Comments on a Need for Improved Data on Water Use

Presentation at Roundtable on Science and Technology

Sujoy Roy, Tetra Tech

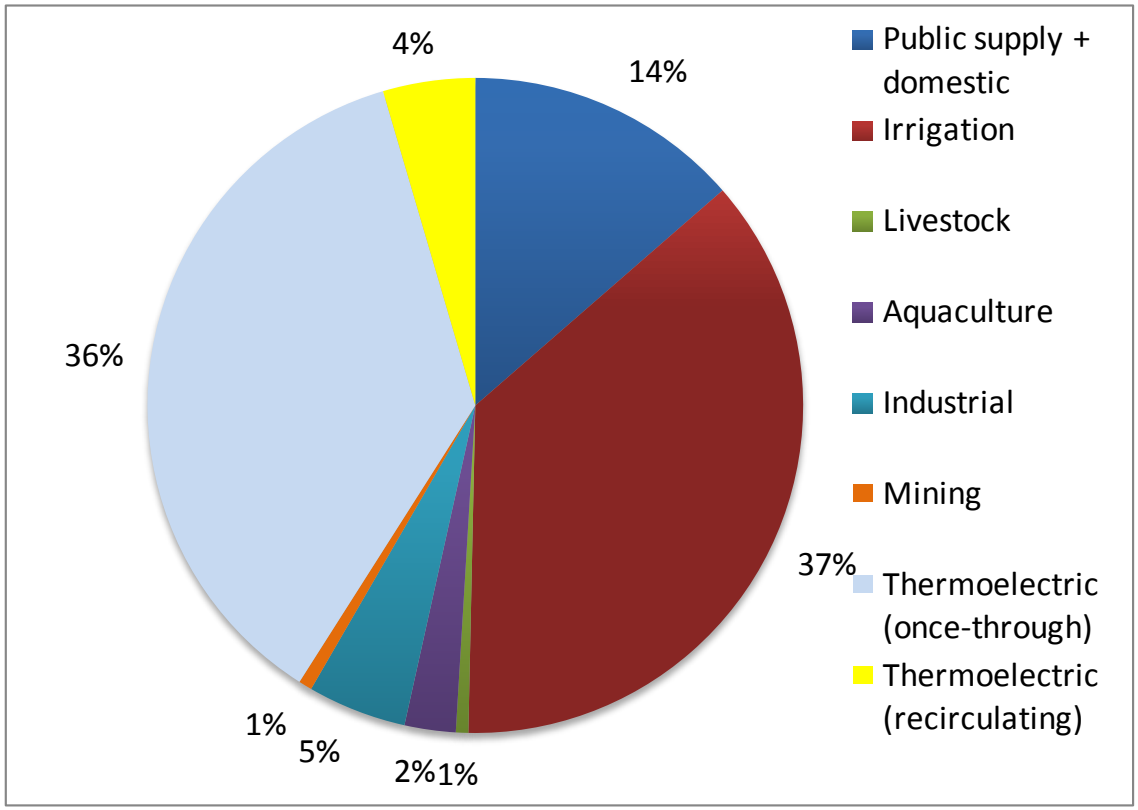
December 11, 2014

Overview

- Current status of national-scale water use reporting
- Extensions of the basic data set into more open ended questions:
  - Consumption
  - Future growth
  - New sectors for use
- Some ideas for future development of the water use data framework

- Acknowledgements: EPRI, US EPA, Metropolitan Water District, LA Department of Water and Power, California Department of Water Resources, Natural Resources Defense Council

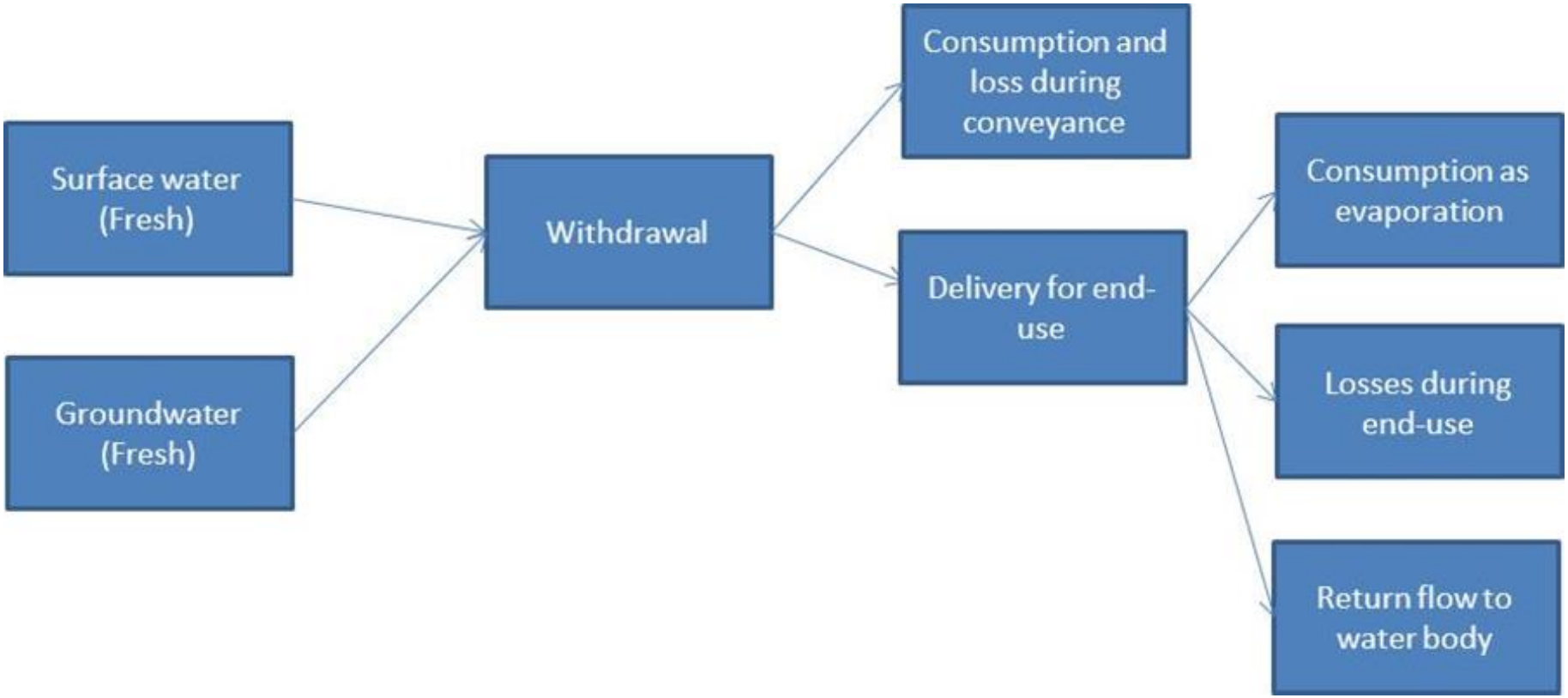
Freshwater Withdrawals in 2005 (USGS 5-Yr Survey)



Total withdrawal estimated by USGS to be: 344,000 mgd

Data source: Kenny, J.F., Barber, N.L., Hutson, S.S., Linsey, K.S., Lovelace, J.K., and Maupin, A., (2009). Estimated use of water in the United States in 2005: U.S. Geological Survey Circular 1344.

Withdrawal and Consumption

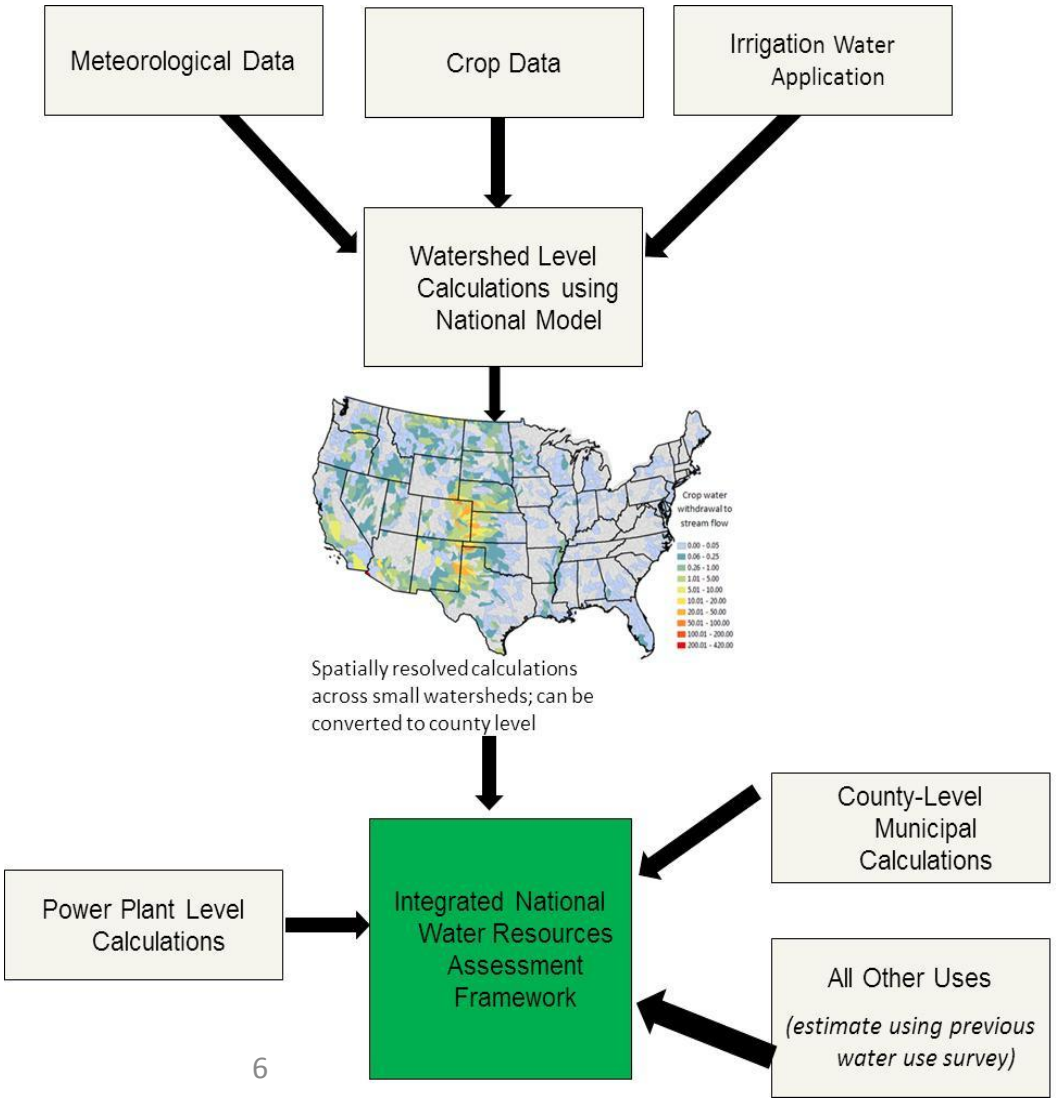


Note that “use” is a non-specific term in this context.

Some Typical Questions

- How does consumption differ from withdrawal?
  Evaluate agriculture and thermoelectric generation.
- How does withdrawal/consumption compare to water availability?
- What are the anticipated trends in future?
  Examples: Climate change, changes in quantity and mix of electricity generation, hydraulic fracturing, new water sources

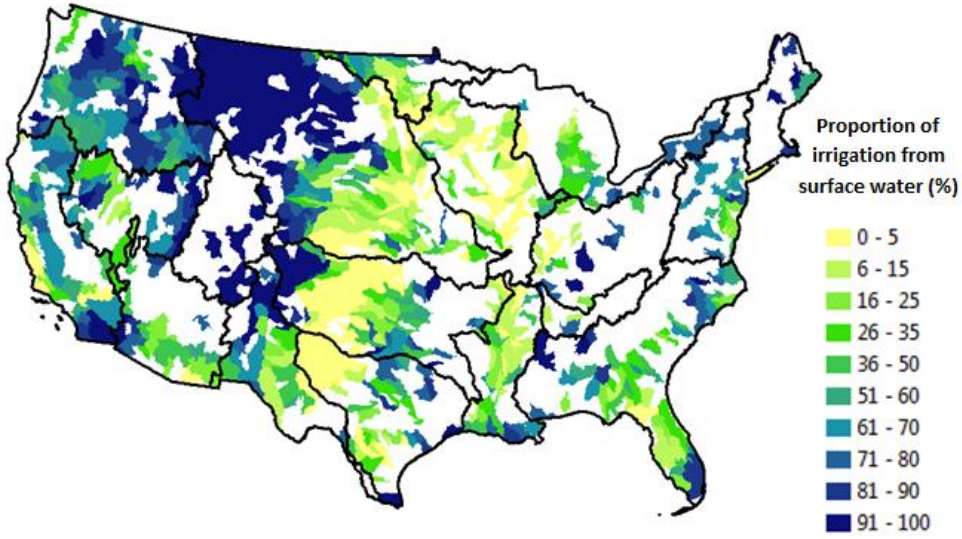
Agricultural Consumption using the Soil and Water Assessment Tool (SWAT)



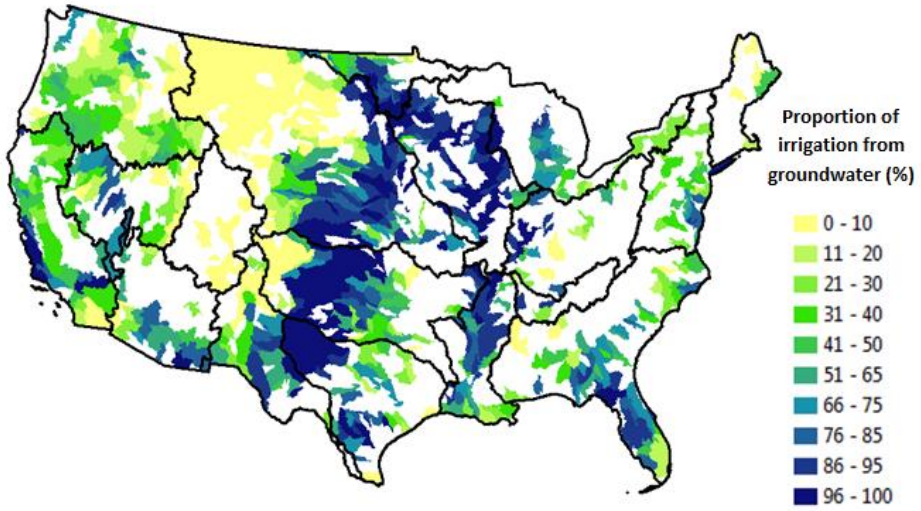
Source: *Evaluating Thermoelectric, Agricultural, and Municipal Water Consumption in a National Water Resources Framework.* EPRI, Palo Alto, CA: 2013. 3002001154.

Irrigation Water Application by Source

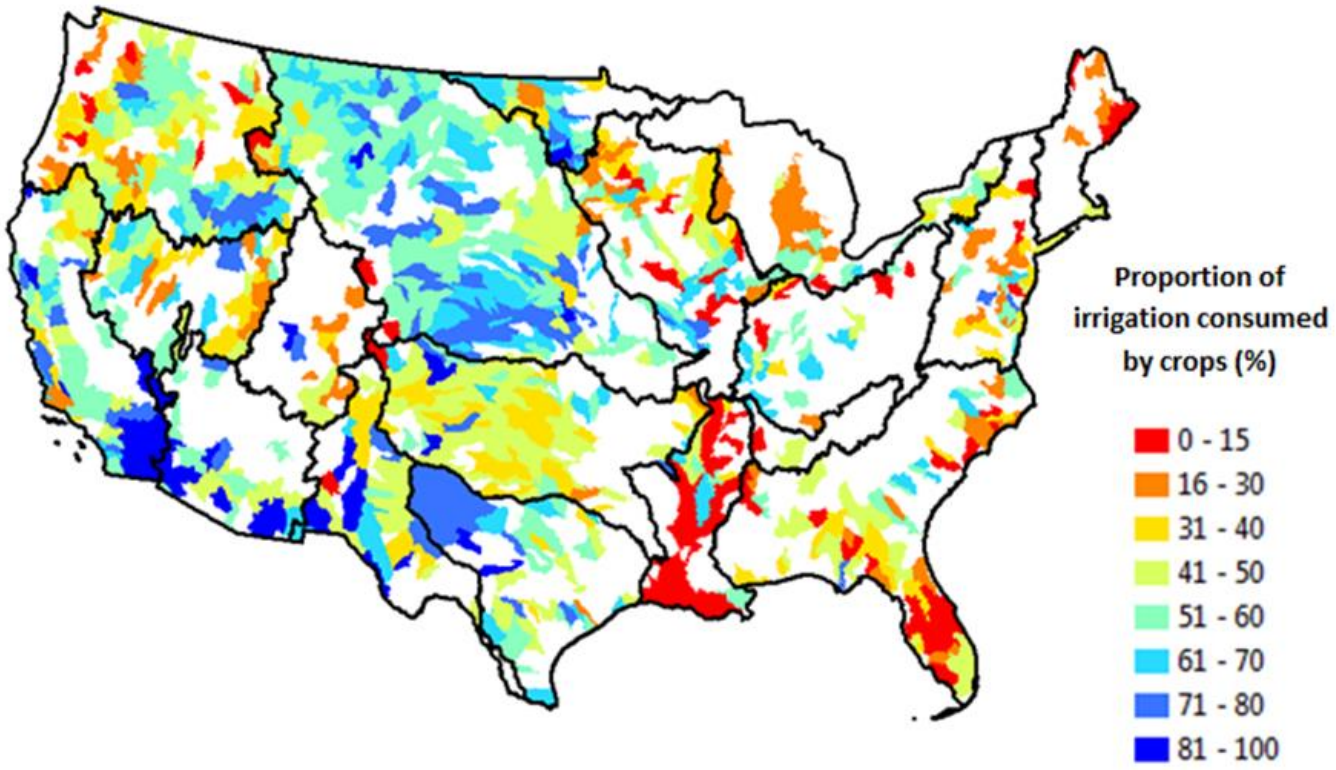
Surface Water



Groundwater



Proportion of Irrigation Water Consumed by Crops



Withdrawal and Irrigation Application Summary: Existing Data and Watershed Model

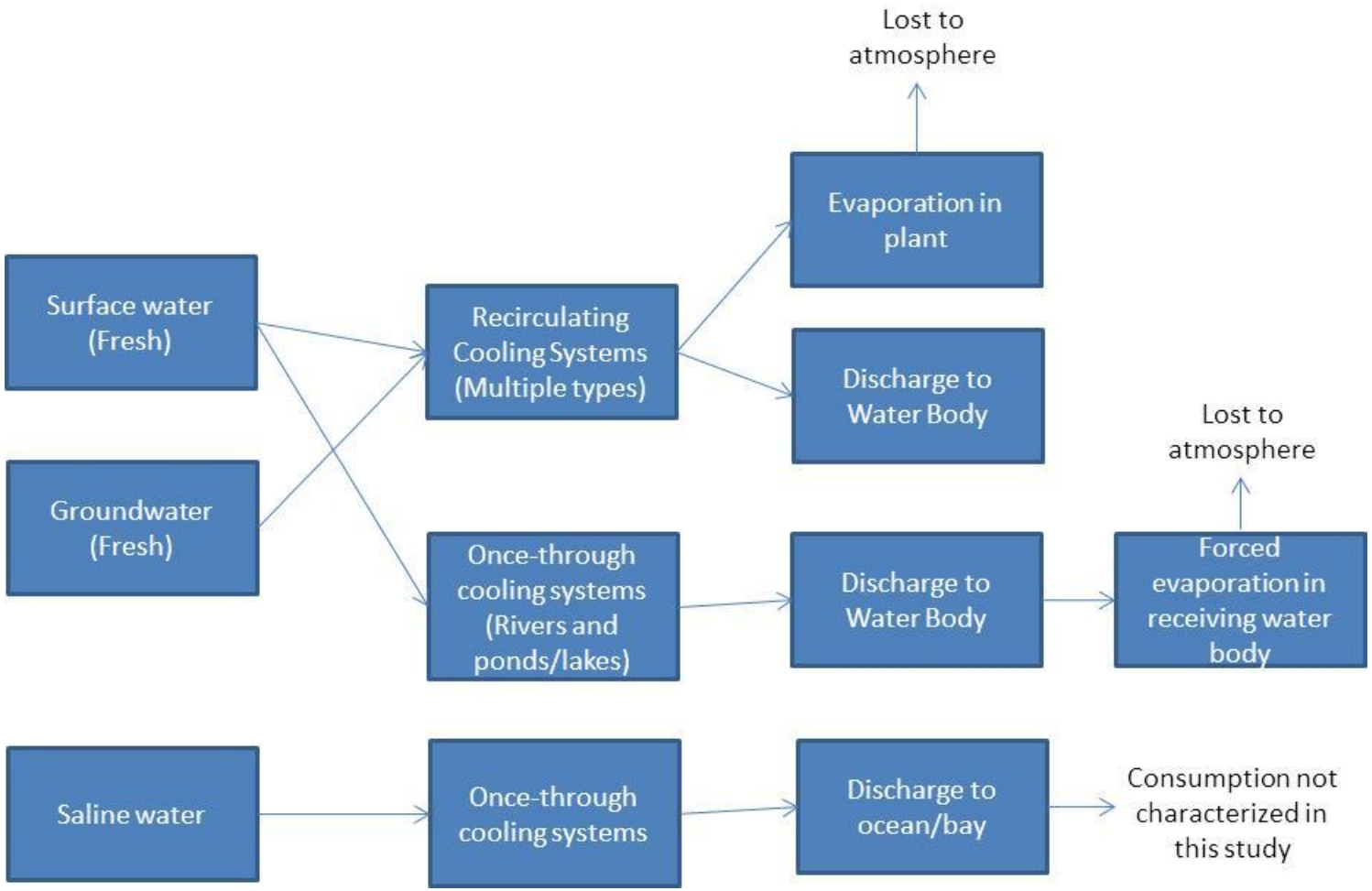
Comparing Different Federal Databases

Item	Quantity (MGD), rounded to nearest 1000 MGD
Irrigation withdrawal, USGS data, 2005	128,000
Farm-level irrigation applied, USDA FRIS data, 2008	81,000
Implied Loss in conveyance (USGS 2005 withdrawal minus FRIS 2008 application)	47,000

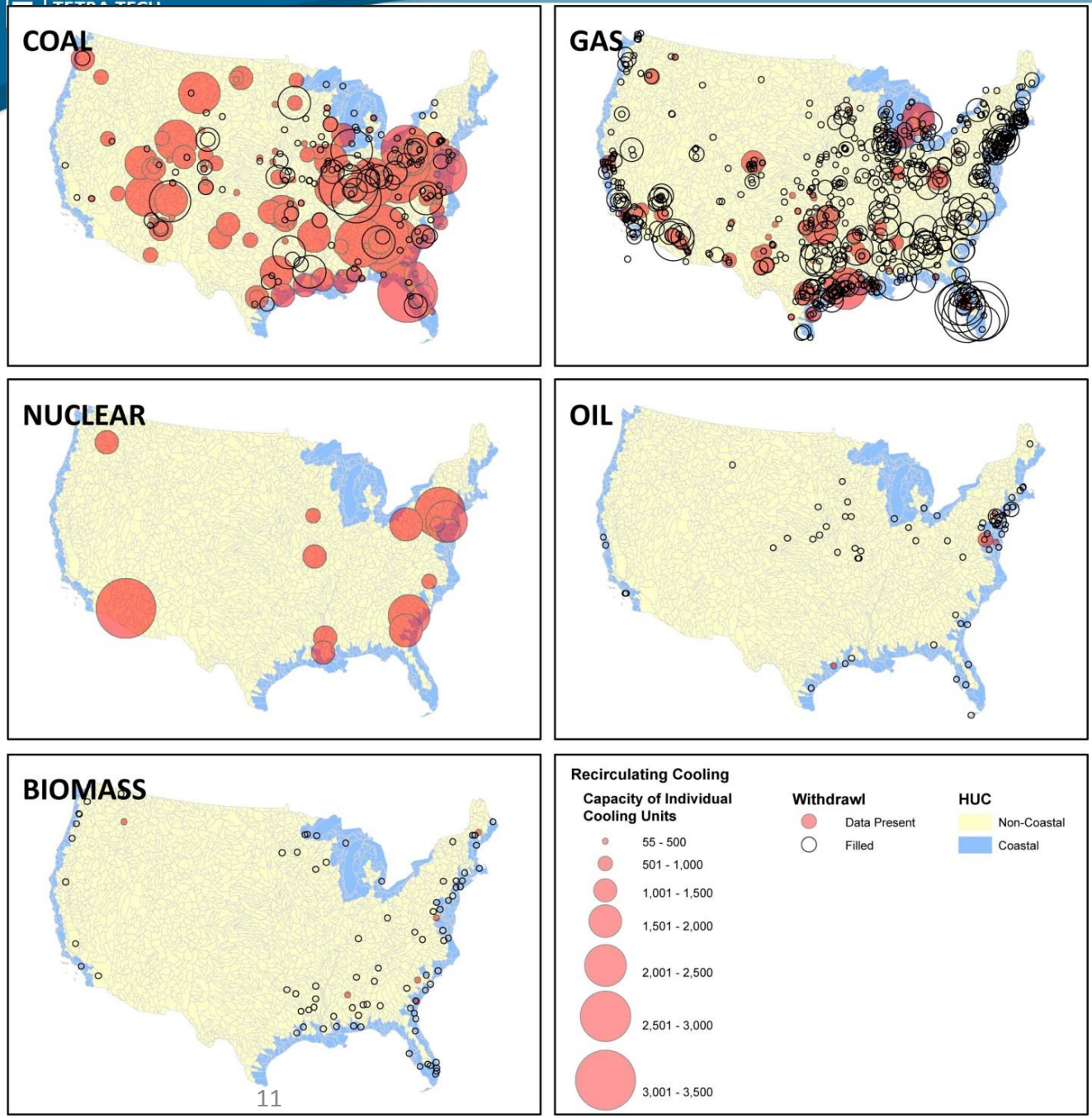
Summary Results from Watershed Model

Item	Quantity (MGD), rounded to nearest 1000 MGD
Irrigation, modeled	73,000
Crop Consumption, modeled	37,000
Base flow, modeled	21,000
Surface runoff, modeled	4,000
Farm-level losses	11,000

Thermoelectric Water Consumption

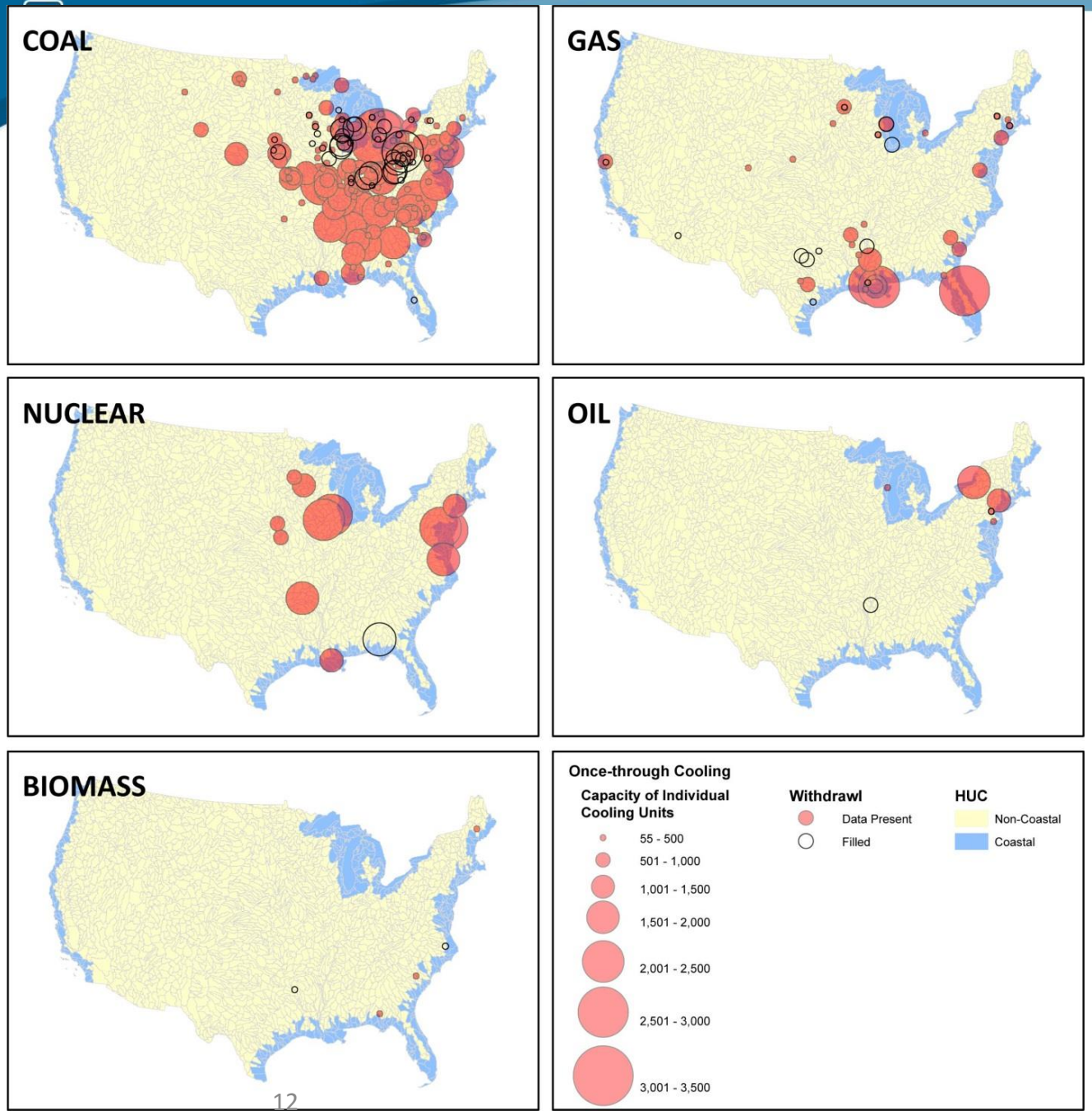


Recirculating Cooling Systems



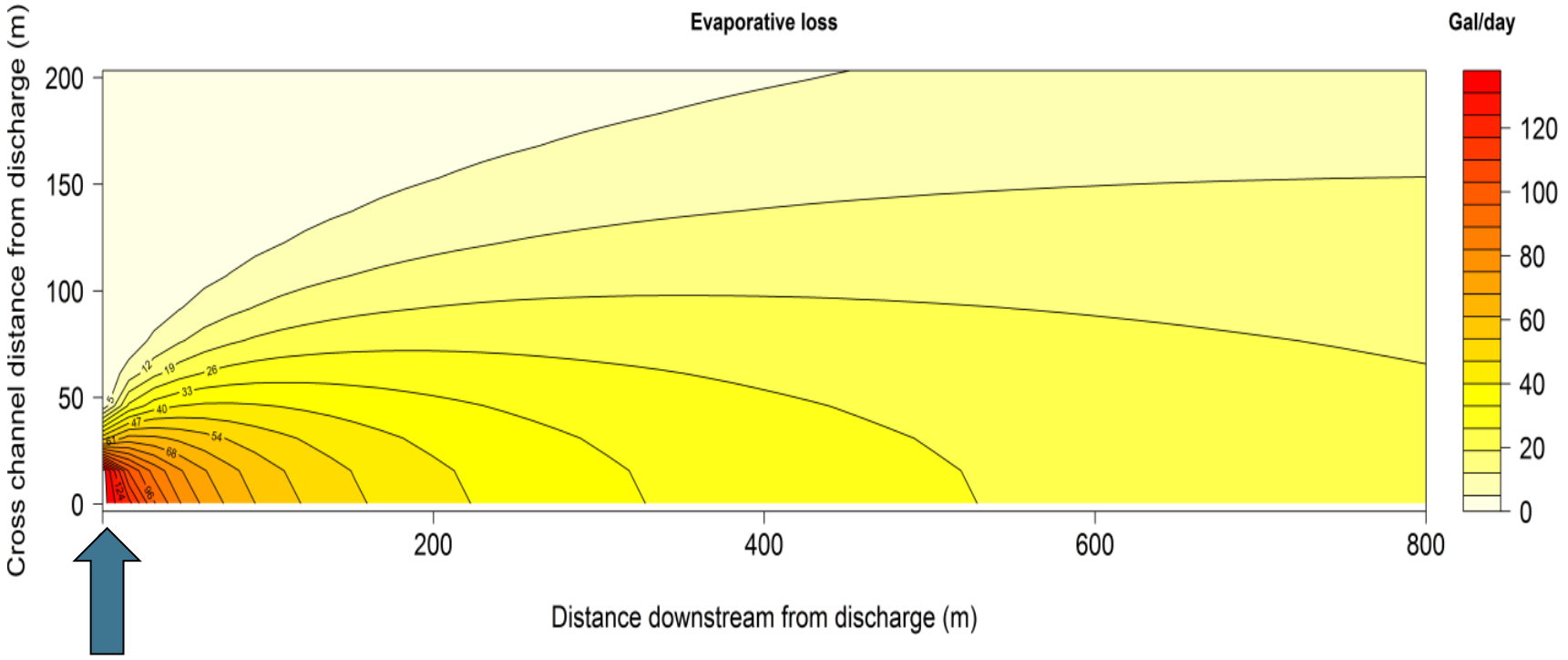
Source: 2009 EIA Power Plant Data

Once-Through Cooling Systems



Source: 2009 EIA Power Plant Data

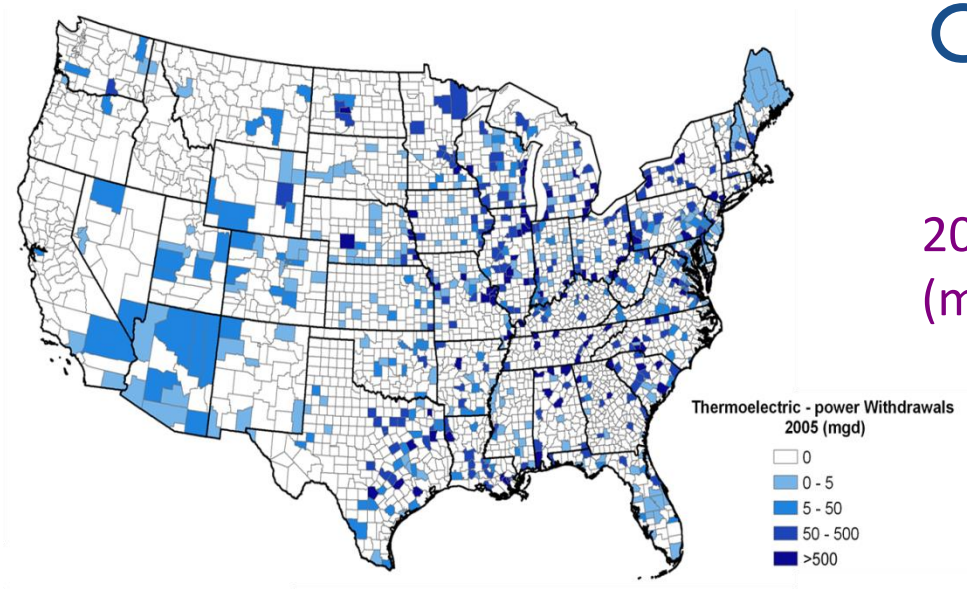
Estimated Forced Evaporation Using 2-D Heat Transport Model



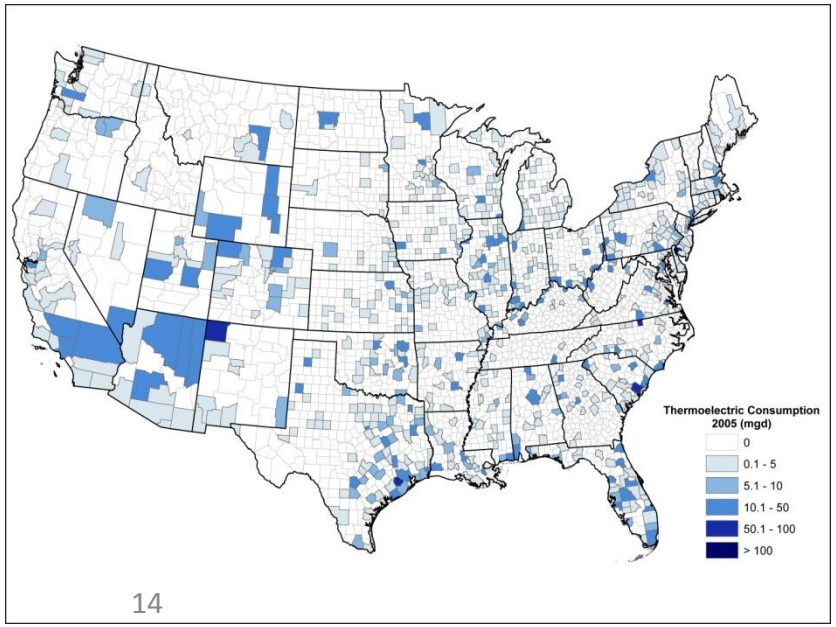
Discharge

In contrast to cooling tower evaporation, forced evaporation is a diffuse sink.

Comparison of Thermoelectric Withdrawal and Consumption



2005 Withdrawals (mgd)



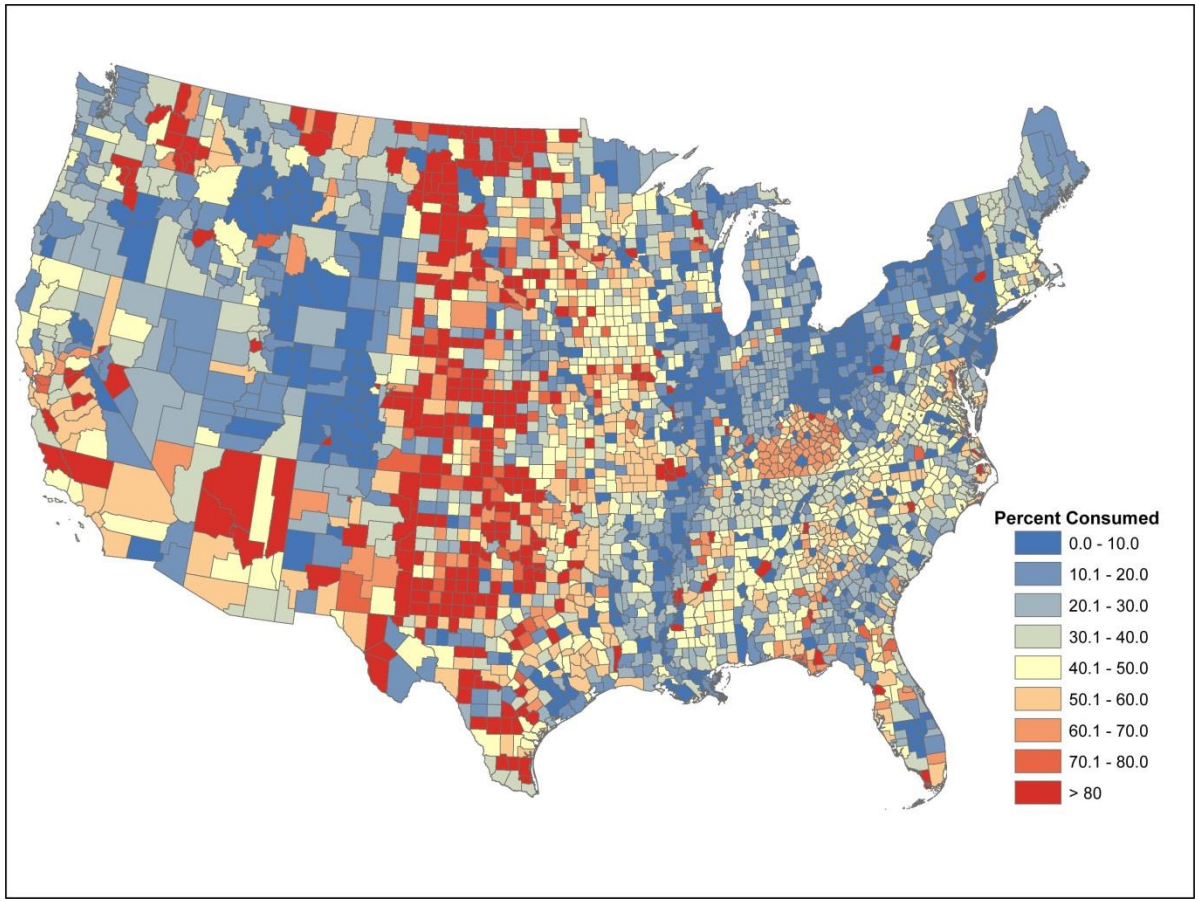
Estimated Consumption (mgd)

National Aggregate Consumption Estimates Compared to Withdrawal

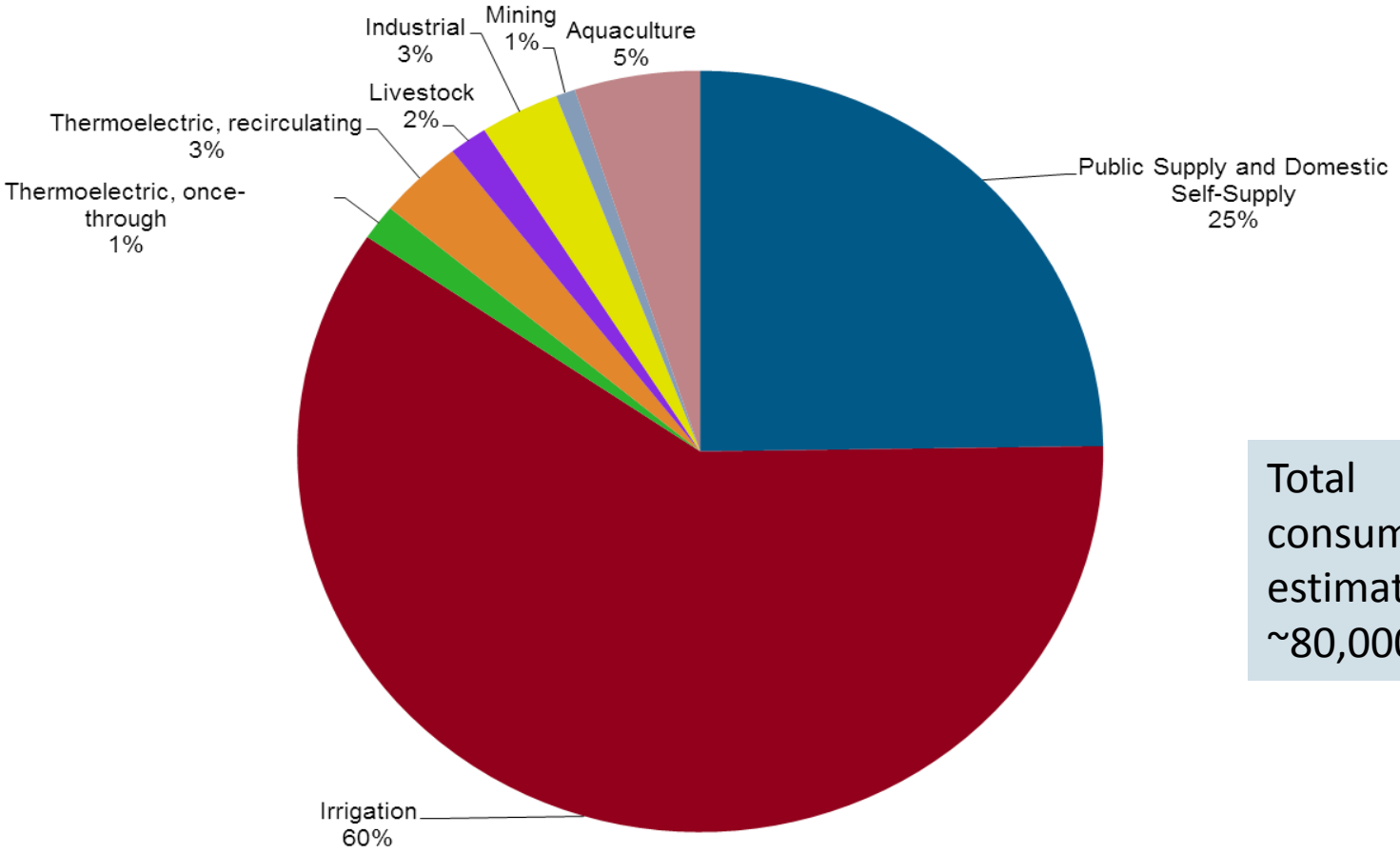
Water Use Category, 2005	Withdrawal (MGD)	Consumption (MGD)	Consumption (% of withdrawal)
Thermoelectric, once-through	134,440	1,200	0.9
Thermoelectric, recirculating	4,730	2,740	58.0
Irrigation	128,000	47,700	37.3
Public Supply and Domestic Self-Supply	47,007	19,778	27.5

Source: *Evaluating Thermoelectric, Agricultural, and Municipal Water Consumption in a National Water Resources Framework.* EPRI, Palo Alto, CA: 2013. 3002001154.

Water consumption from all sectors as a percent of total freshwater withdrawal



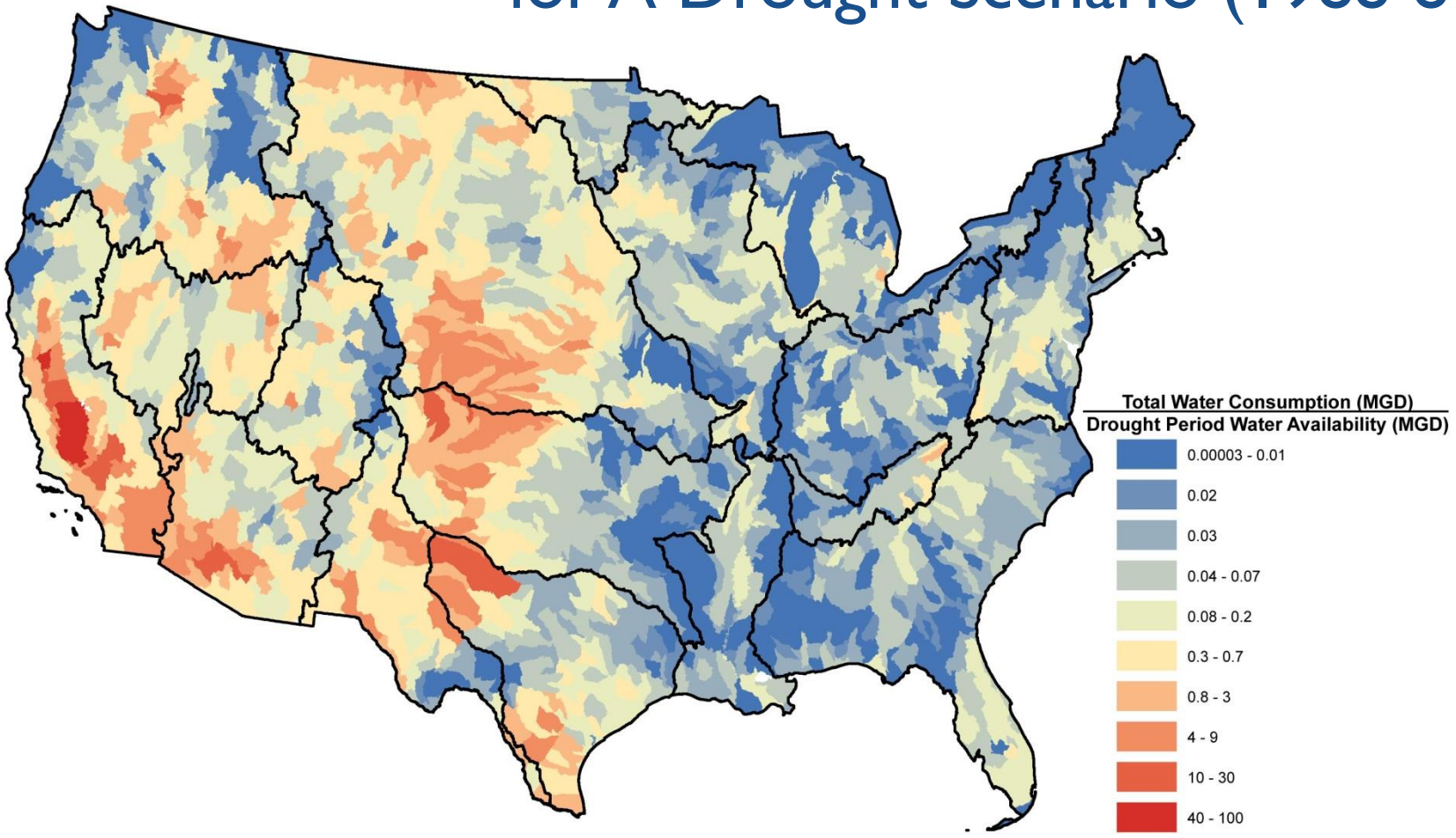
Estimated Consumption in 2005



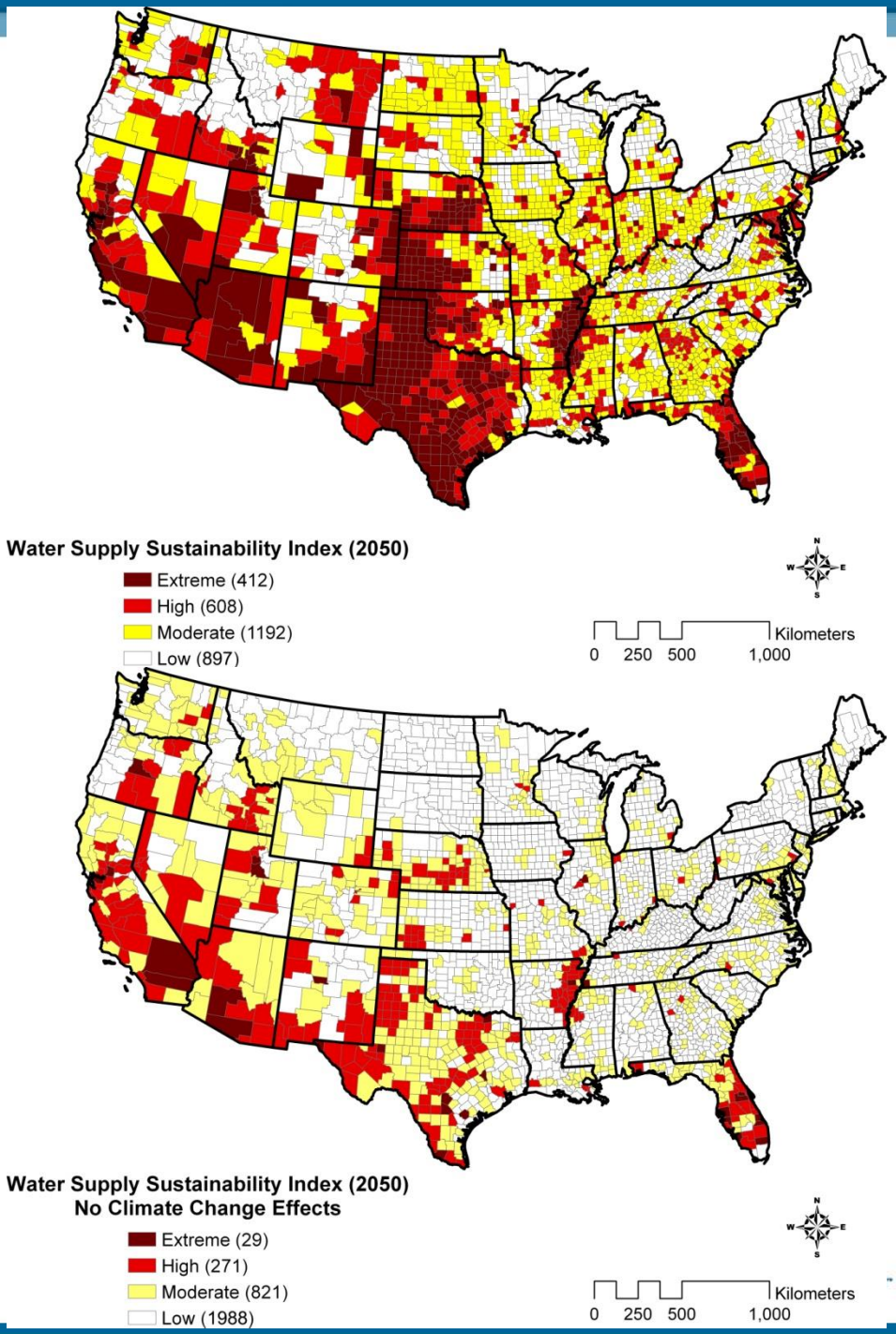
Total consumption estimated to be: ~80,000 mgd

Source: *Evaluating Thermoelectric, Agricultural, and Municipal Water Consumption in a National Water Resources Framework.* EPRI, Palo Alto, CA: 2013. 3002001154.

Ratio of Water Consumption to Water Availability for A Drought Scenario (1988-89)

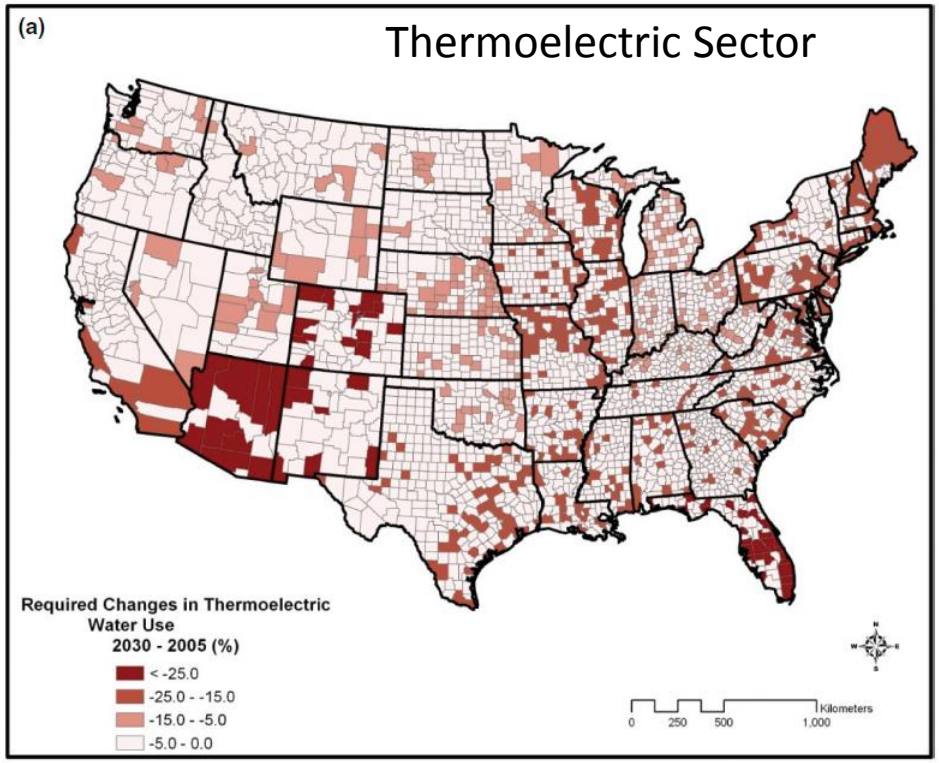


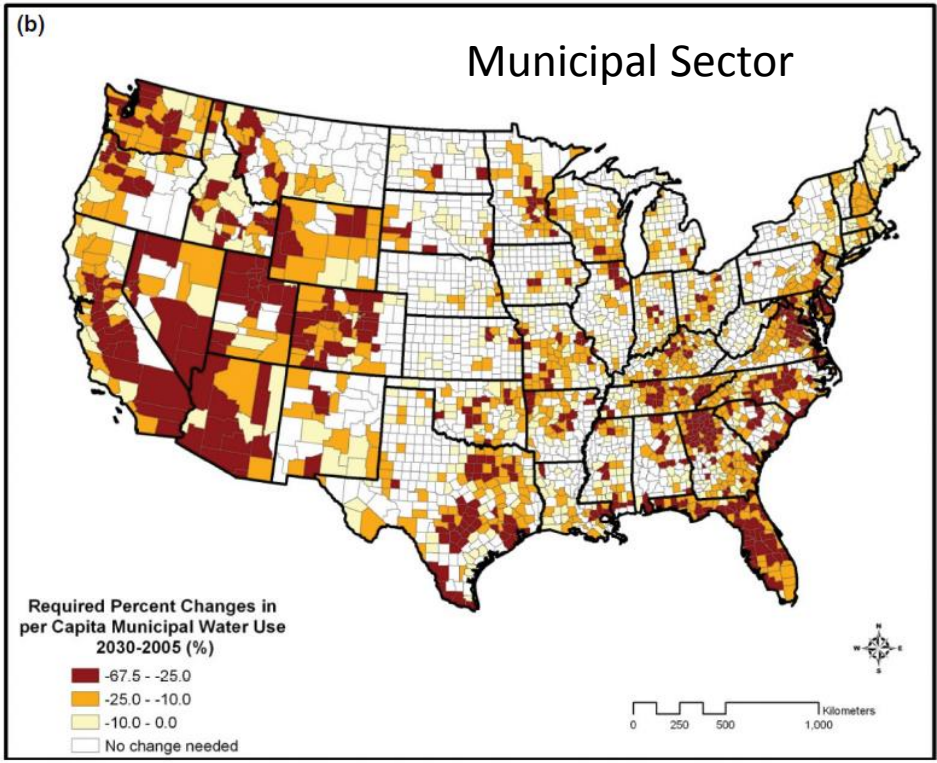
Future Considerations: (1) Business as Usual Growth With Consideration of Climate Change



Source: Roy, S.B., L. Chen, E. Girvetz, E.P. Maurer, W.B. Mills, and T.M. Grieb, 2012. Projecting Water Withdrawal and Supply for Future Decades in the U.S. Under Climate Change Scenarios. Environmental Science and Technology 46(5):2545-2556.

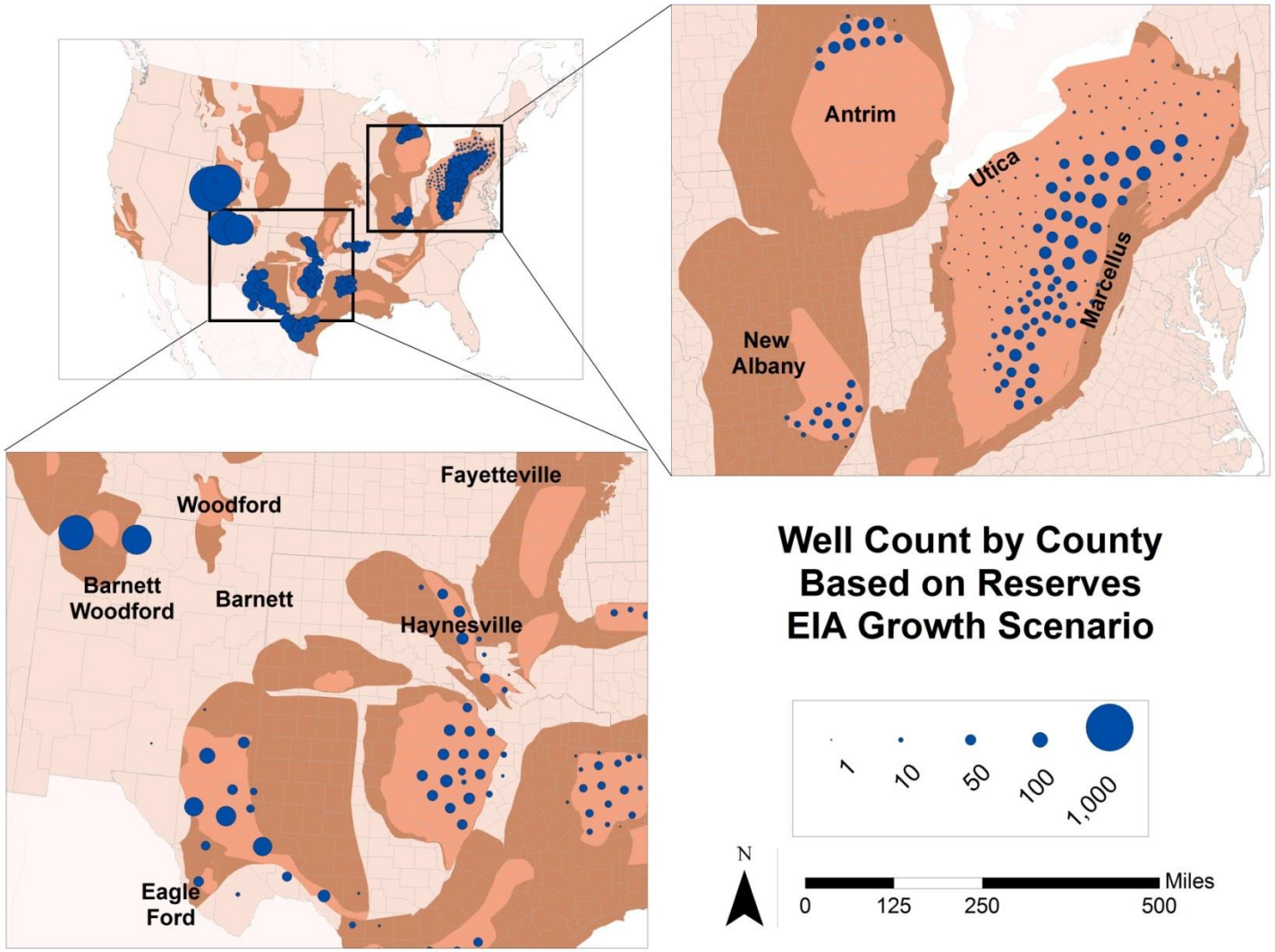
Future Considerations: (2) Efficiency Requirements Under Constraints of Water Availability (2030)





Source: Chen, L., Roy, S. B., and R.A. Goldstein. 2012. Projected Freshwater Withdrawals Under Efficiency Scenarios for Electricity Generation and Municipal use in the United States for 2030. Journal of the American Water Resources Association, Vol. 49(1): 231-246.

Future Considerations: (3) Growth in Hydraulic Fracturing by 2030



Source: Projecting Future Water Use for Hydraulic Fracturing in Shale Gas Production. EPRI, Palo Alto, CA

Key Observations

- The water use survey is a valuable resource, and long-term support and enhancement of the program is essential
- Need more explanation of the methodologies used in the estimation of the different sectors; this could be the basis of ongoing scientific analysis
- Need information on data quality; not all states/regions are equal
- There is a great deal of temporal variation that is not captured in the data
- Need to determine the role of this work: paint the big picture, or provide localized, fine resolution decision support to manage community water resources?

Recommendations for Future Development: Long Term

- More frequent reporting of water withdrawal data
- More temporal and spatial detail in reporting: sub-annual data, consider point locations of withdrawal where appropriate
- Integration with observations:
  - Ground-based observations of flow, groundwater level, reservoir storage, and snowpack
  - Remote-sensed estimates of irrigated area and evapotranspiration
- Greater consideration of non-traditional water supply sources such as stormwater, degraded water, flood peaks