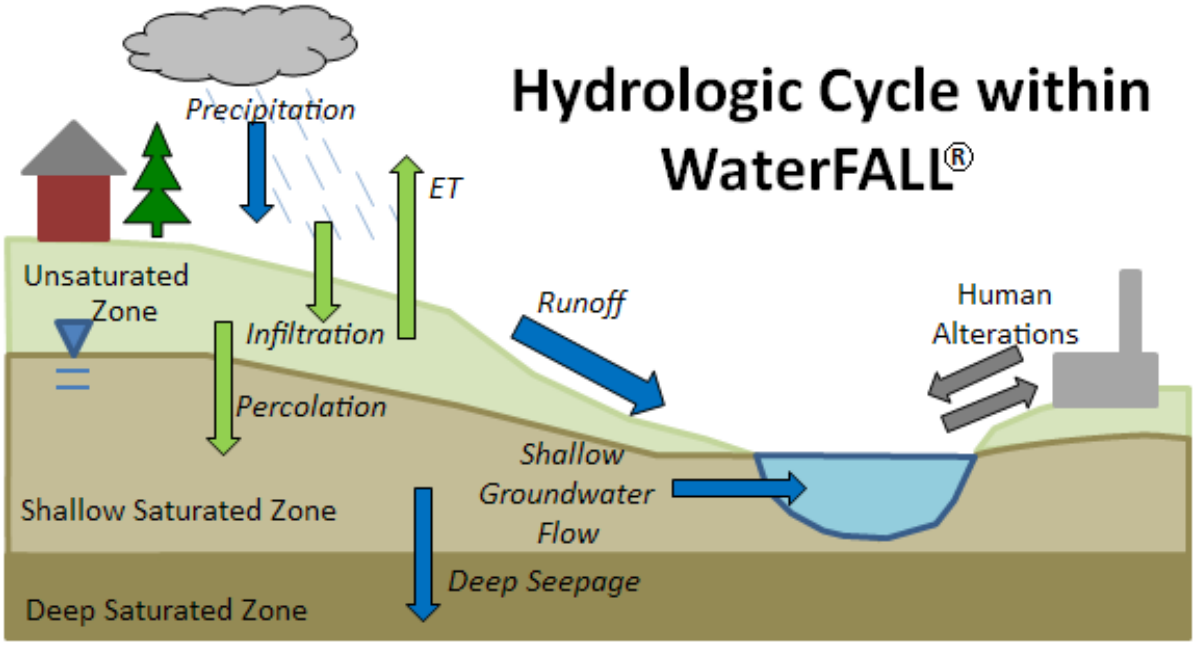
Application of the Watershed Flow and Allocation model (WaterFALL®) in Louisiana

Michele Cutrofello Eddy
RAE-TCS 2016

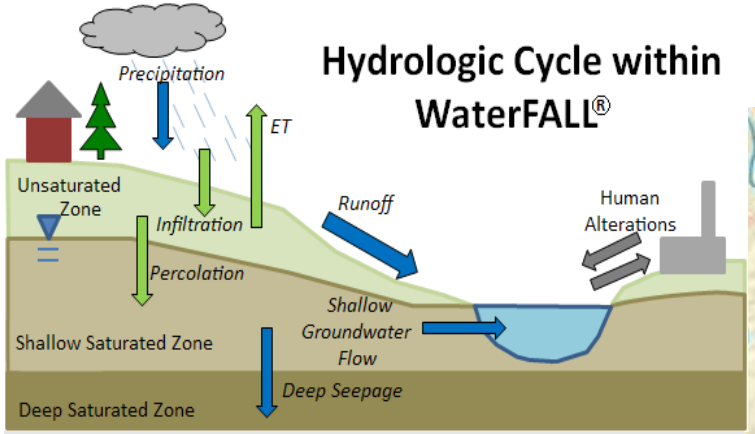


WaterFALL®: Watershed Flow and ALLocation Model

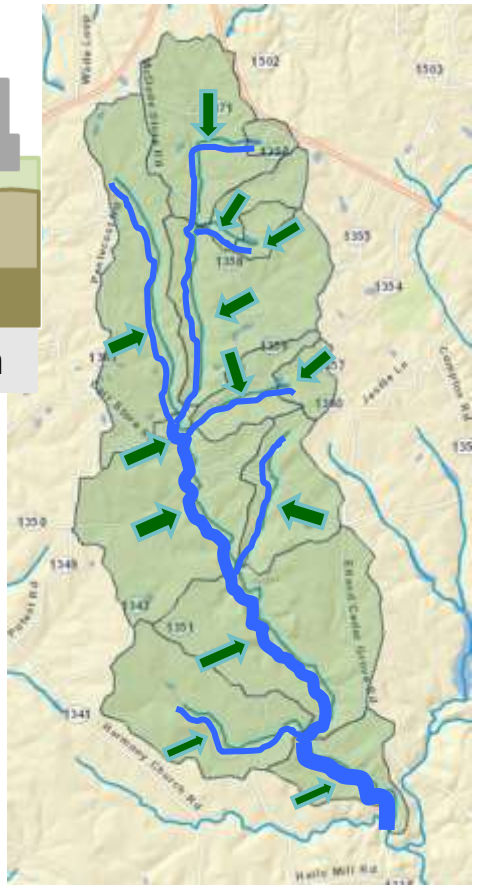
Model input data are pre-indexed to each NHDPlus catchment:

- Precipitation
- Temperature
- Land cover
- Soils
- Water use

Input Parameters

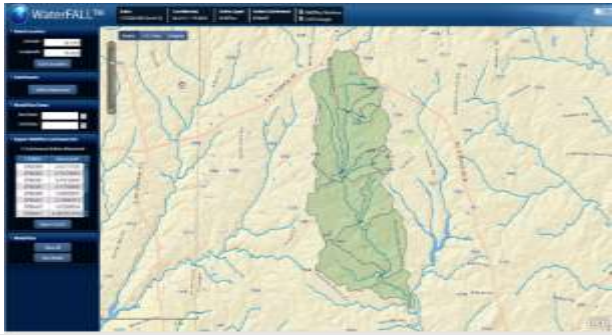


Generalized Watershed Loading Function



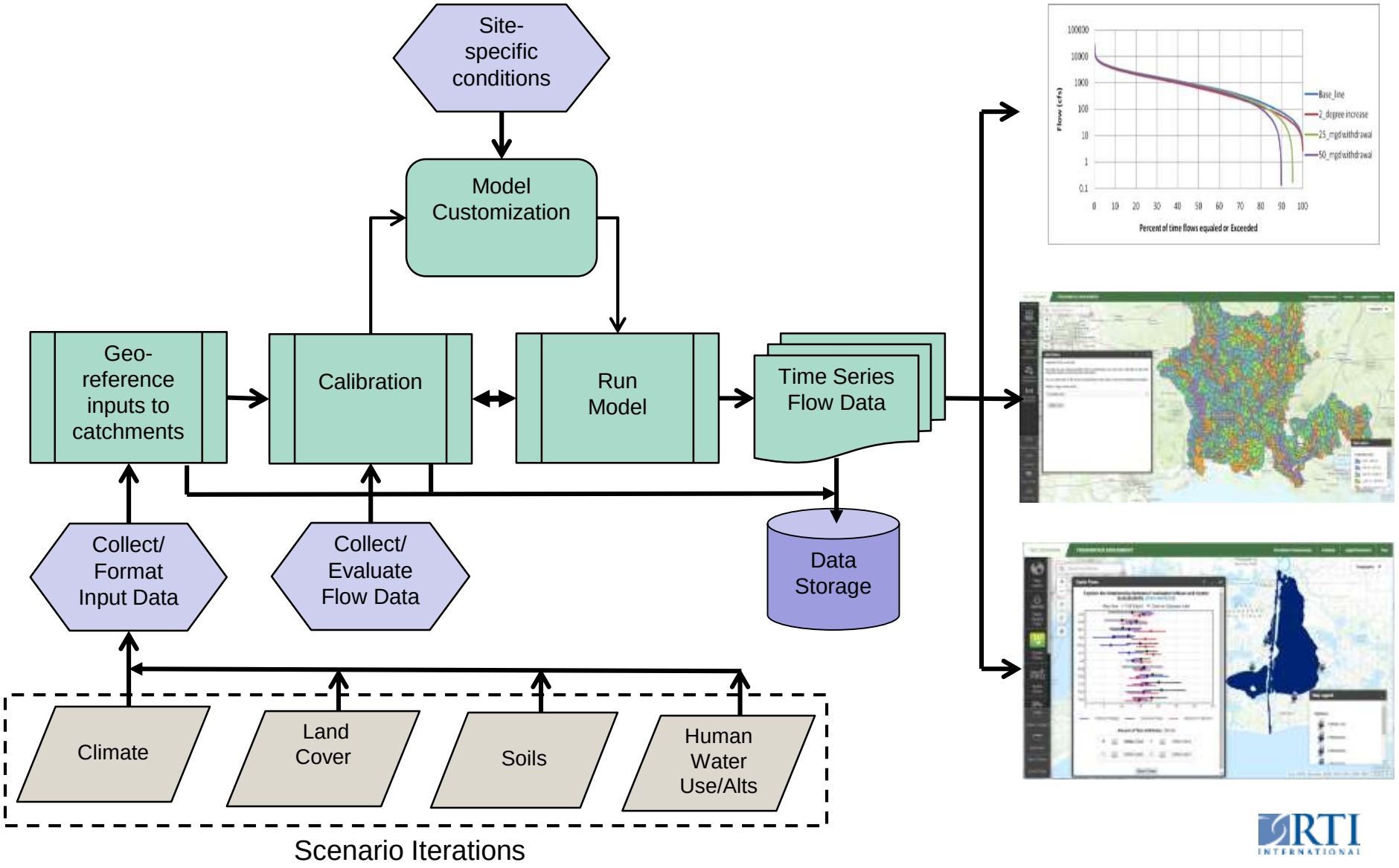
Modeled Flows & Routing

Hydrologic Network

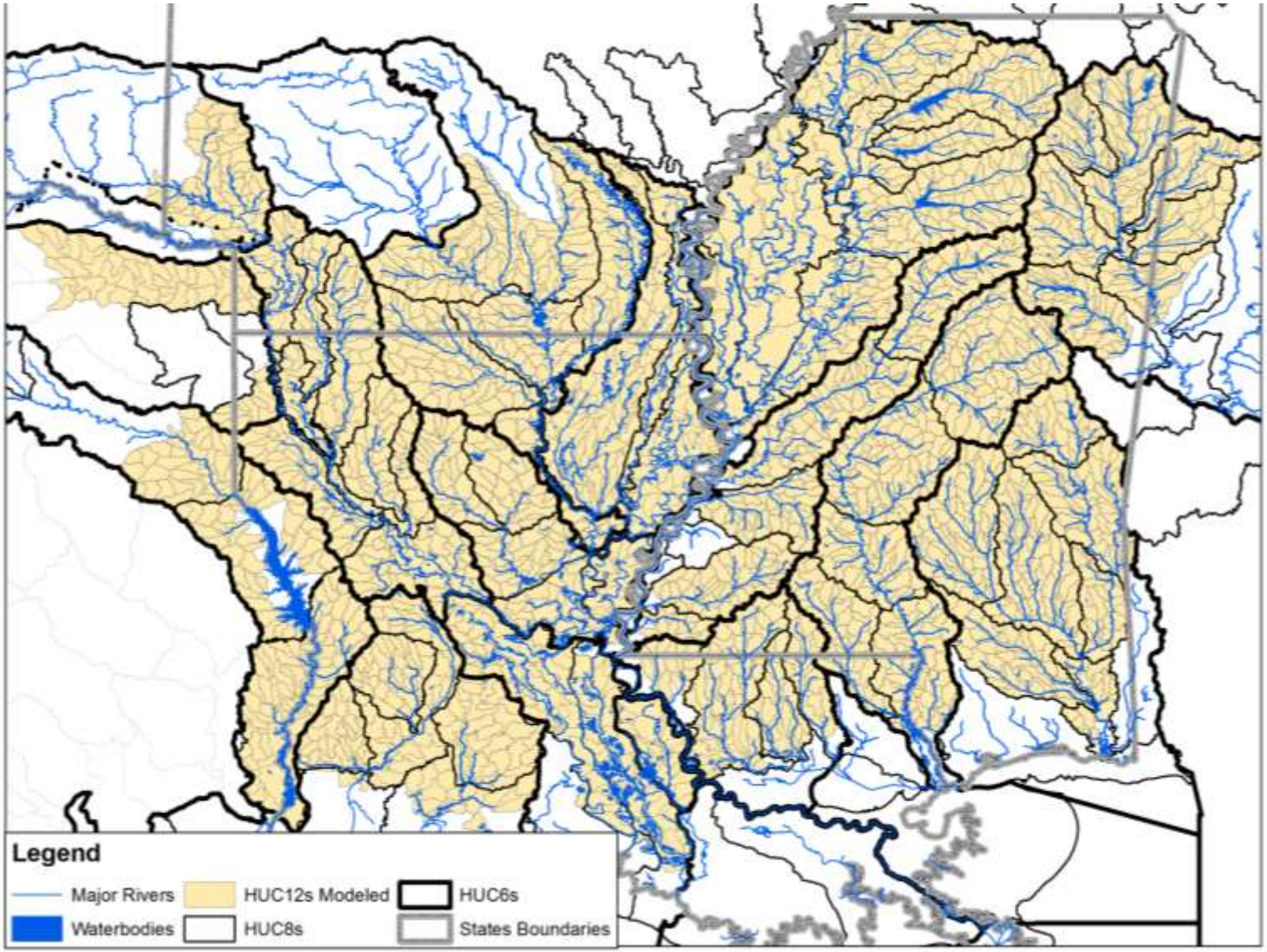


Watershed Delineation

Generalized WaterFALL Work Flow



LA/MS WaterFALL Domain

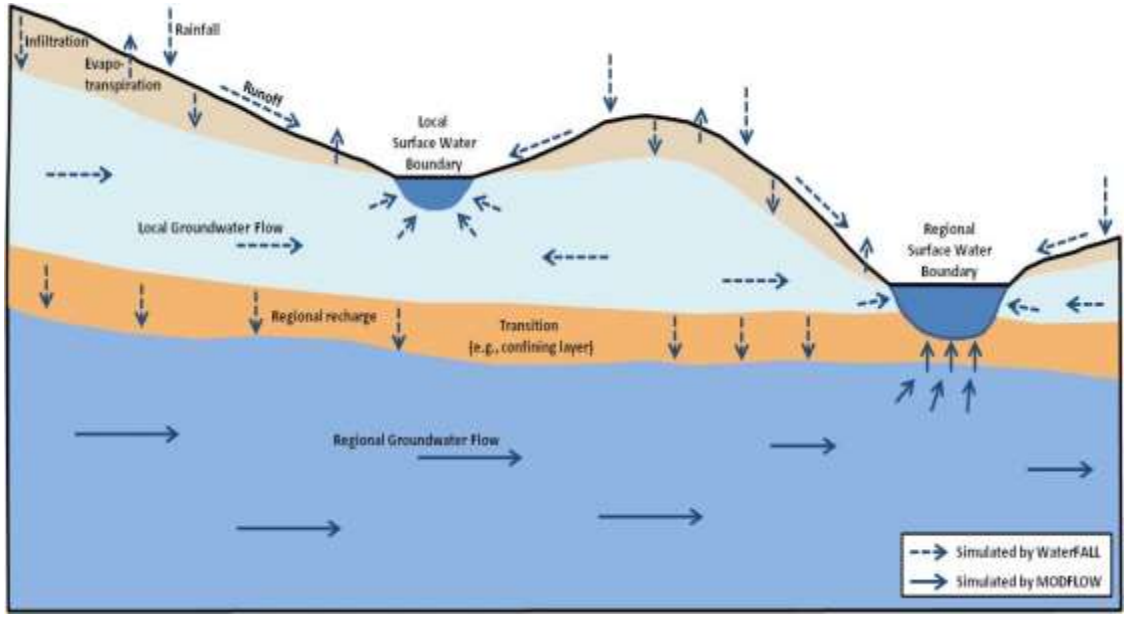


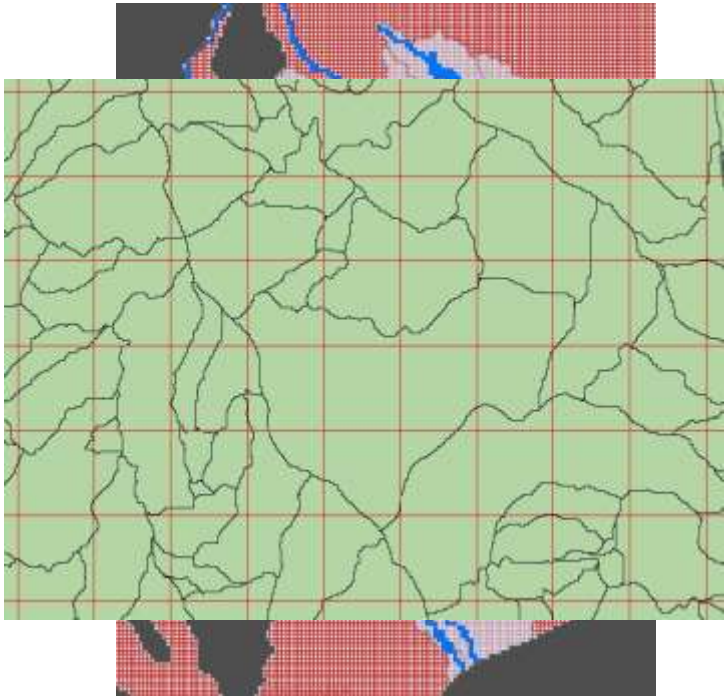
LA WaterFALL Details

- Louisiana
  - 15 watersheds and subwatersheds (including Pearl)
  - 15,011 HUC12s
  - 58,053 individual catchments
- 30-year simulation period at daily time step
- Includes tabulated withdrawals and discharges throughout the state
- Hydrologic results presented as maps, flow metrics, and charts through “HydroFlows App”
- Results utilized to assess impact of flow changes on receiving lake salinity levels with “Oyster Flows App”

Pilot Study of Integrated Groundwater Model

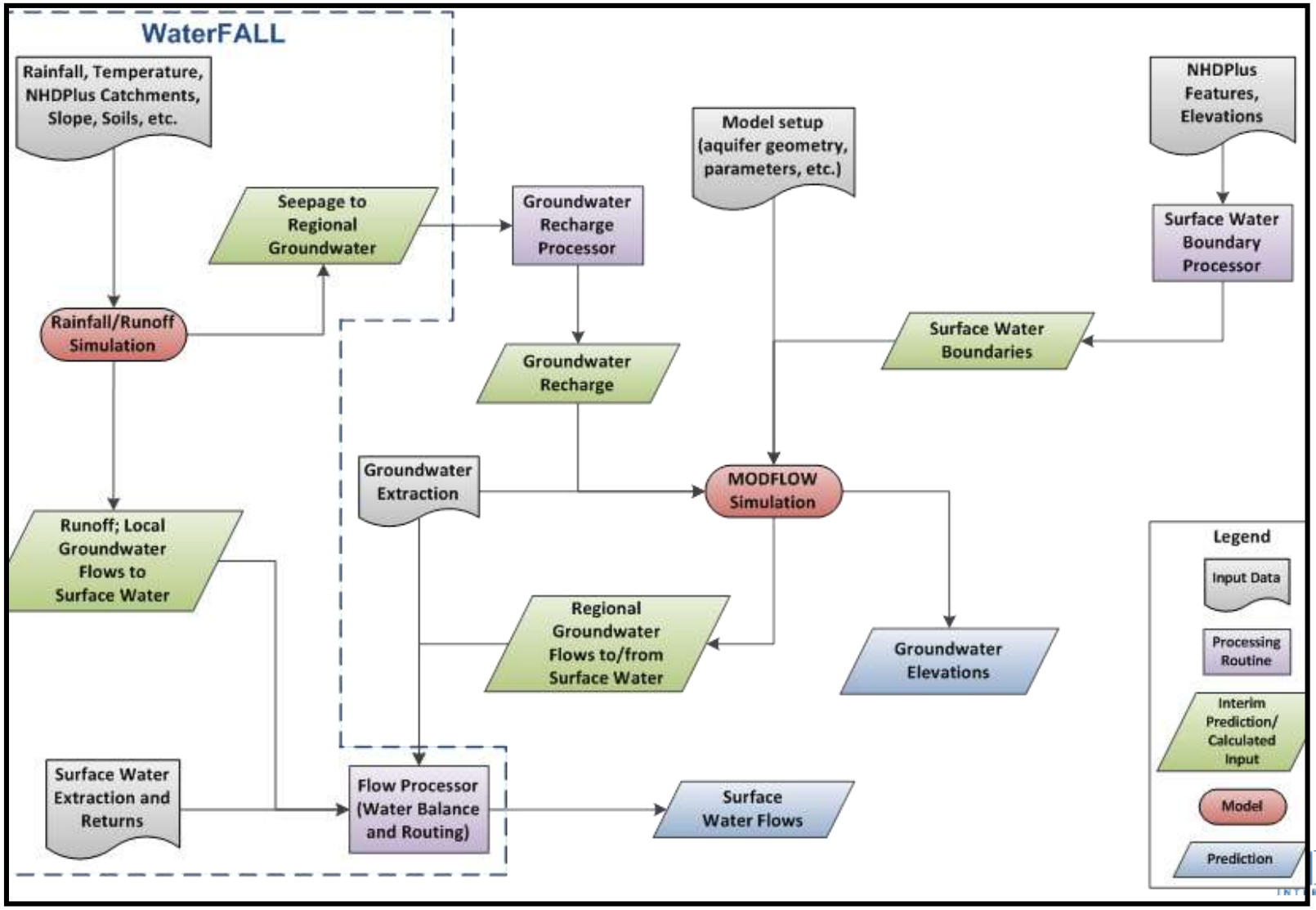
- Coupled regions method
- Link RTI's WaterFALL® surface water model with the MODFLOW groundwater model





Only major surface water bodies in MERAS

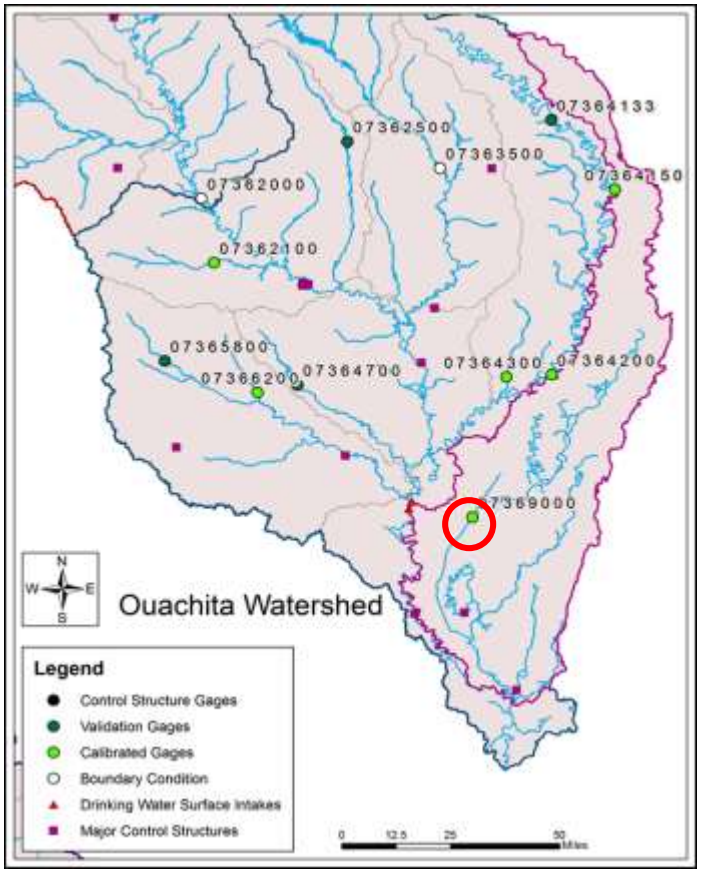
Integrated surface water and groundwater availability model simulation and data flow schematic

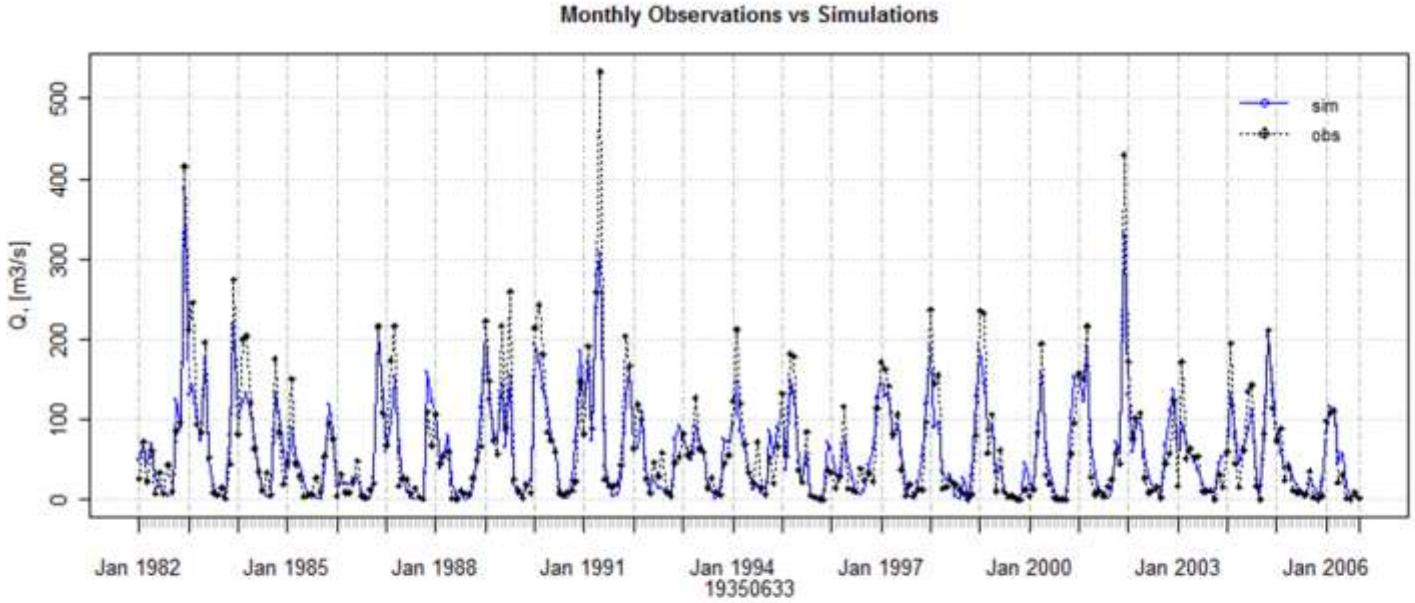


Example Model Performance in LA

Ouachita Watershed Calibration Gages

Gage ID	Site Name	DA (mi^2)	NSE	% BIAS	R^2
07366200	Little Corney Bayou near Lillie, LA	208	0.73	-5	0.74
07369000	Bayou Lafourche near Crew Lake, LA	361	0.84	-5	0.86
07364133	Bayou Bartholomew at Garrett Bridge, AR	380	0.70	9	0.71
07364150	Bayou Bartholomew at McGehee, AR	576	0.67	19	0.71
07364200	Bayou Bartholomew near Jones, LA	1,187	0.49	36	0.66
07362100	Smackover Creek near Smackover, AR	385	0.65	6	0.66





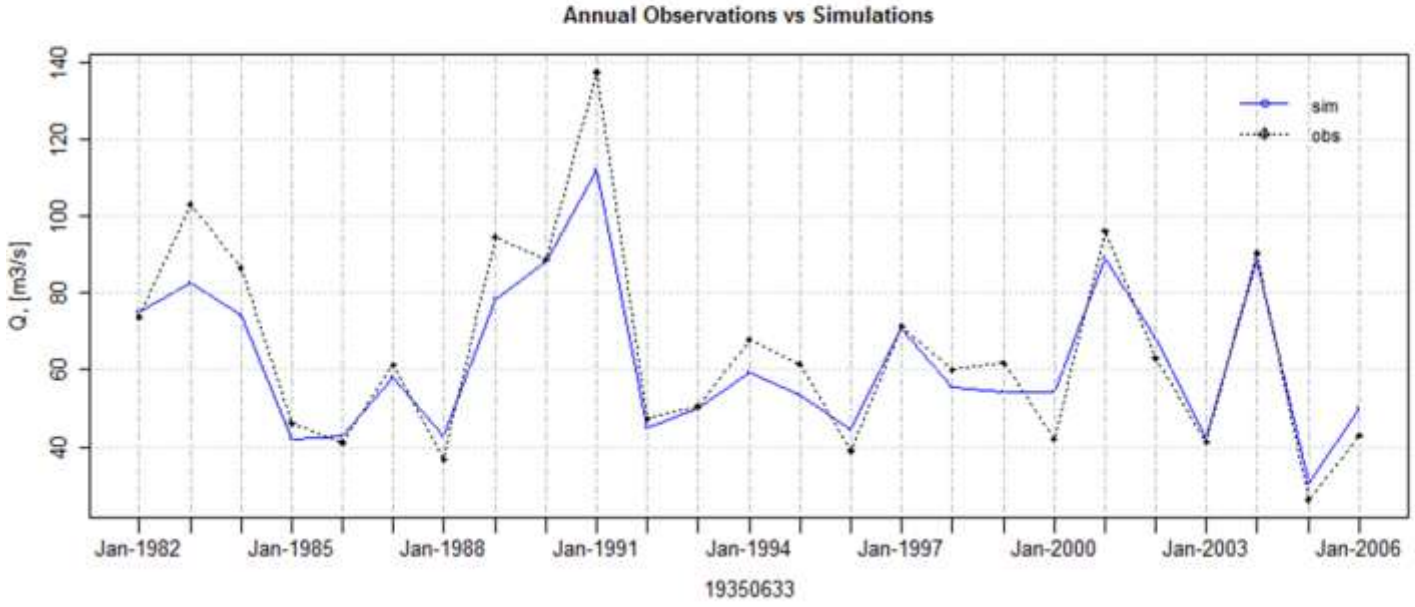
GoF's:

NSE = 0.84

PBIAS = -4.9

RMSE = 31

R2 = 0.86



GoF's:

NSE = 0.87

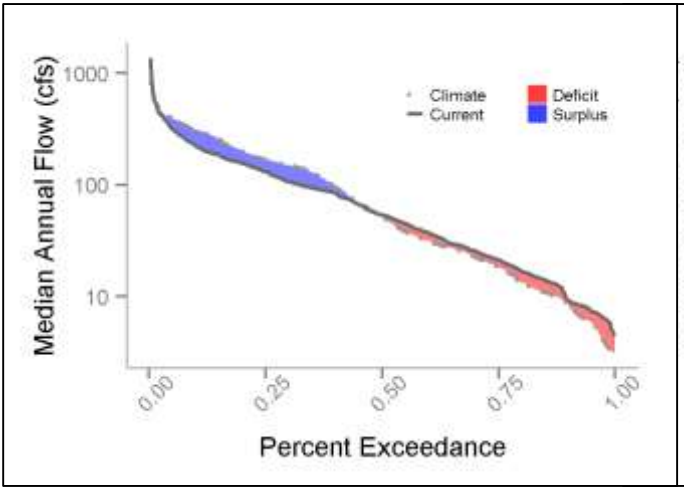
PBIAS = -4.8

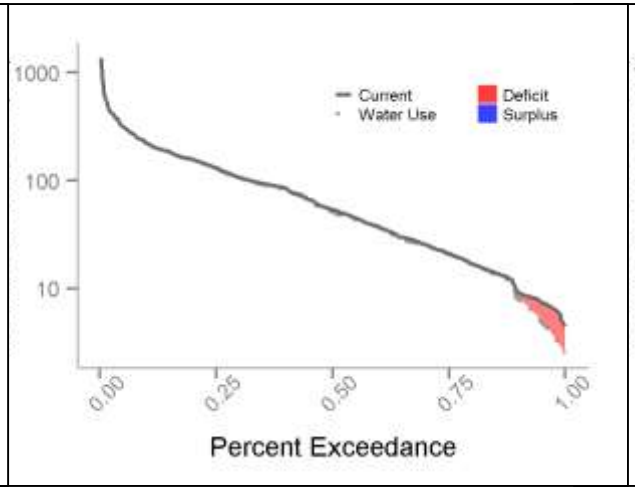
RMSE = 9.14

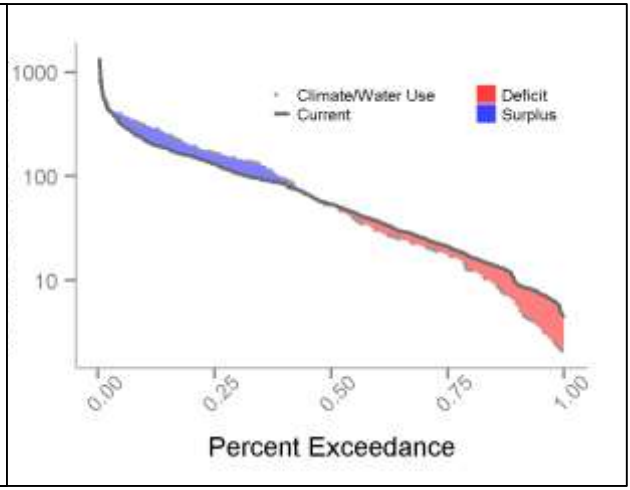
R2 = 0.93

LA/MS WaterFALL Scenarios

- 4 scenarios modeled
  - Current conditions
  - Projected water use change
  - Projected climate change
  - Combined water use and climate change
- Scenario Metric: Ecochange
  - Ecosurplus: fraction of water now available in excess of baseline
  - Ecodeficit: fraction of water lost from baseline
  - Represented through flow duration curves







Hydrologic Metrics

Name	Description	Unit	Note
Monthly median	Monthly median flow	cfs	Mean over period of record (POR); value per month
Monthly mean	Monthly mean flow	cfs	Mean over POR; value per month
1-Day Min	Annual minima, 1-day mean	cfs	Mean over POR
1-Day Max	Annual maxima, 1-day mean	cfs	Mean over POR
3-Day Min	Annual minima, 3-day mean	cfs	Mean over POR
3-Day Max	Annual maxima, 3-day mean	cfs	Mean over POR
7-Day Min	Annual minima, 7-day mean	cfs	Mean over POR
7-Day Max	Annual maxima, 7-day mean	cfs	Mean over POR
30-Day Min	Annual minima, 30-day mean	cfs	Mean over POR
30-Day Max	Annual maxima, 30-day mean	cfs	Mean over POR
90-Day Min	Annual minima, 90-day mean	cfs	Mean over POR
90-Day Max	Annual maxima 90-day mean	cfs	Mean over POR
Zero flow days	Number of zero flow days	count	Mean over POR
Baseflow index	Base flow index: 7-day minimum flow/mean flow for year	unitless	Mean over POR
Date of Min	Julian date of each annual 1-day minimum	unitless	Mean over POR
Date of Max	Julian date of each annual 1-day maximum	unitless	Mean over POR
Low pulse count	Number of low pulses within each water year	count	Mean over POR; the pulse thresholds are the 25th and 75th percentiles of the distribution of flows.
High pulse count	Number of high pulses within each water year	count	Mean over POR; the pulse thresholds are the 25th and 75th percentiles of the distribution of flows.
Low pulse duration	Mean duration of low pulses	days	Mean over POR; the pulse thresholds are the 25th and 75th percentiles of the distribution of flows.
High pulse duration	Mean duration of high pulses	days	Mean over POR; the pulse thresholds are the 25th and 75th percentiles of the distribution of flows.

Summary

- Statewide surface water modeling completed
- Groundwater integration methods created and piloted within the Ouachita basin
- Online App's created to serve up the data to the public
- Planning stages for more comprehensive, integrated assessment involving groundwater and coastal modeling within the state

Questions?

Michele C. Eddy
Environmental Engineer
919.990.8458
mceddy@rti.org