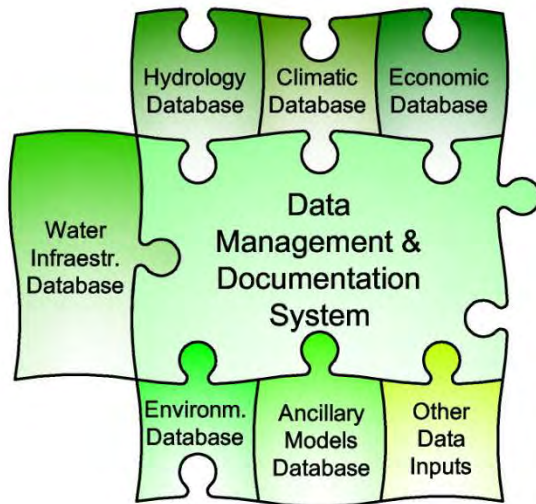

Water infrastructure

Environmental Services
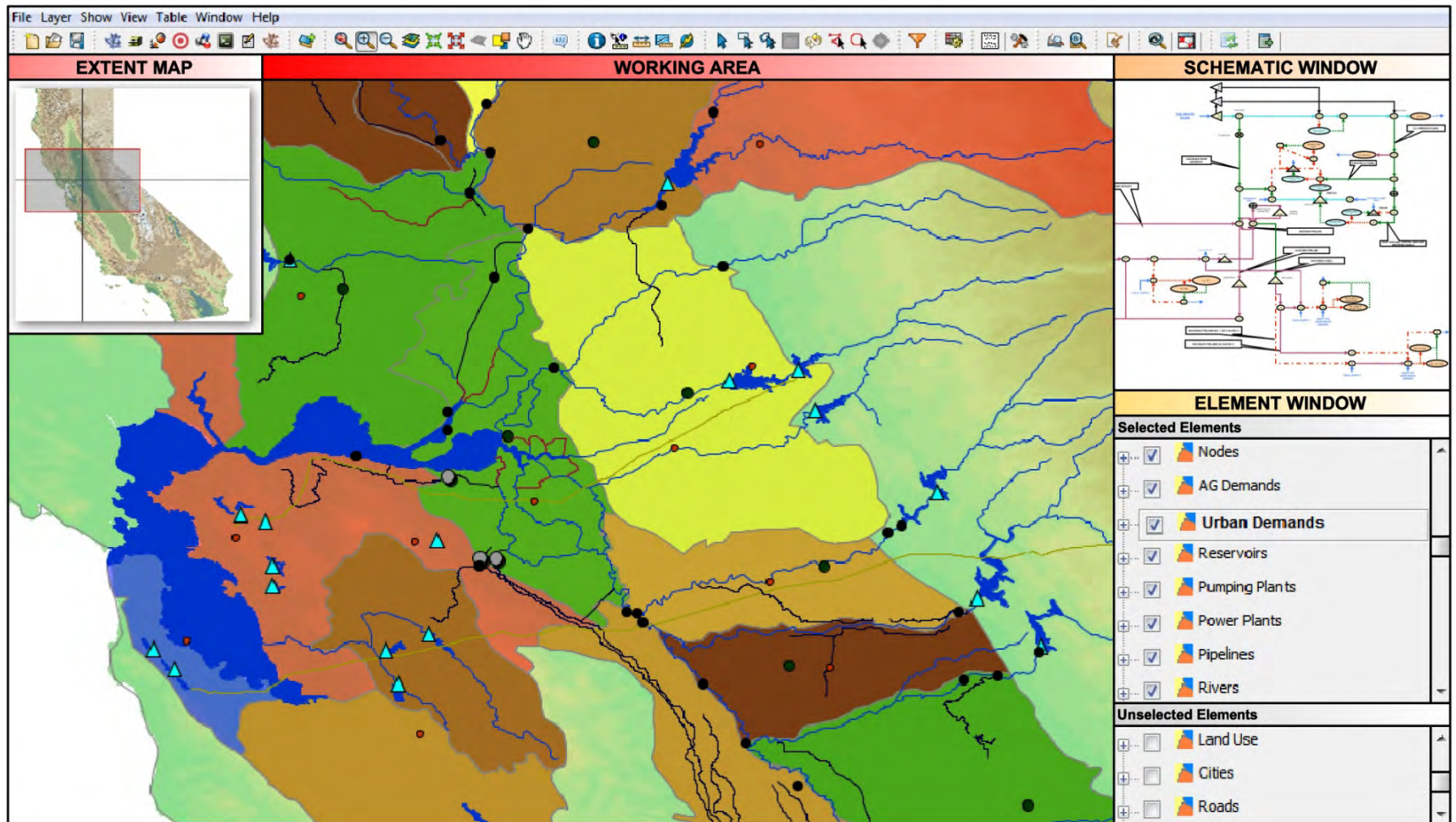

Hydrology

+ 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.