TRENDS IN FLOWS FOR THE RED RIVER BASIN IN SOUTHEAST OKLAHOMA

SOUTH CENTRAL CLIMATE ADAPTATION SCIENCE CENTER

Choctaw and Chickasaw Nations

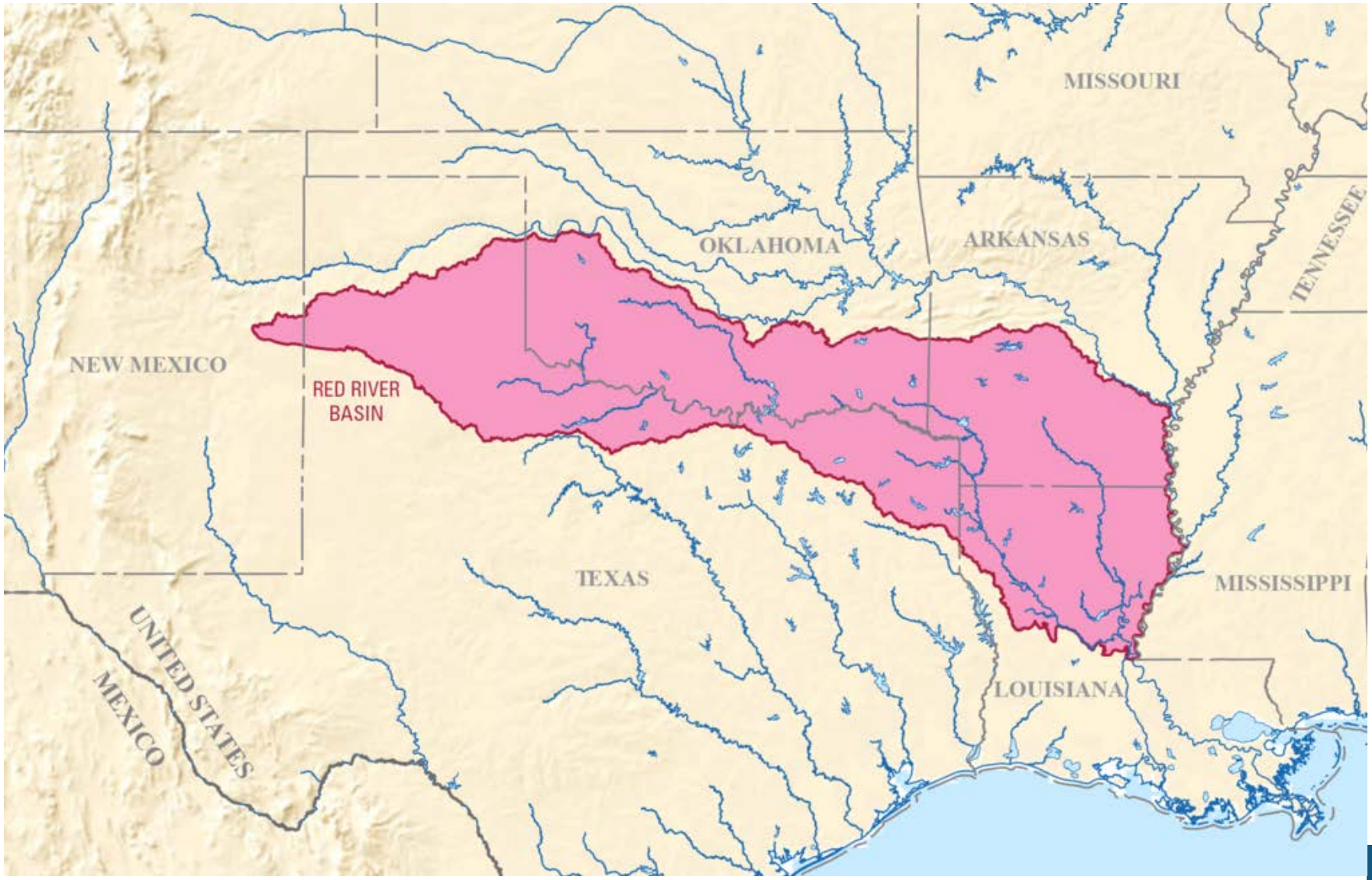
AquaStrategies

Barney Austin

April 3, 2019

The Red River Basin

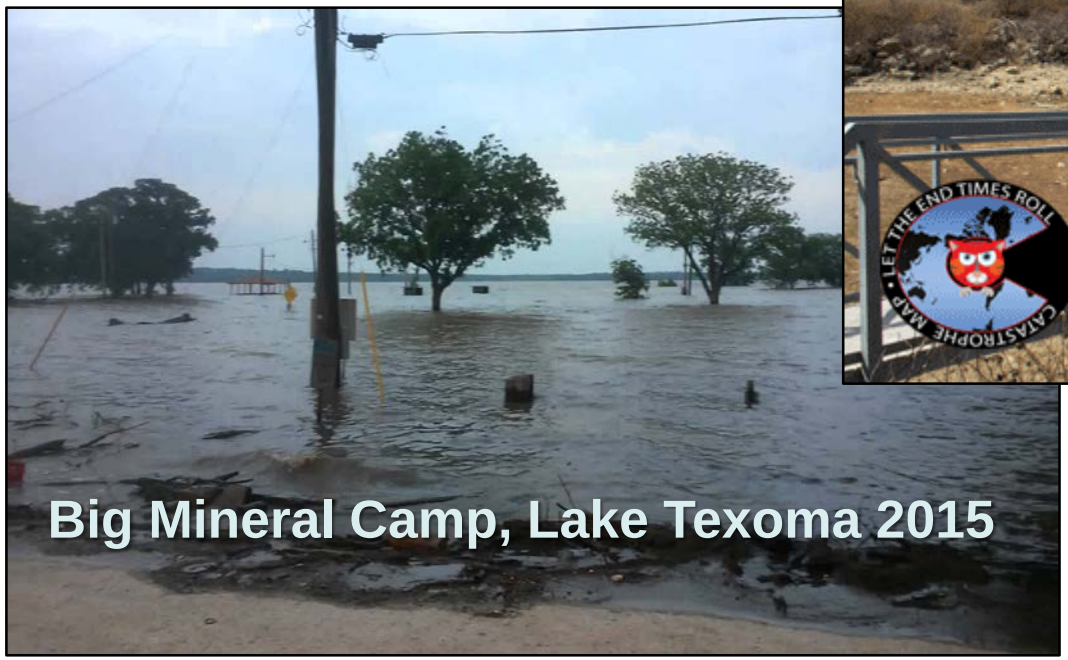
93,000 mi²
1,290 miles



Recent floods and droughts

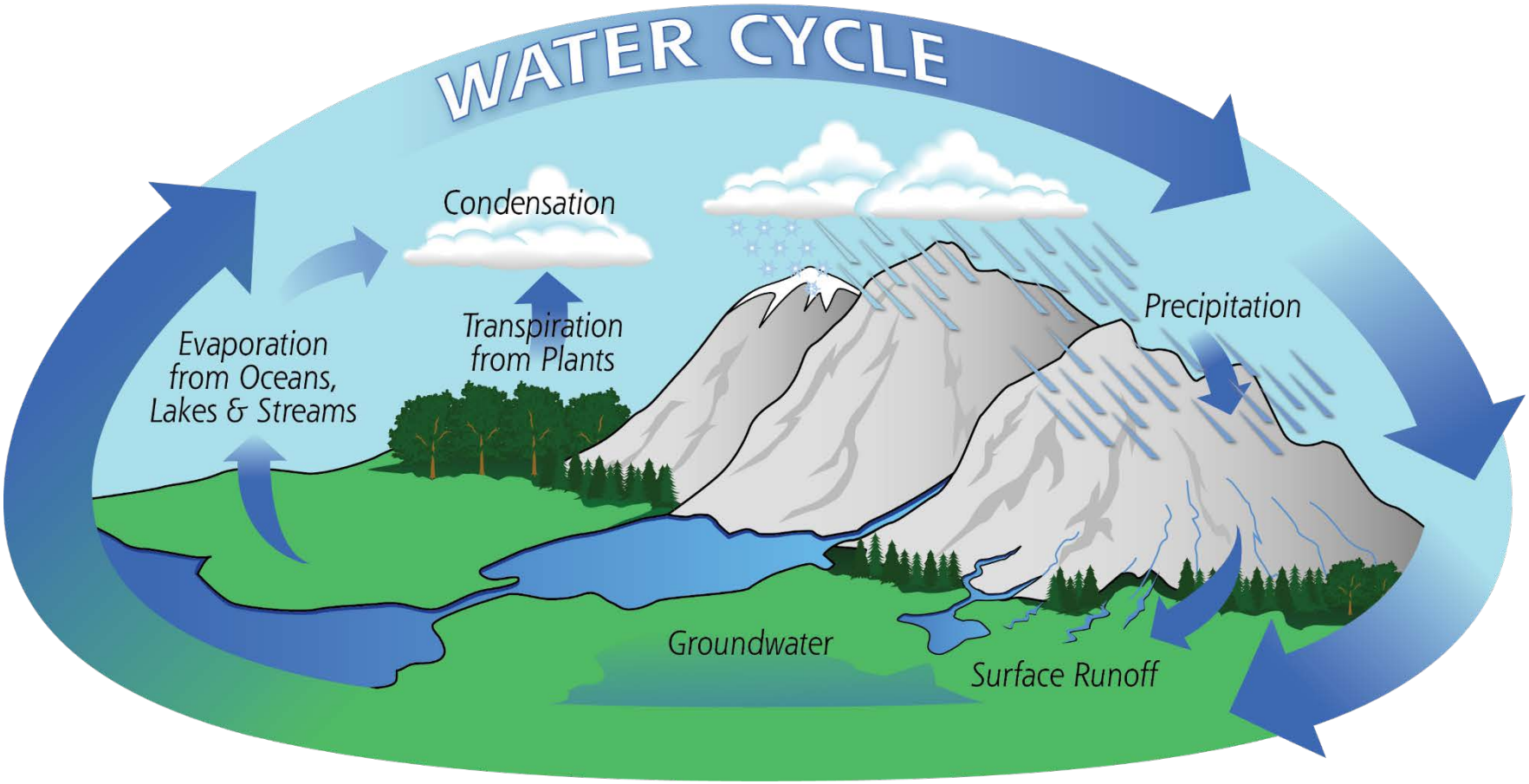
△Variability?

Scope: How will our future climate affect flows and water availability in the Red River Basin?



Rainfall-runoff models

e.g. HSPF / VIC

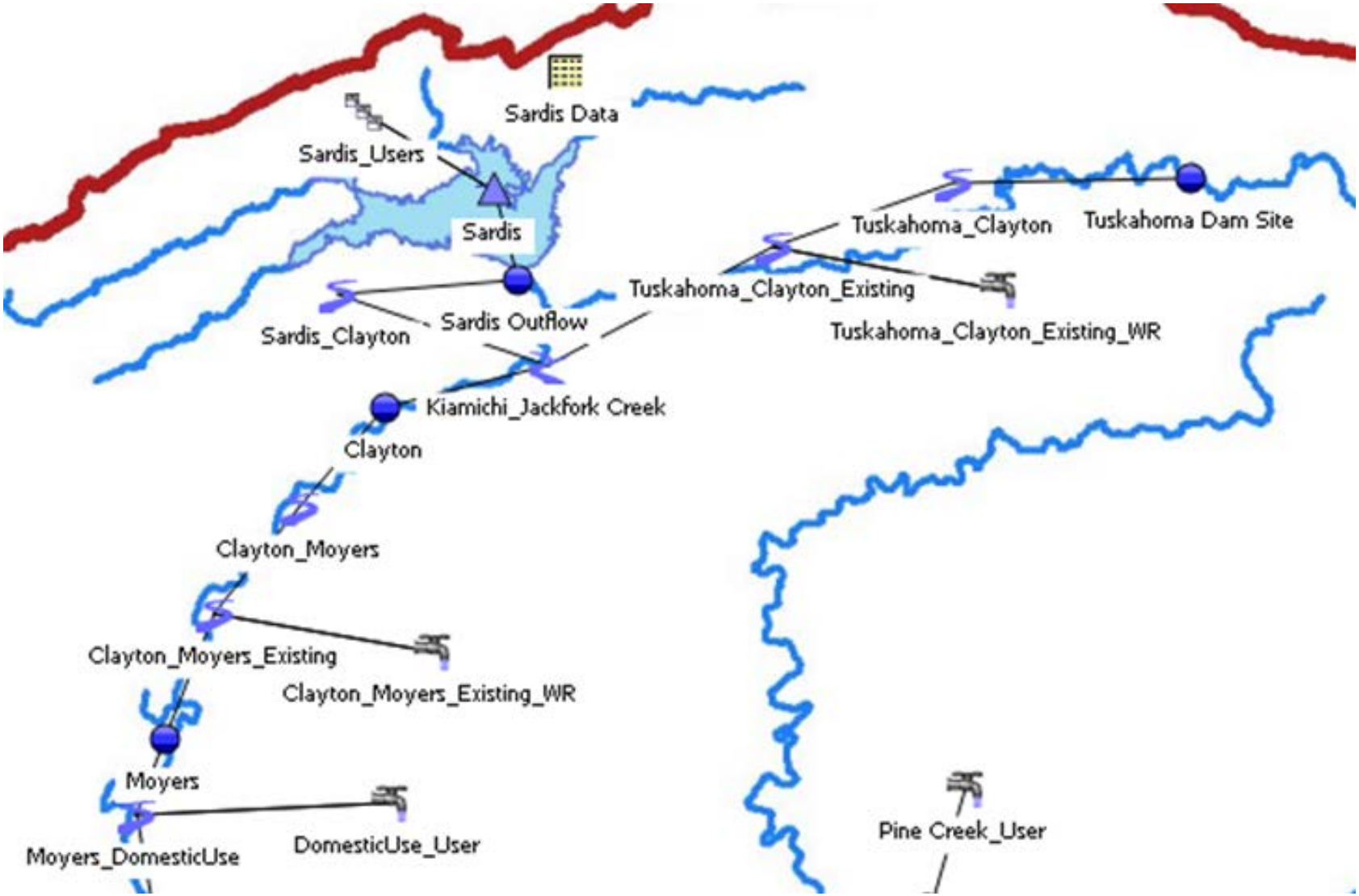


Water availability models

RiverWare

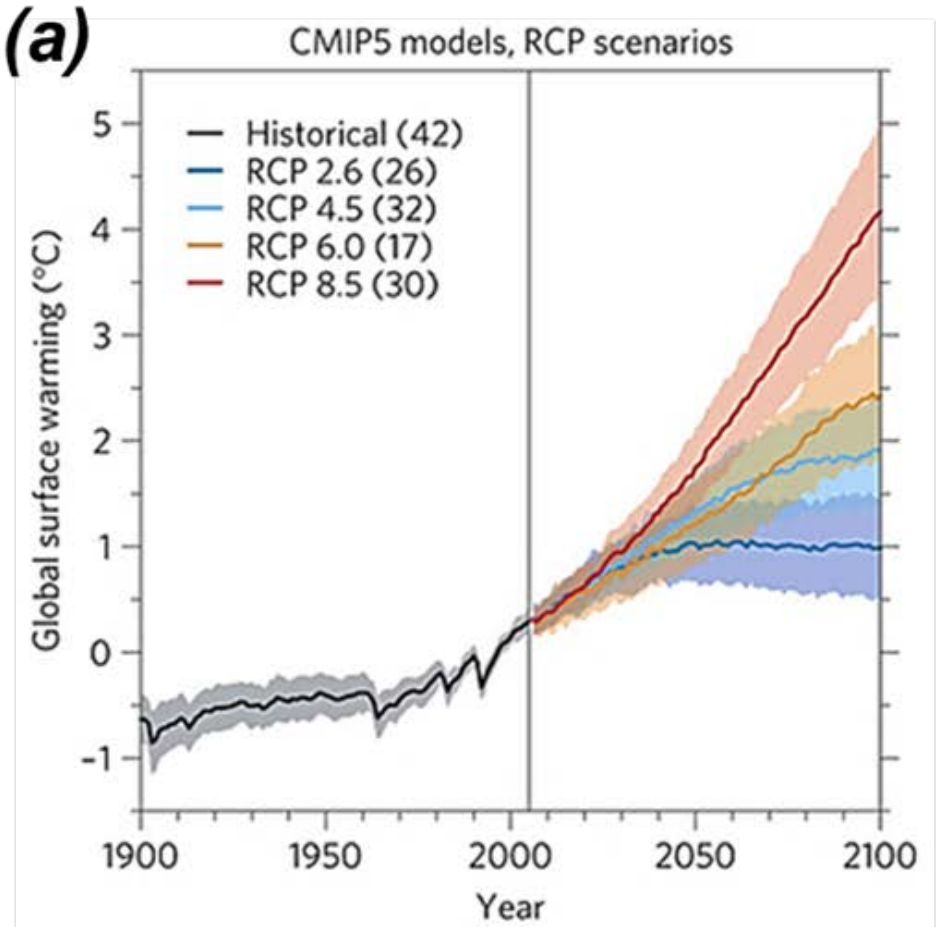
Channel routing/Prior appropriation

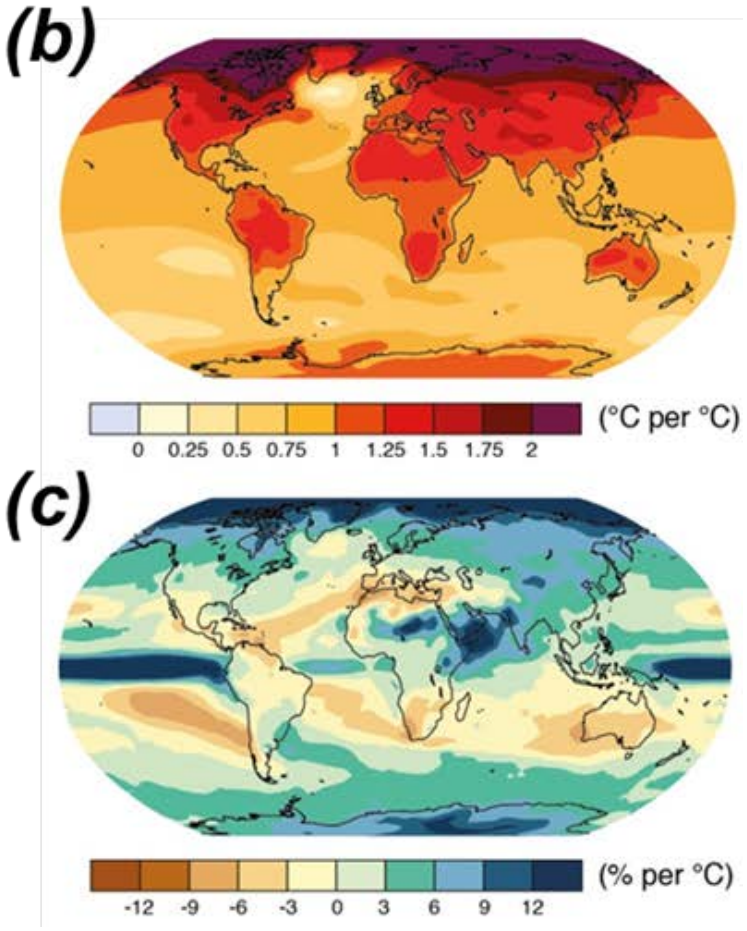
RiverWare



Choosing the right GCMs

CMIP5

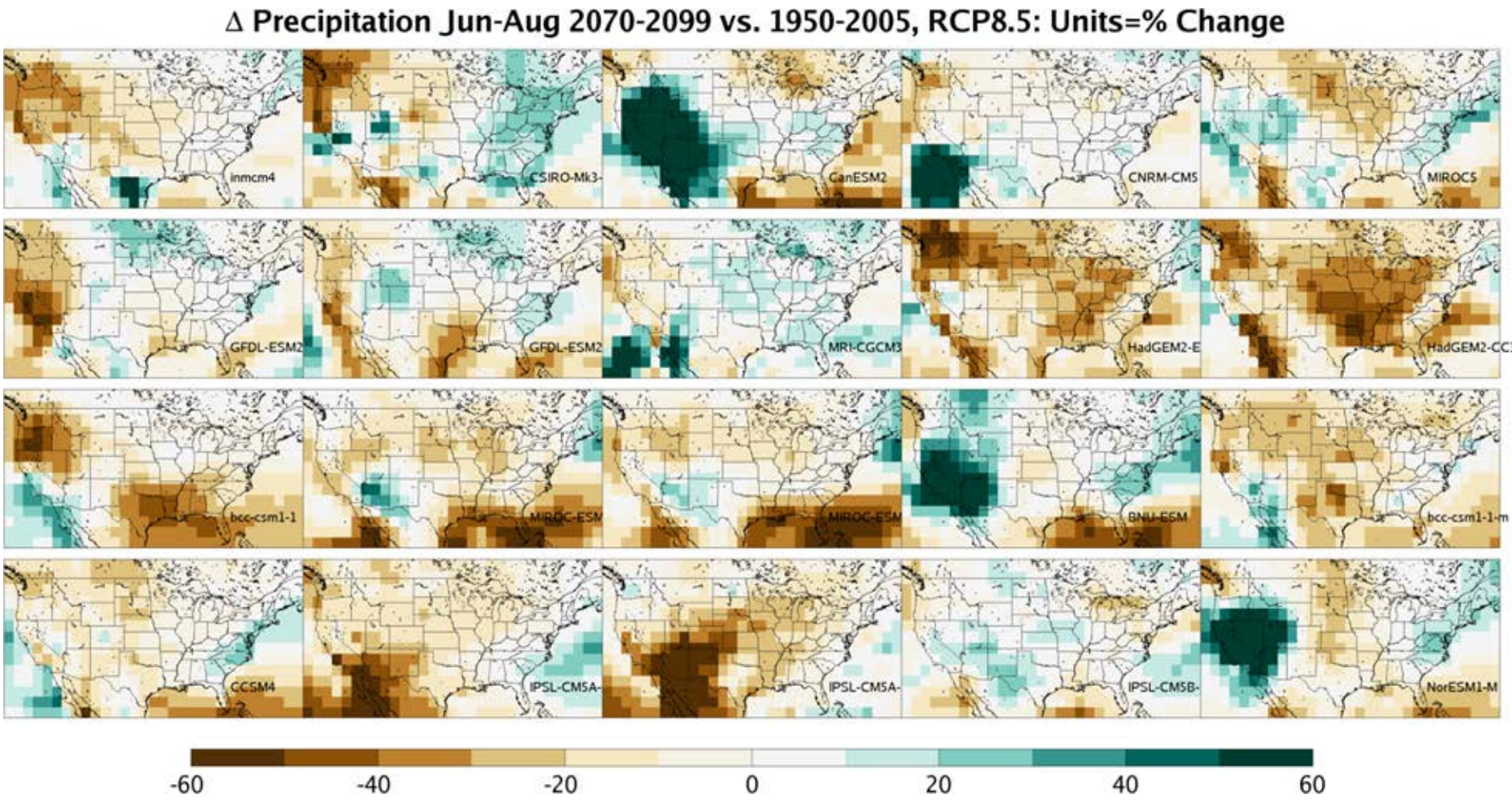




* Note: The RCP naming convention is based on the difference in radiative forcing levels reached in the year 2100 relative to pre-industrial values for each pathway. Units are W/m^2.

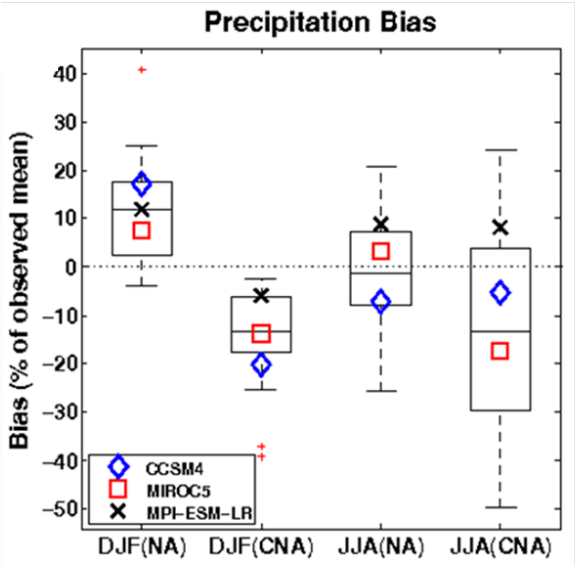
Choosing the "right" GCM

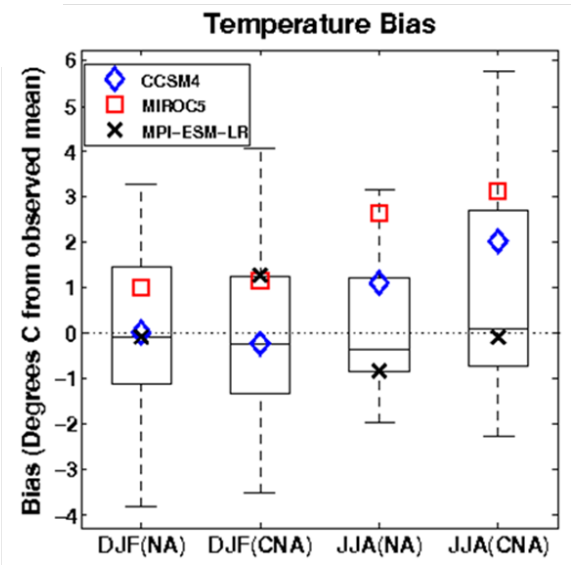
RCP8.5

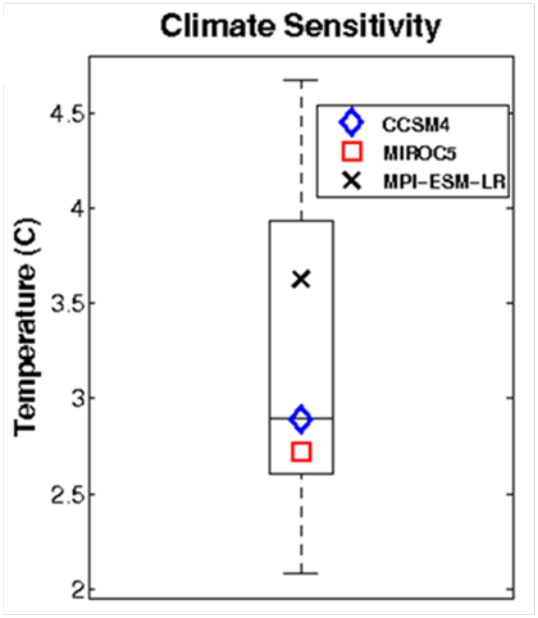


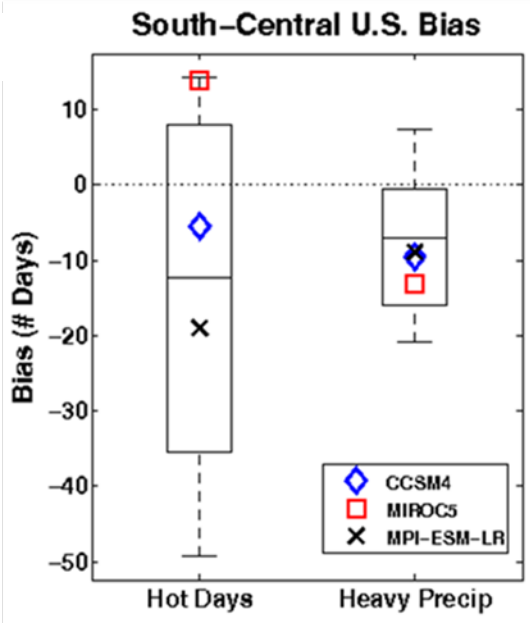
Choosing the right GCM

Sim vs. Obs









CCSM4
MIROC5
MPI-ESM-LR

RCP 2.6
RCP 4.5
RCP 8.5

Downscaling for hydrologic applications

Approach chosen

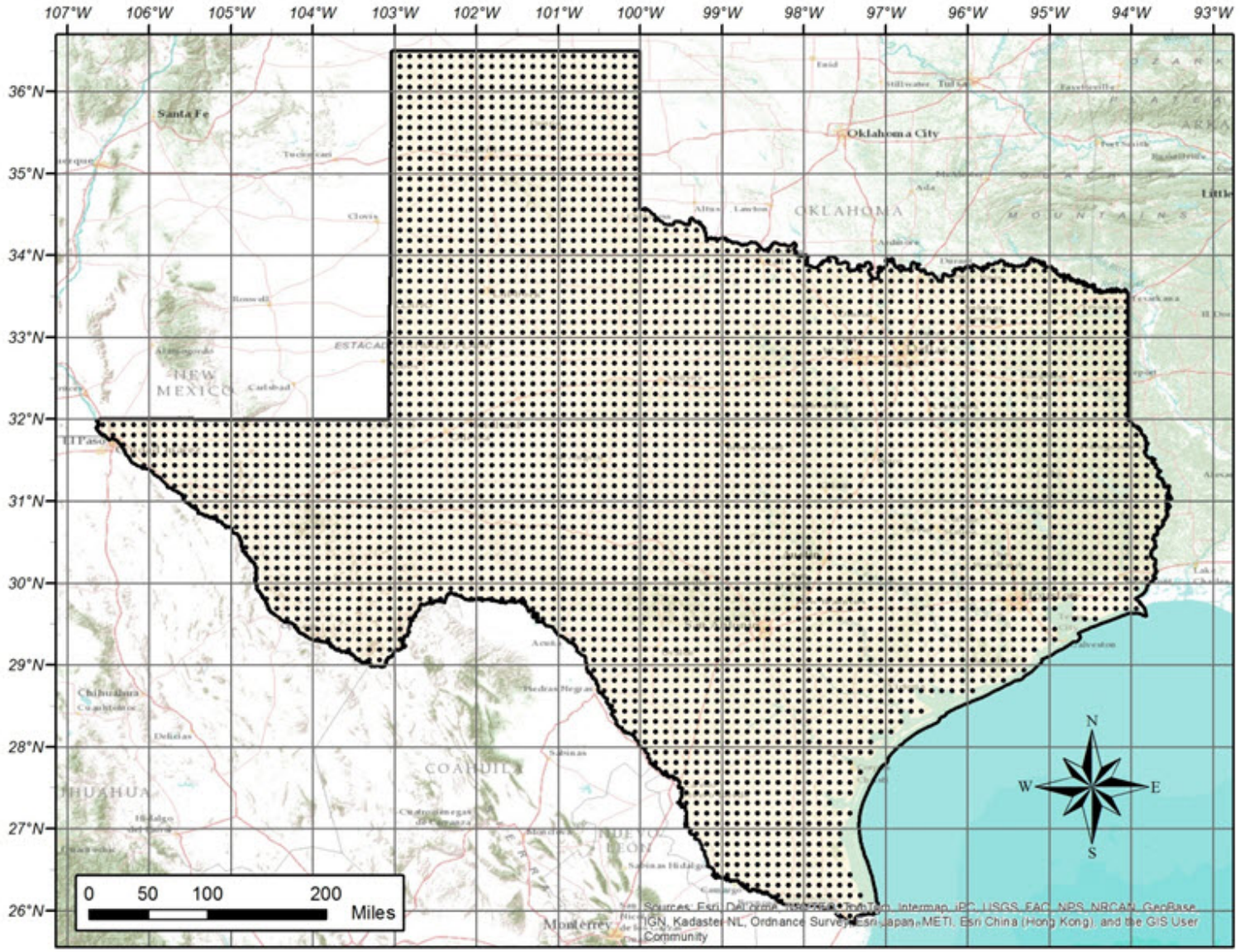
1. Run same model at higher resolution
2. Nested model (RCM: use boundary conditions from GCM)
3. Statistical downscaling

a) Regression models
b) Weather typing/classification schemes
c) Weather generators

i. Cumulative Density Function Transform (CDFt)
ii. Equi-Distant Quantile Mapping (EDQM)
iii. Change Factor Quantile Mapping (CFQM)

Downscaling for hydrologic applications

Space & Time



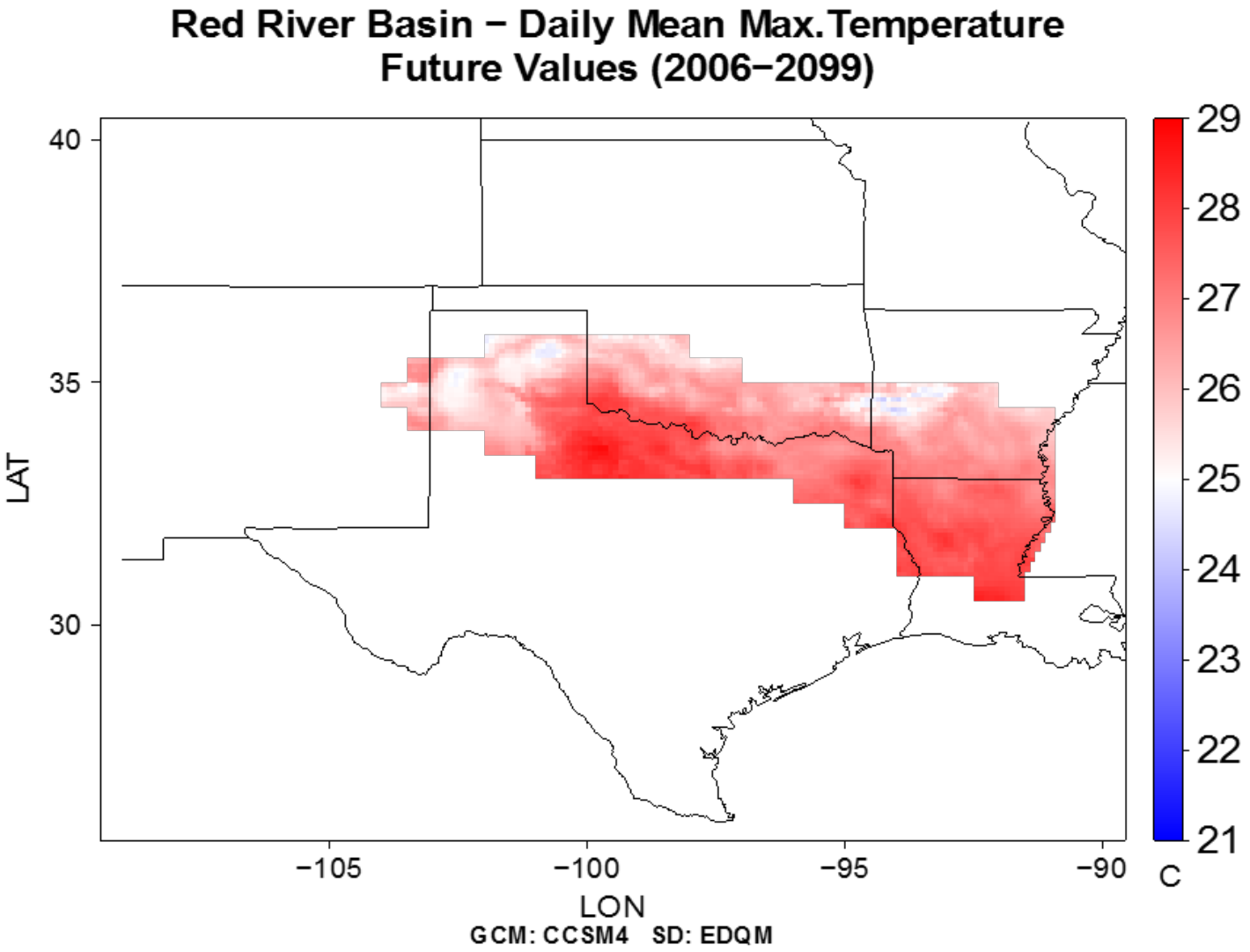
Methodology

Tasks

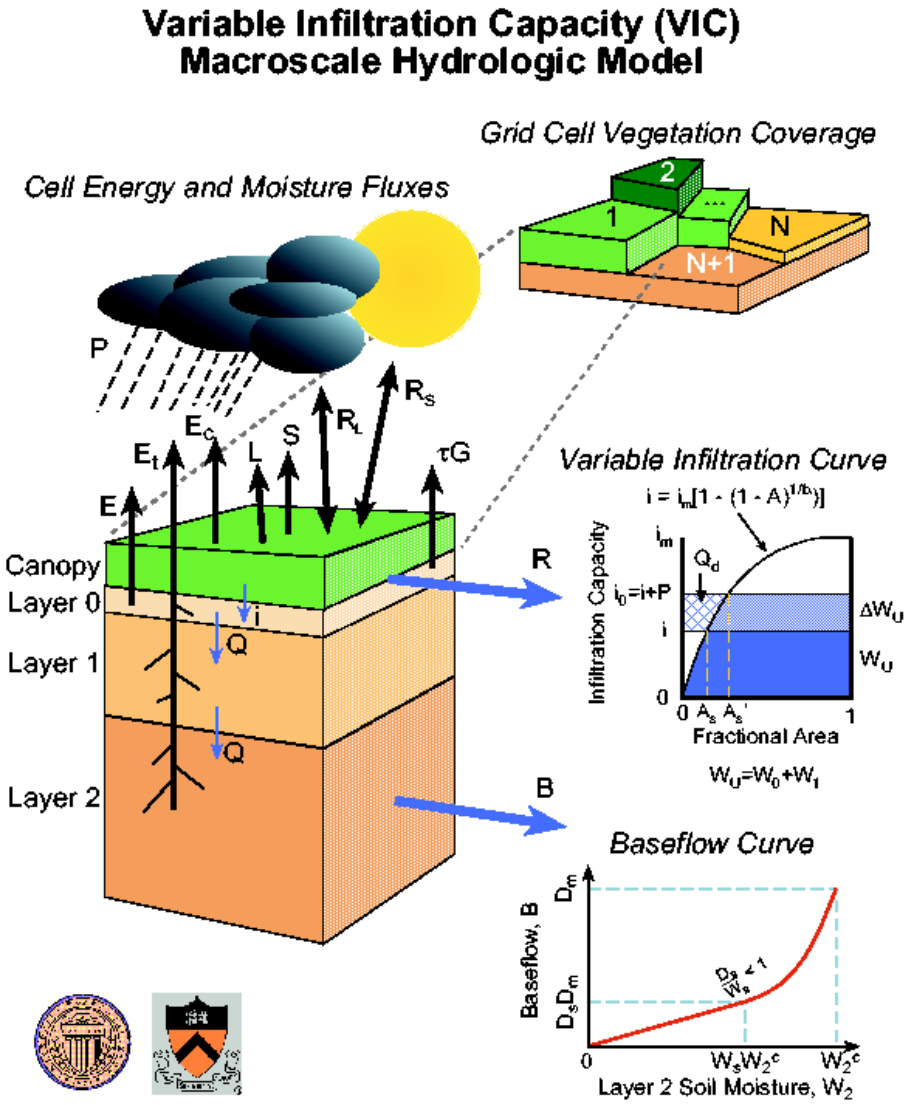
- Choose GCM
- Choose RCP
- Downscale
- Rainfall-runoff
- H_20 Availability
- Uncertainty

Example output

Fine resolution!

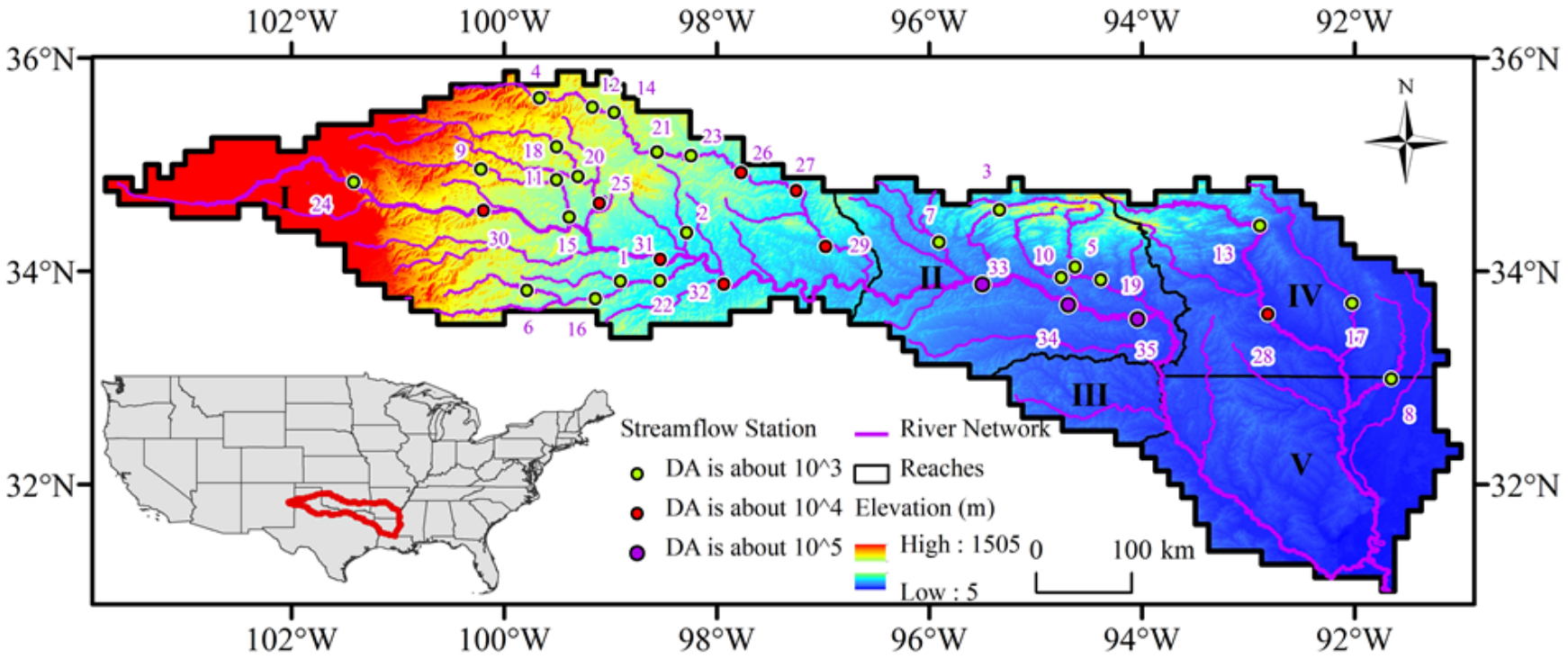


Rainfall-Runoff Modeling with VIC



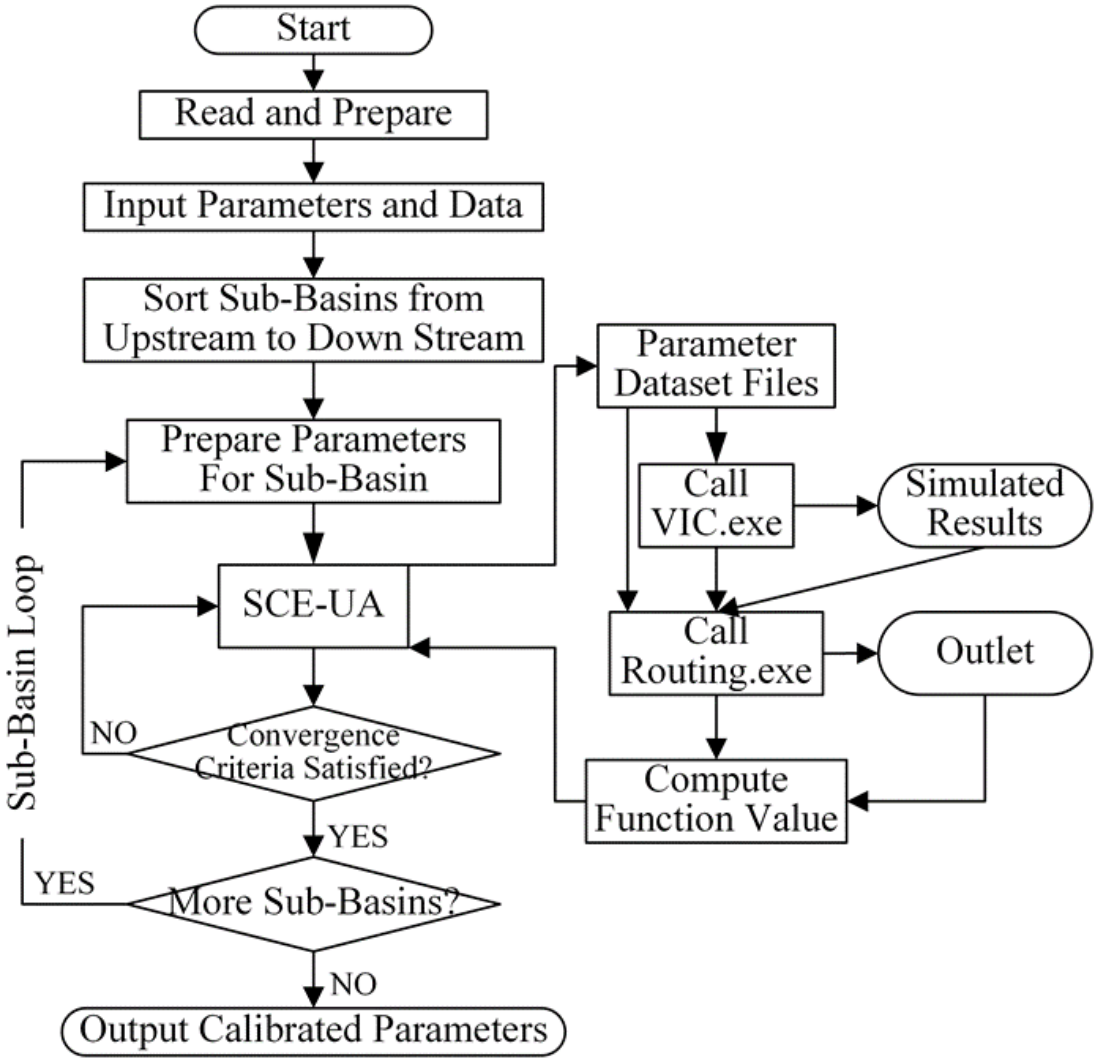
Rainfall-Runoff Modeling with VIC

Topography



Rainfall-Runoff Modeling with VIC

Nesting

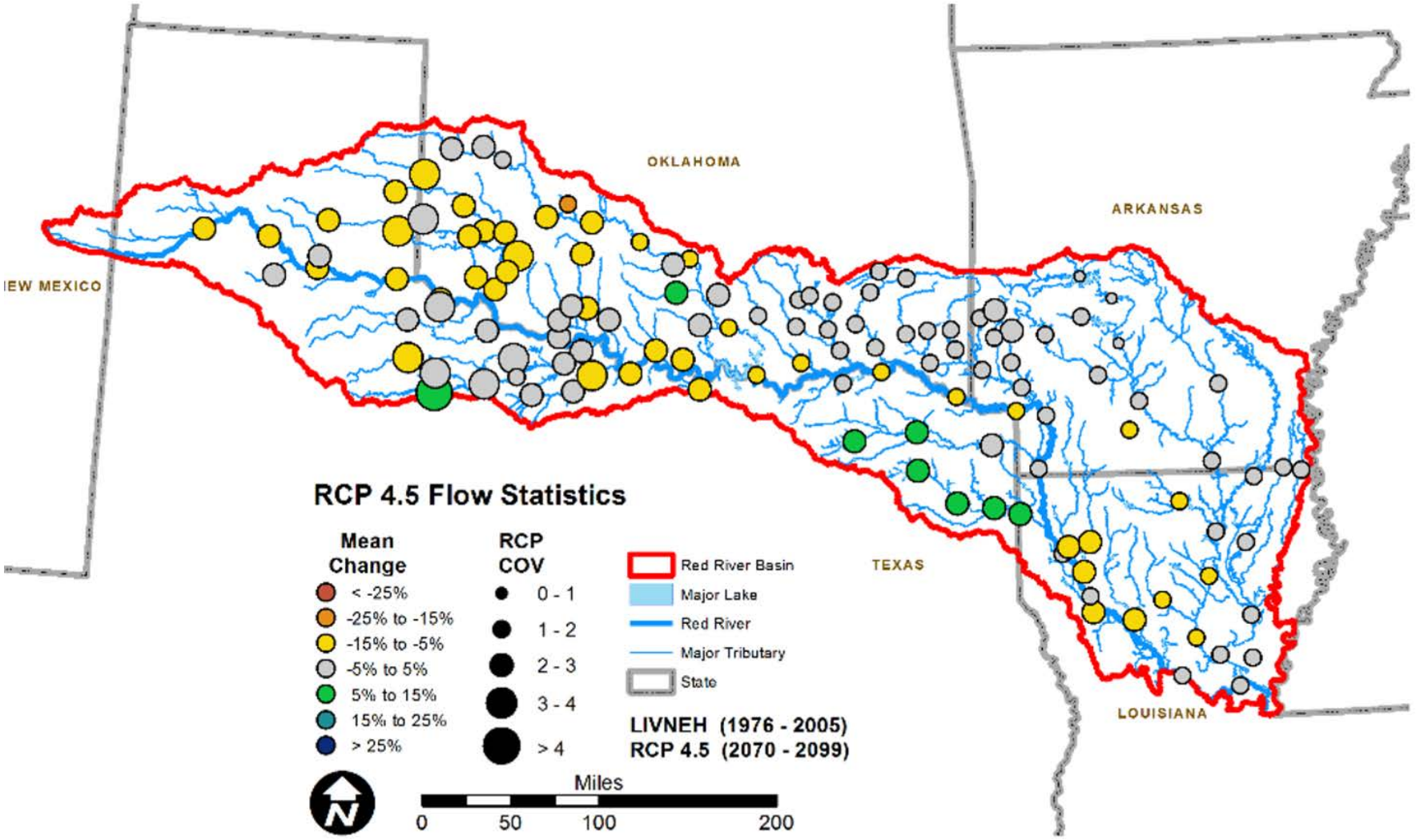


Water Availability – the RiverWare model

USACE

Flow statistics example

Uncertainty!



Towns, the environment and water resources at the local scale

Phase II

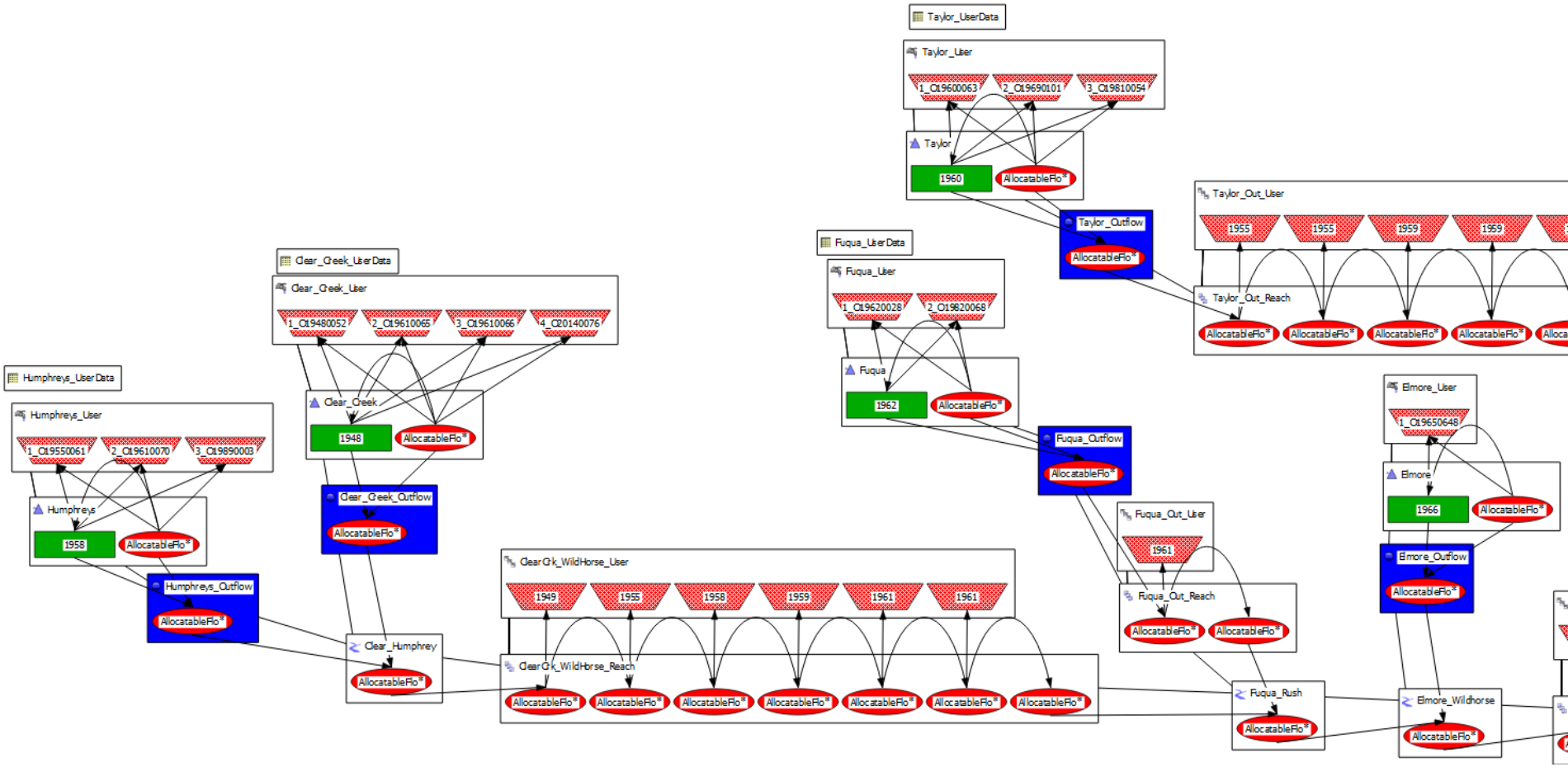
Red River Basin Climate Change: Phase II

TASKS

- Existing Data & Models
- Refine RiverWare Model
- Determine Vulnerability
- Fish Flows Analysis

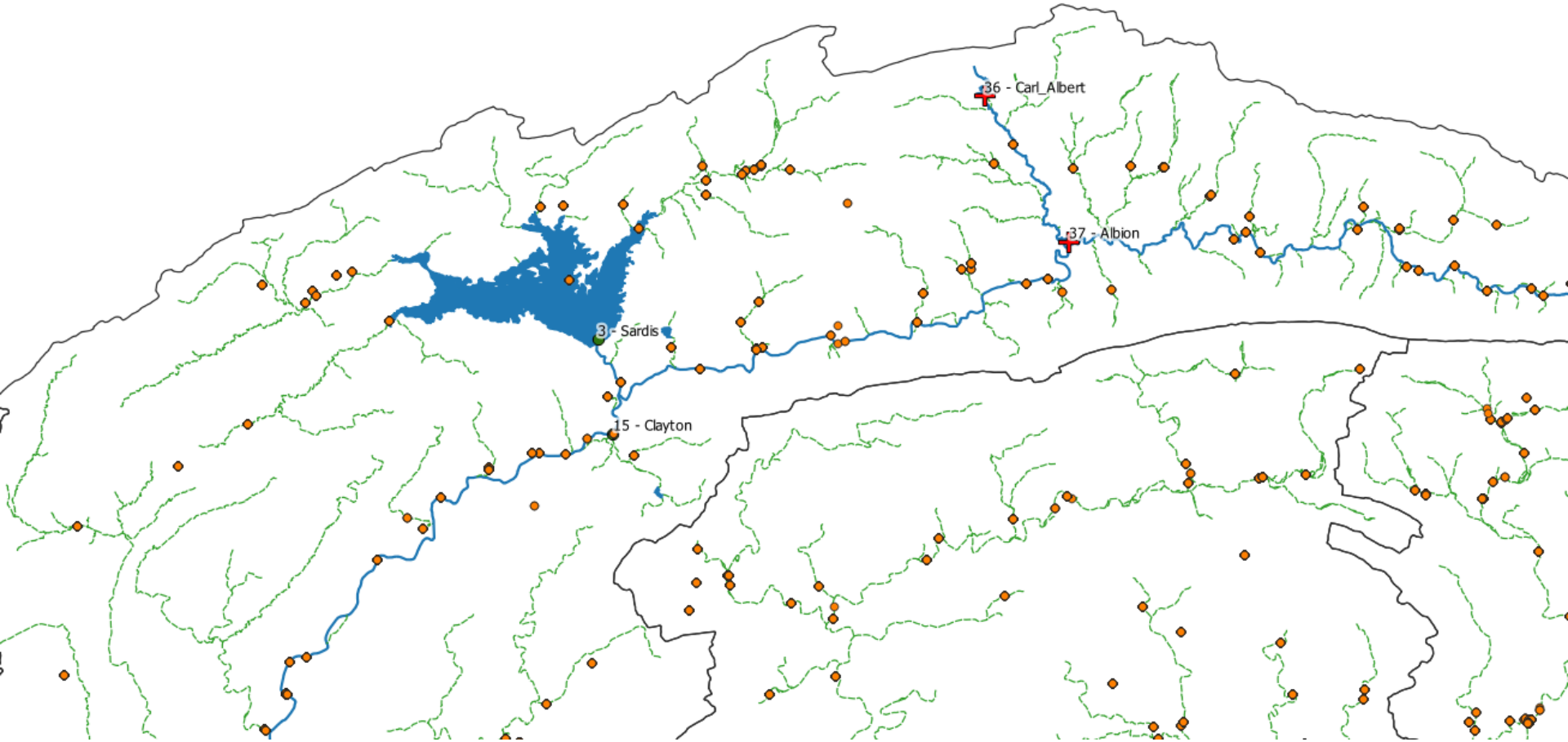
Phase II: Spatial Refinement

RIVERWARE



Phase II: Fish and rural communities

Sampling locations



Current Status and Ongoing Work

PHASE II

- Running climate scenarios
- Quantifying vulnerability
  - Fish
  - People

Conclusions

- Choose climate models wisely
- Understand and quantify uncertainty
- Drier in some parts of the basin, wetter in others
- Impacts in Southeast Oklahoma may be modest
- Future study on **Canadian River?**