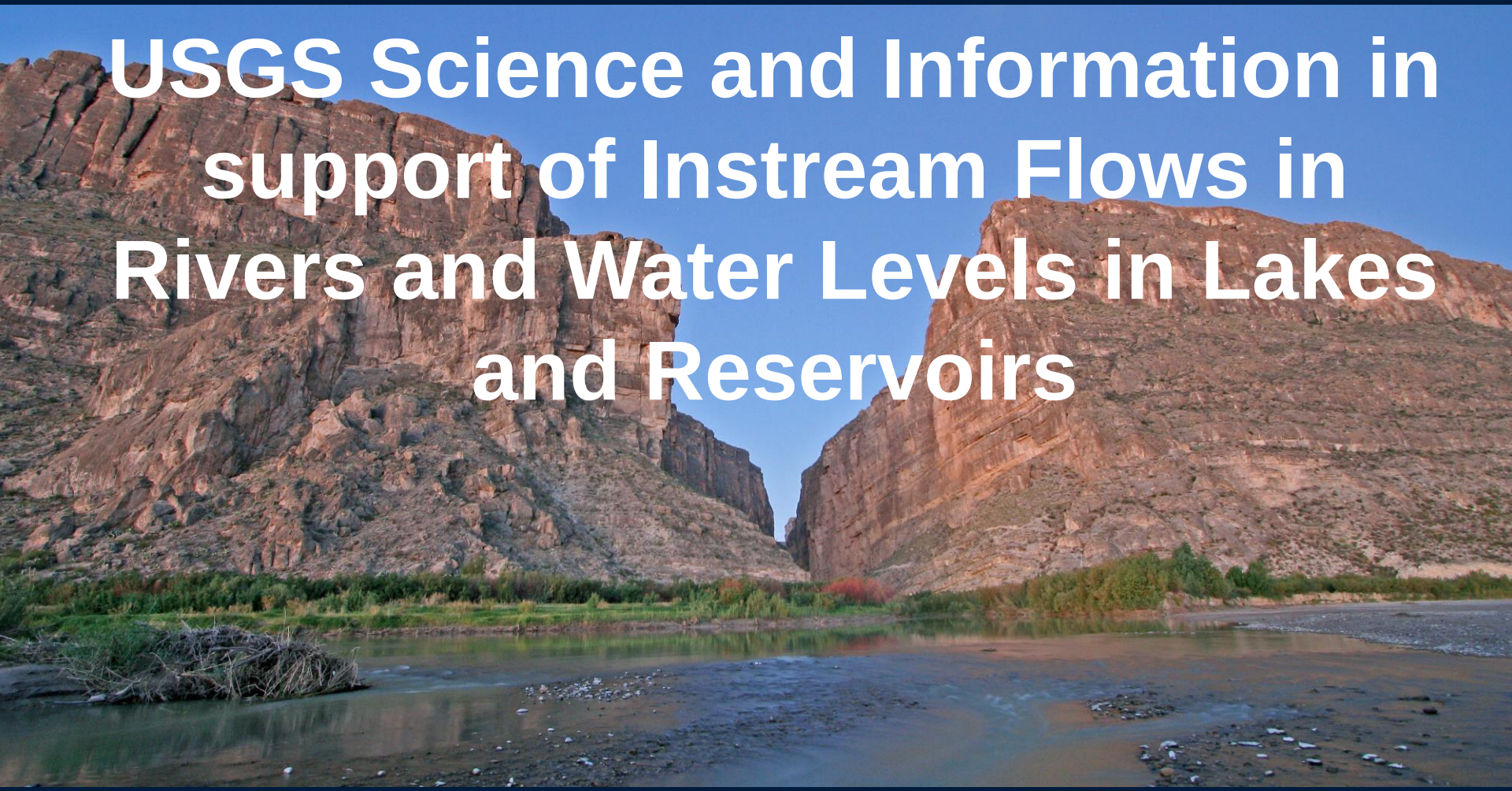
USGS
science for a changing world

USGS Science and Information in support of Instream Flows in Rivers and Water Levels in Lakes and Reservoirs



Mindi Dalton
Instream Flow Council
FLOW 2018
April 25, 2018
Fort Collins, CO

USGS Water Mission Area

Four Budget Programs

- Groundwater and Streamflow Information Program (GWSIP)
- National Water Quality Program (NWQP)
- Water Resources Research Institutes (WRRIs)
- Water Availability and Use Science Program (WAUSP)

WAUSP PRIORITIES

USGS Water Science Strategy

1. Expand and enhance monitoring networks
2. **Characterize the hydrologic cycle with 3-D/4-D framework models**
3. **Link human water use and the hydrologic cycle**
4. **Advance ecological flow science**
5. Provide flood-inundation science
6. Hazard rapid deployment teams
7. **Conduct integrated watershed assessment, research, and modeling**
8. **Deliver water data and analyses to the Nation**

SECURE Water Act

Water Use by HUC and Aquifer (9508)

- Comprehensive national inventory of spatial and temporal **patterns of water use**
- Applied research and statistical water use estimation of the human impacts on water and ecological resources

Water Availability Assessments (9508)

- Develop and evaluate **nationally consistent indicators of water availability** including;
  - streamflow and storage
  - recharge, withdrawals, saltwater intrusion, mine dewatering, land drainage, artificial recharge, other relevant factors
  - impaired supplies used to meet demand
- Develop and apply predictive models and tools that integrate groundwater, surface water, and ecological systems

WAUSP Components

National Water Budget Components

- Research on water budget components
- GW Model Development and Maintenance
- Data Delivery

Regional Water Budget Components

- GW Availability Studies (MAP, TAAP)
- Cooperative Matching Funds

National Water Census

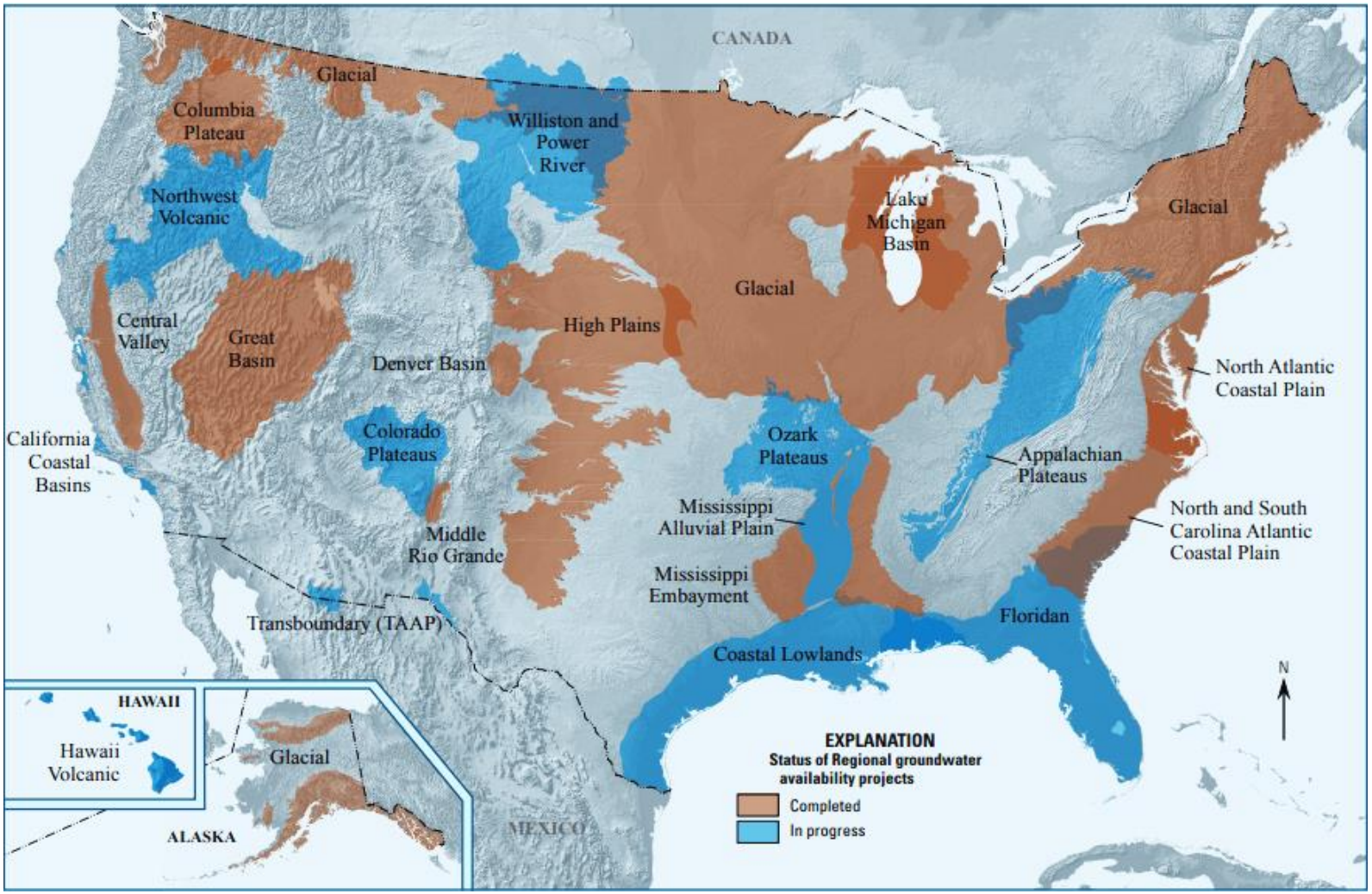
- Brackish GW Assessment
- Focus Area Studies
- HUC 12 Water Budgets
- Water Use (including WUDR)

GW Availability Studies

Program developed to enable National level synthesis of groundwater resources (Circular 1323)

- Current estimates and trends in ground-water use
- Storage, recharge, and discharge (water-budget analysis)
- Models of regional ground-water systems (GW/SW)
- Regional estimates of hydraulic properties for major aquifers
- Evaluation of existing networks for monitoring ground-water availability
- Testing and evaluating new approaches for analysis of regional aquifers

GW Availability Studies



National Water Census

Focus Area Studies

- 3 complete, 3 wrapping up in FY18 (FY19)

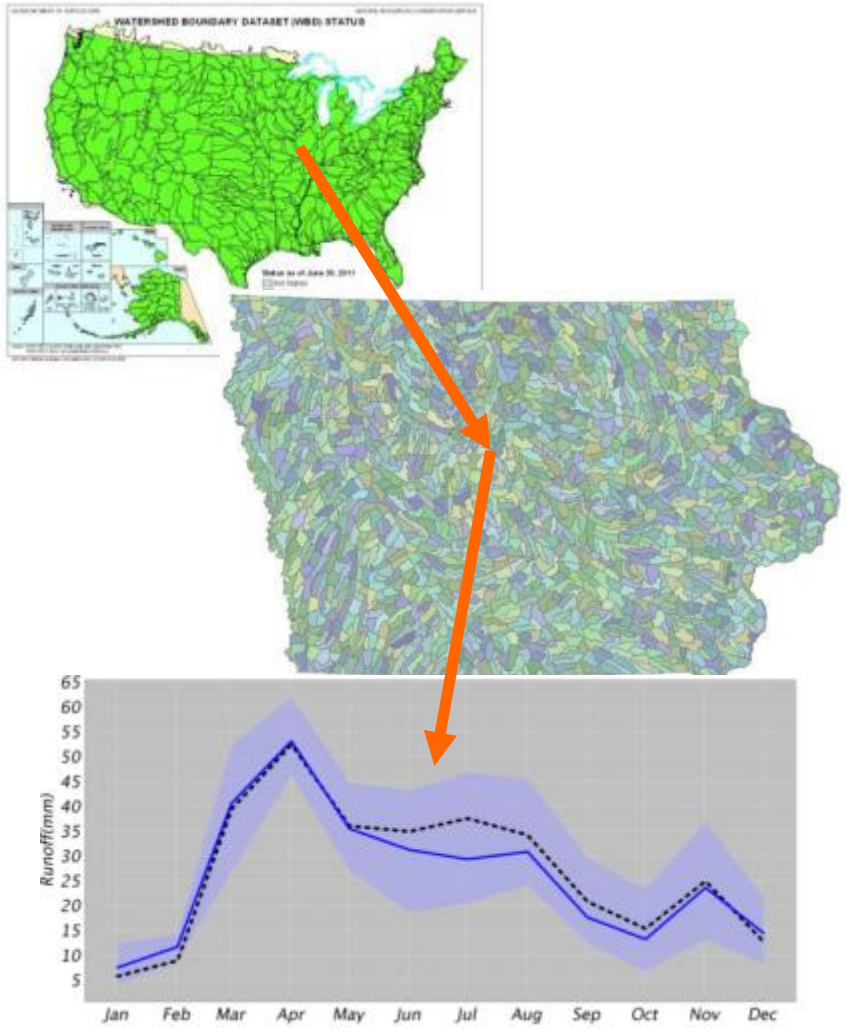
National water budget components

- Improved understanding of processes
- Estimate on a daily time-step at the HUC12
- Deliver the information in a format useful to resource managers

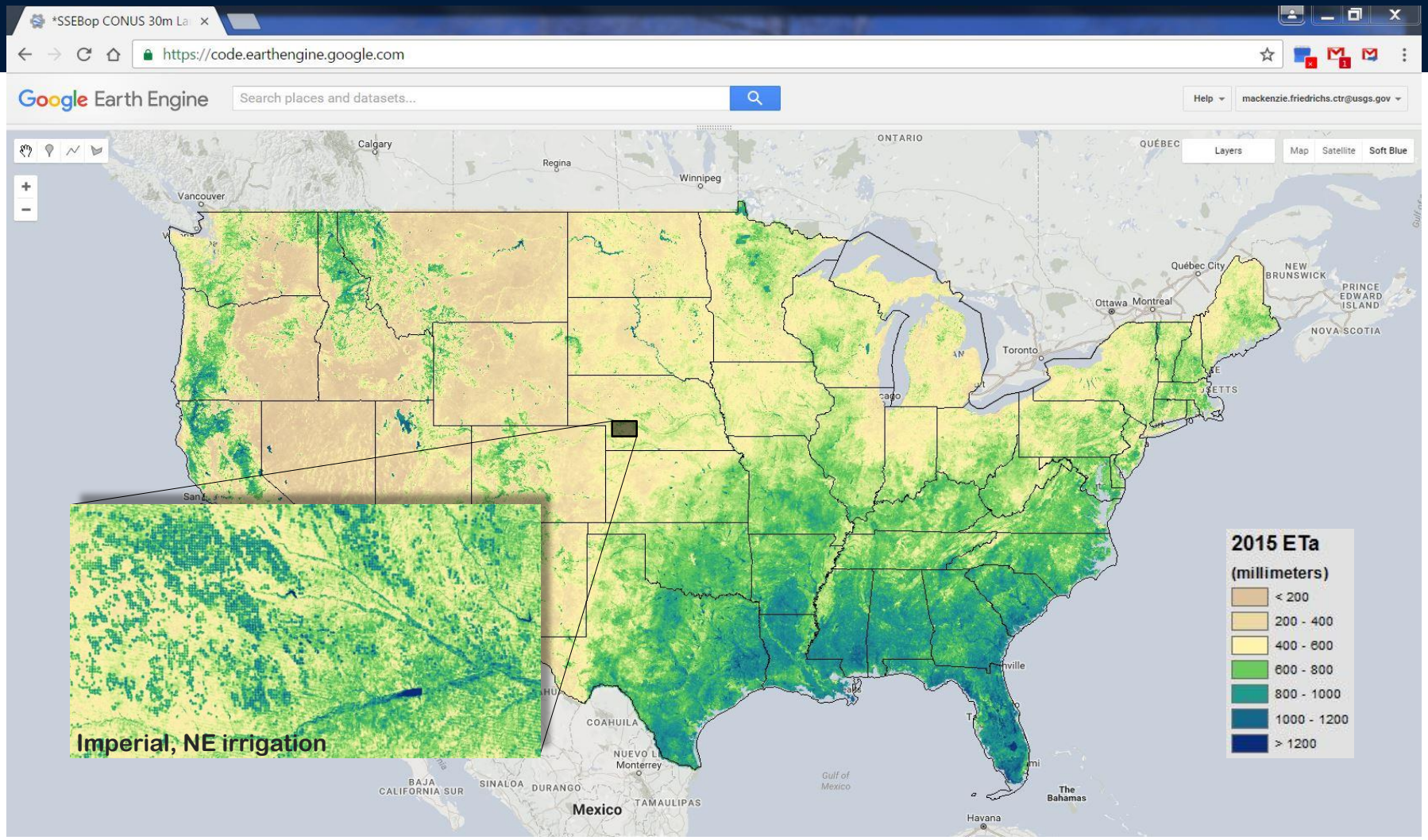
Flows in Ungaged Basins

- Estimates of daily ungaged streamflow at a HUC-12 scale, leveraging the advantages of both statistical and process-based models

- Uncertainty in ungaged flows and improved calibration (statistical informing deterministic)



Landsat SSEBop ET (CONUS)



2015 Total Actual ET from Landsat (Preliminary)

Water Use

WAUSP Activities to Date

- Public Supply SWUDS Database
- Comparison of water use reporting and collecting activities with Bureau of Reclamation
- Modeled Irrigation Consumptive Use and Thermoelectric Water Use (by plant)
- Unconventional Oil and Gas Topical Study
- Water Use Estimation Technique and Model Development

Future Science Activities and Data Products

- Reservoir Storage and Evaporation
- Hydroelectric Water Use
- Improved data on Interbasin Transfer

Water Withdrawals by Category

Focus for water use will be placed on the impacts of the 3 largest categories which make up approximately 90% of water use any given year

Thermoelectric, 41%

Watts Bar Nuclear Powerplant, Rhea County, Tennessee

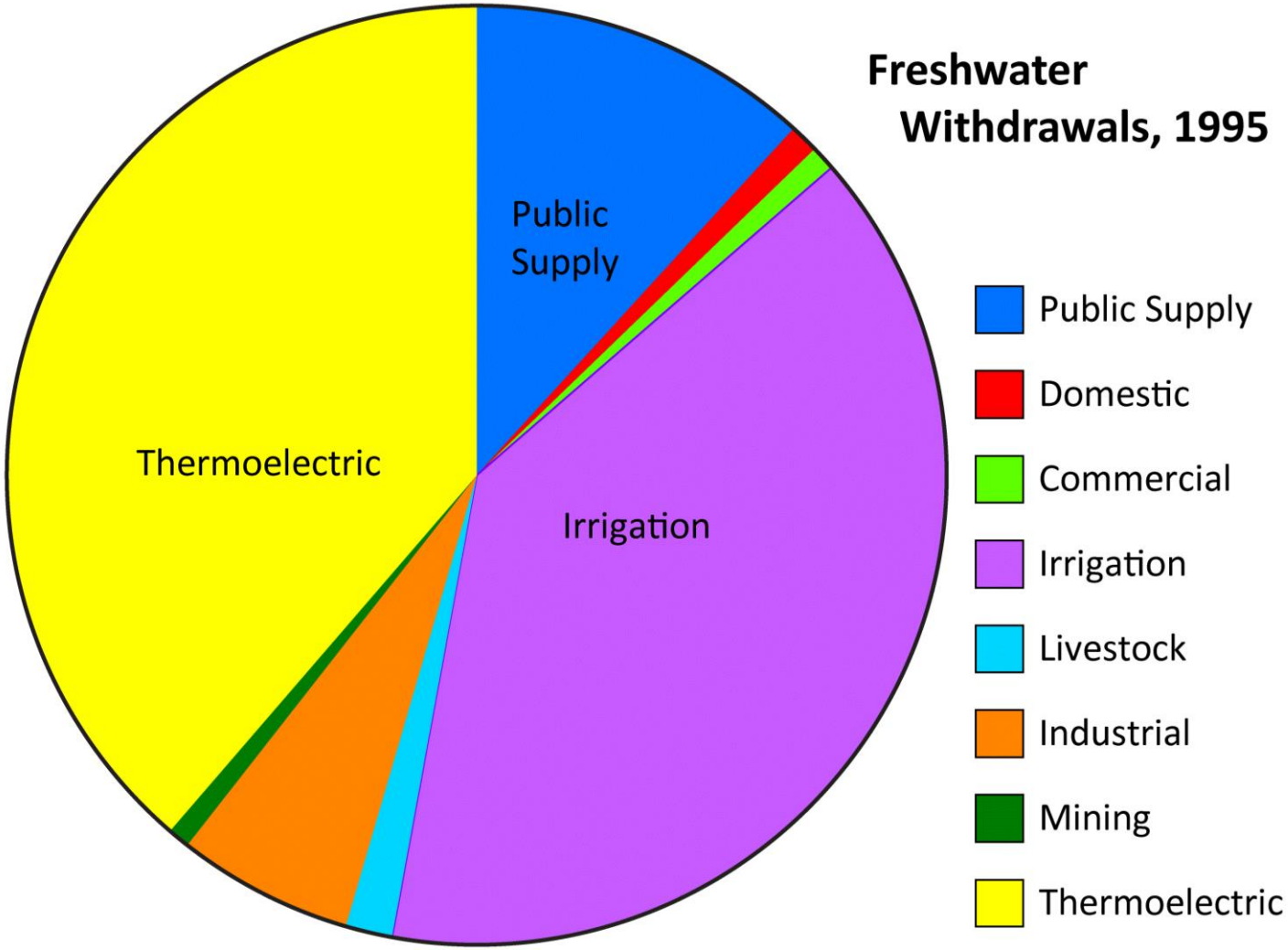
Irrigation, 37%

Sprinkler irrigation system, Blaine County, Idaho

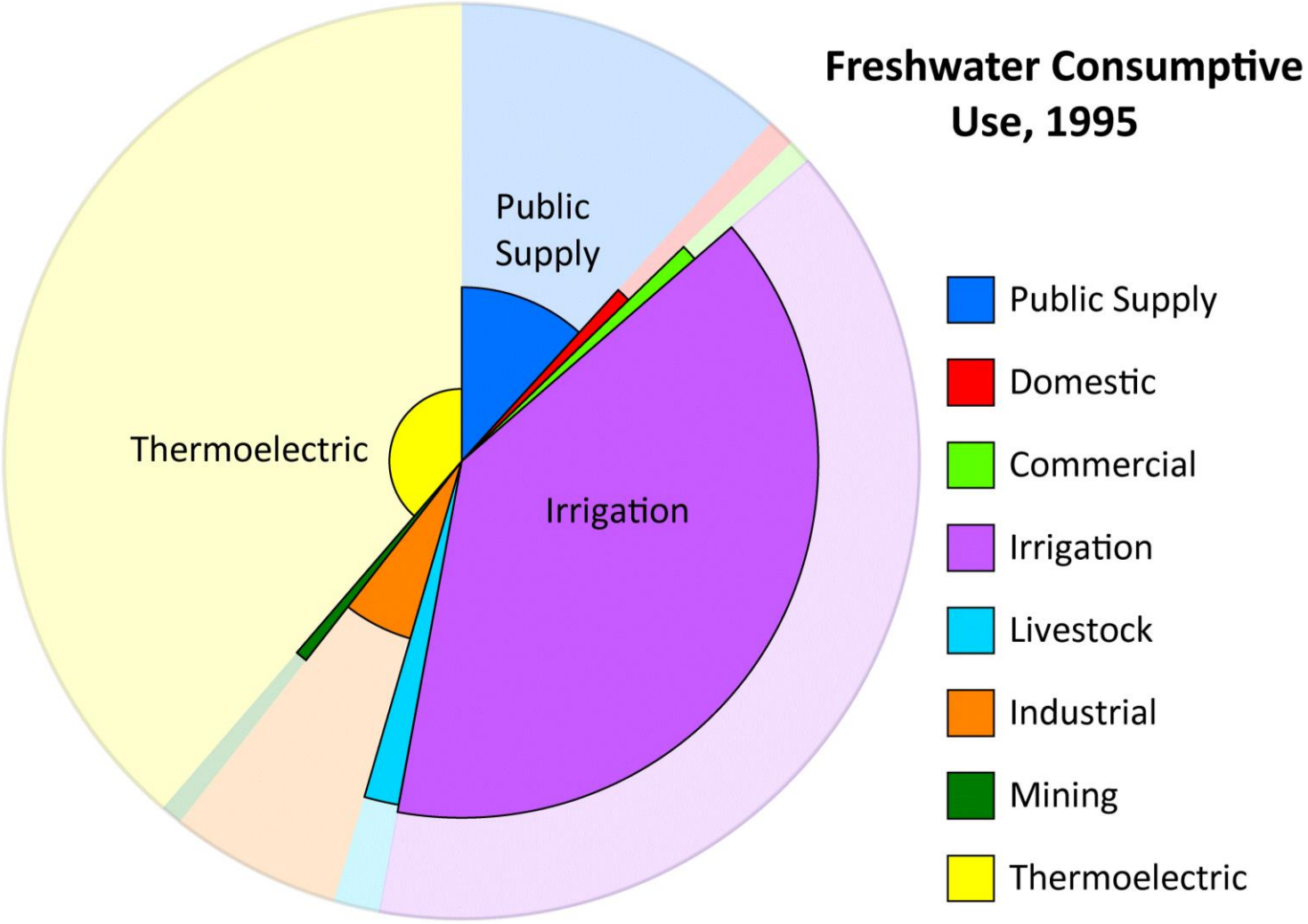
Public Supply, 12%

Water tower, Newton, Kansas

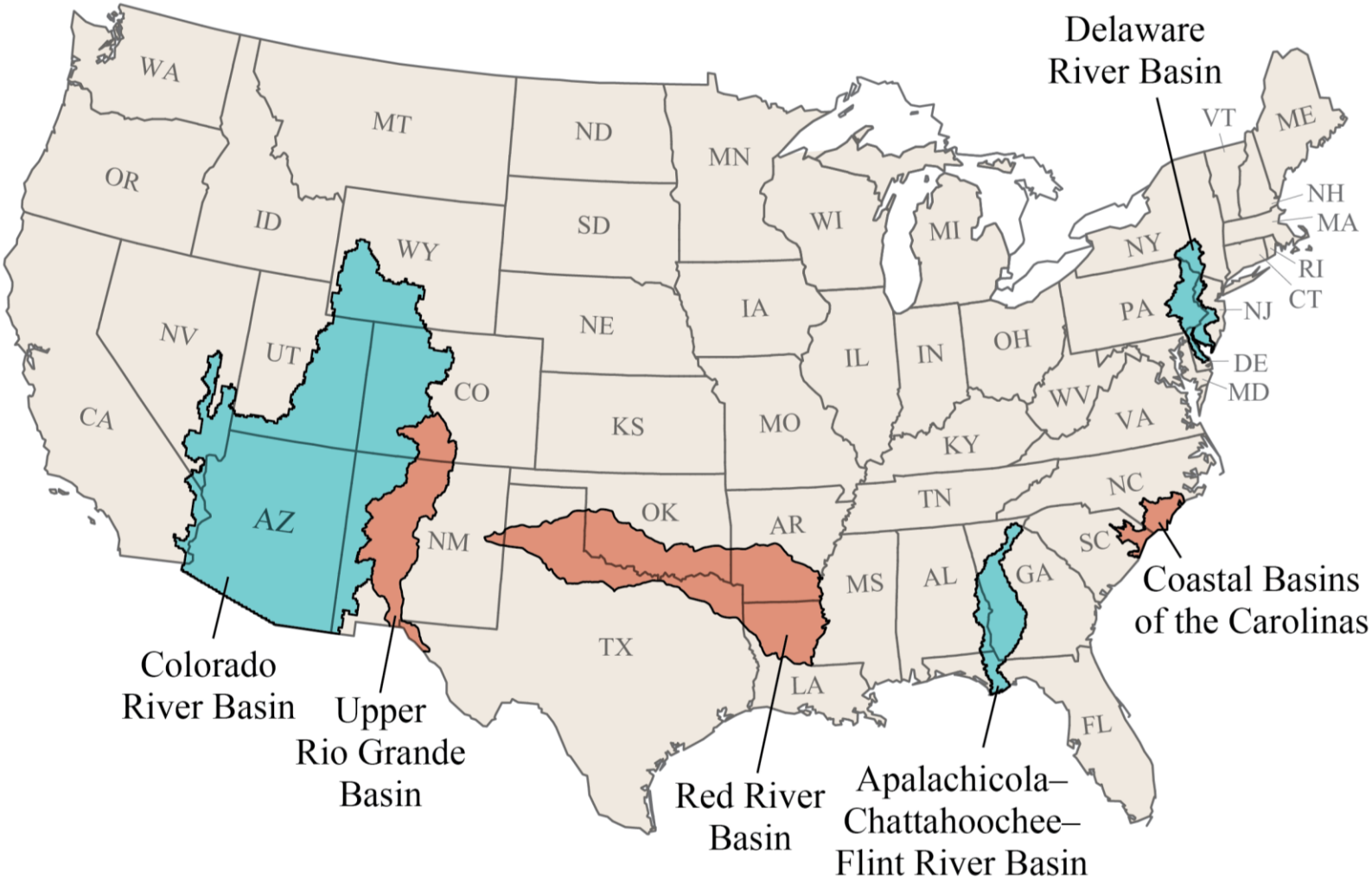
Withdrawal


Freshwater
Withdrawals, 1995
Public Supply
Thermoelectric
Irrigation
Public Supply
Domestic
Commercial
Irrigation
Livestock
Industrial
Mining
Thermoelectric

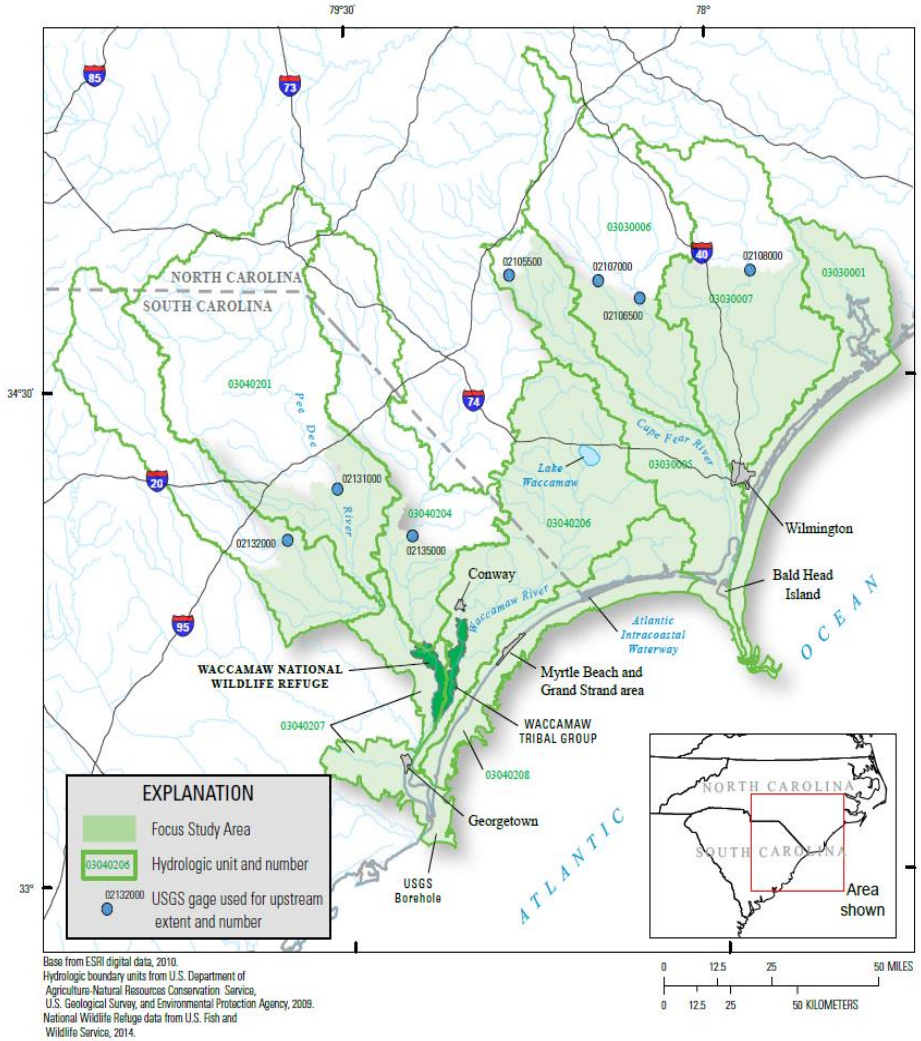
Consumptive Use



Focus Area Studies



Coastal Carolinas



Fish and invertebrate response modeling will:

- inform how flow, climate, and land use affect biological conditions in the Yadkin/PeeDee and Cape Fear watersheds
- predict how fish and invertebrate assemblages may change with projected changes in flow and land cover due to water-use, climate change, and patterns of urban development

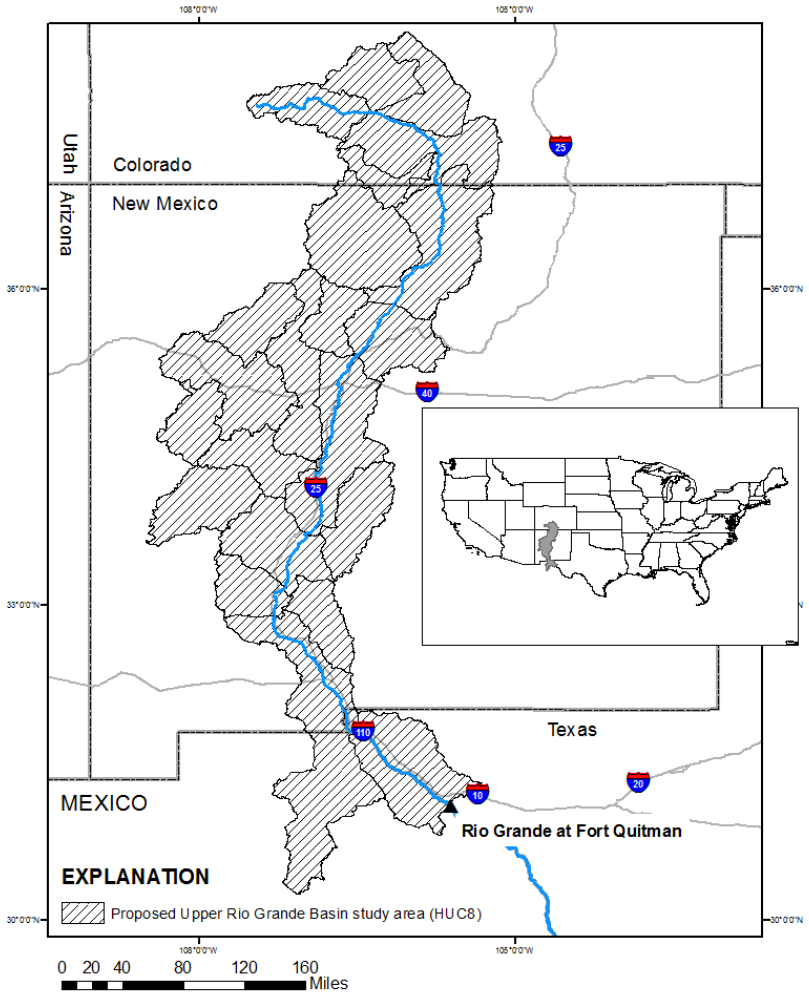
Red River (of the South):

- Developing groundwater model (MODFLOW) and a surface-water model (PRMS) to determine changes in water availability with climate, land use, and water use
- Evaluation of predicted flow alteration and the associated changes in the fish assemblage over time

Upper Rio Grande

Study focused on improving our understanding of six important water-availability components:

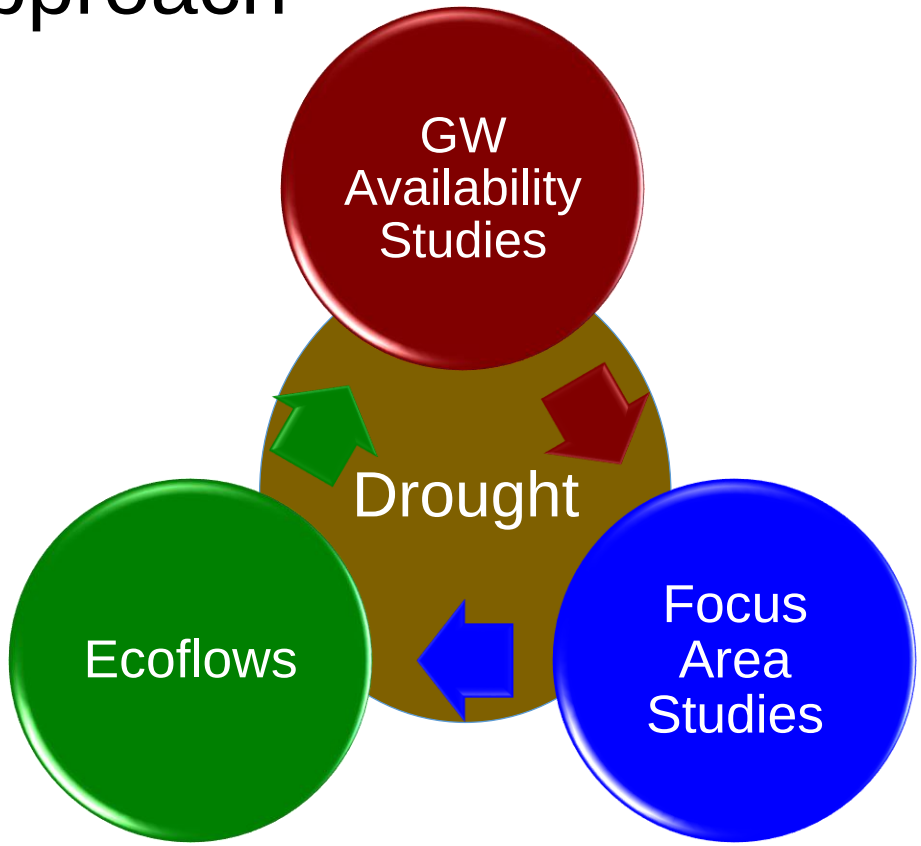
- water use
- groundwater
- ET
- snow processes
- streamflow processes, and
- watershed processes



Integrated Planning in the Water Mission Area

Water issues are complex and crosscutting, requires an integrated approach

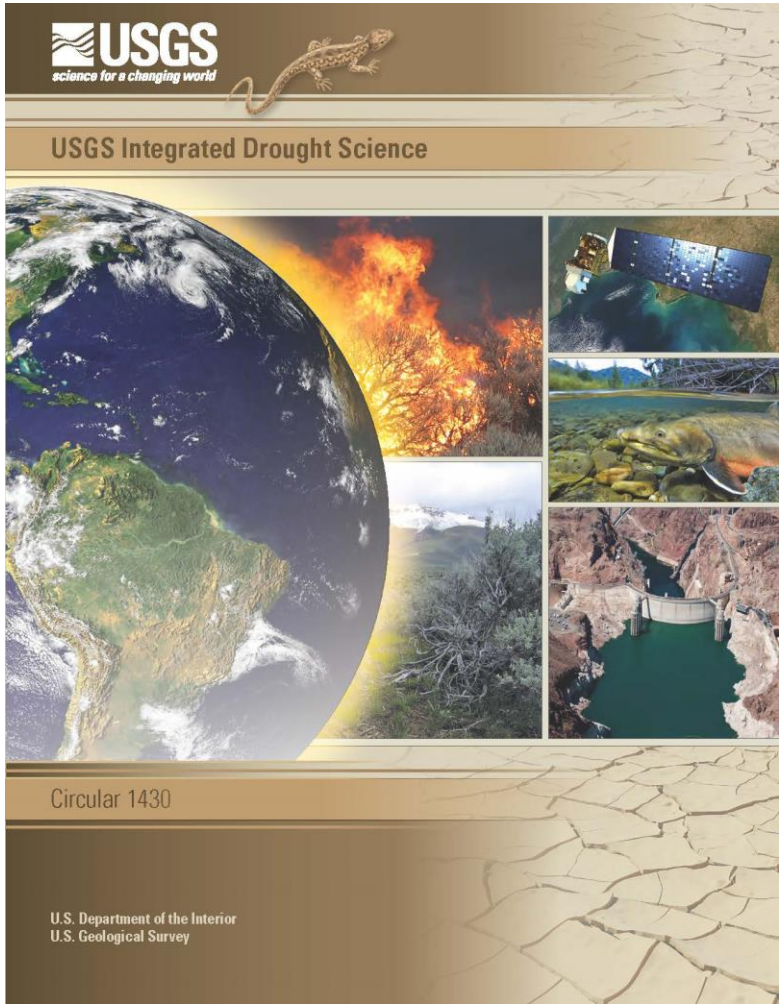
- WAUSP is working with other Programs and Mission Areas to develop an overarching plan for Integrated Water Availability studies
- Programmatic focus includes water availability for human and ecological uses



Integrated Drought Science

1. Integrated information to better understand spatial and temporal variability in drought processes
   a. Uncertainties of how drought affects freshwater ecosystems
   b. Spatial and temporal scale for drought science
   c. Key ecohydrological parameters

2. Incorporate biological data to understand how drought affects species and ecosystems
   a. Drought processes and ecosystem sensitivity
   b. Linkages, commonalities, and critical differences that determine the consequences of drought



So…how will WAUSP contribute to these types of Integrated Science efforts...

Water Prediction Work Program

"2WP" Development

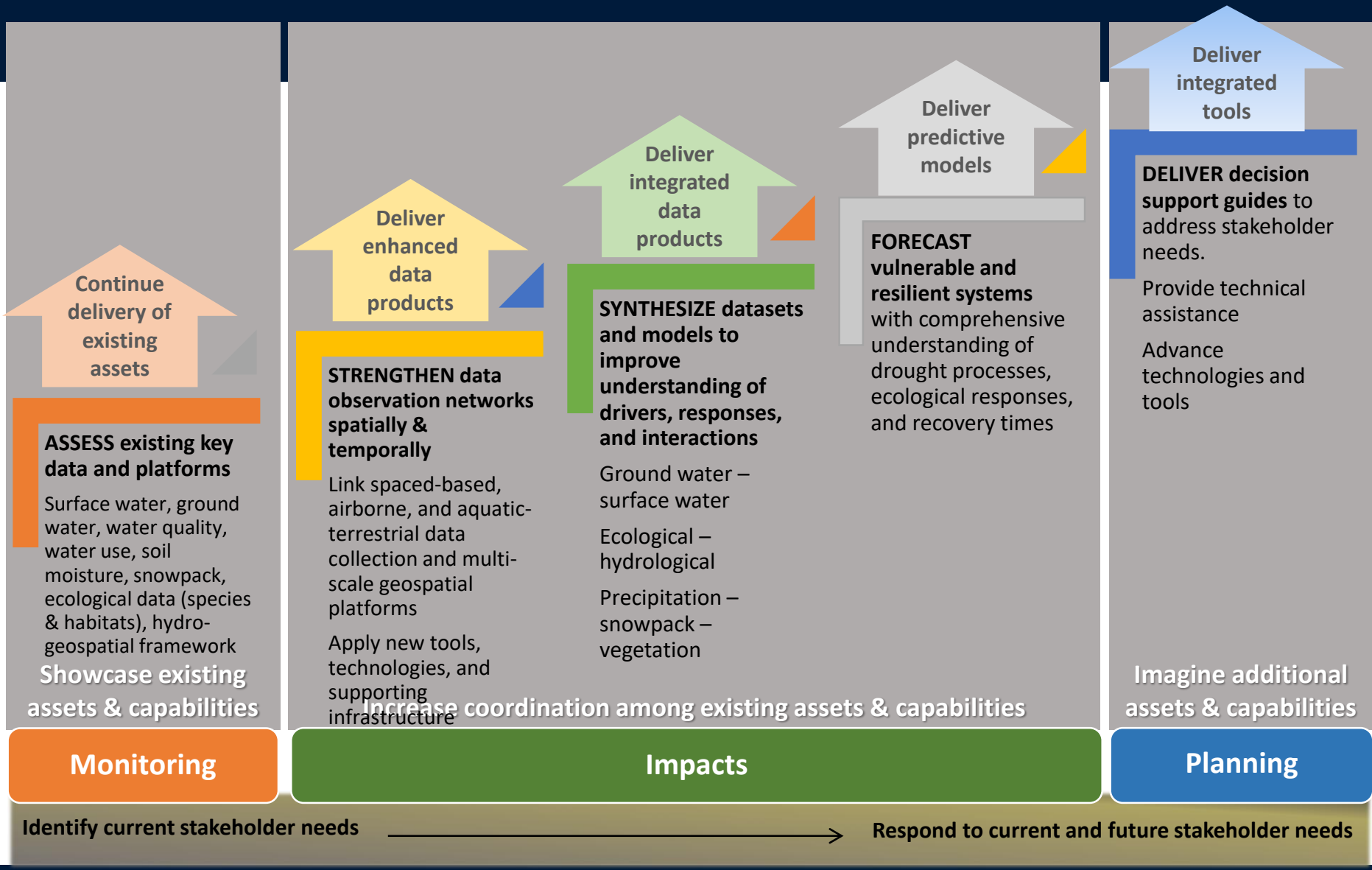
2WP Development
Major Prediction Components

- **Water Temperature**
  - National analysis (i.e. ”nowcast”) and prediction of thermal characteristics of every stream reach in NHD+ hydrography (N = 2.7 million)
- **Surficial Processes: Erosion and Sediment/Constituent Entrainment**
  - National analysis and prediction of sources, characteristics, and movement of materials that end up in NHD+ stream channels
- **In-Channel Constituent Transport**
  - National analysis and prediction of materials being transported in NHD+ stream channels, including physical and chemical fate

2WP Development
Potential Products and Services

- **Hypothetical Examples:**
  - Dot Maps of current stream temperature observations
  - Stream temperature nowcasts and forecasts out X days for every stream reach in NHD+, with estimates of uncertainty
  - Derivative (change) products describing warming and cooling trends over periods of time
  - National map of sediment sources, mobility trends, scouring and deposition zones
  - NHD+ stream network interactive travel time maps updated hourly, daily, etc. for threat response planning
  - Next-generation HABS forecasts with timing, characteristics and source information
  - Many more possibilities…

Coordinated & Integrated Science



Questions

USGS