UPDATE: Groundwater model for the ACF Focus Area of the National Water Census

ACF Focus Area Meeting

USGS Georgia Water Science Center, May 12, 2014

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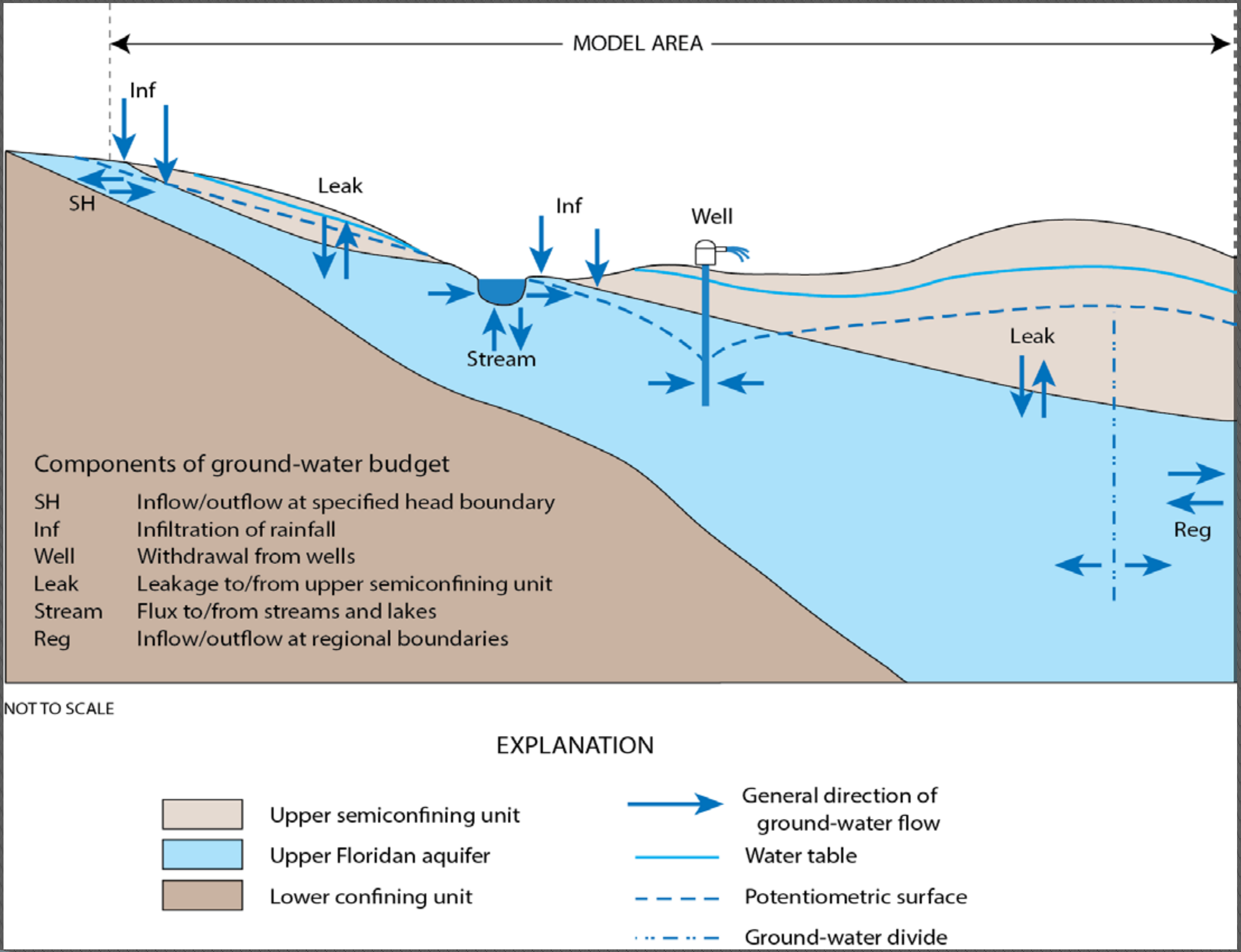
Conceptual Groundwater Flow Model



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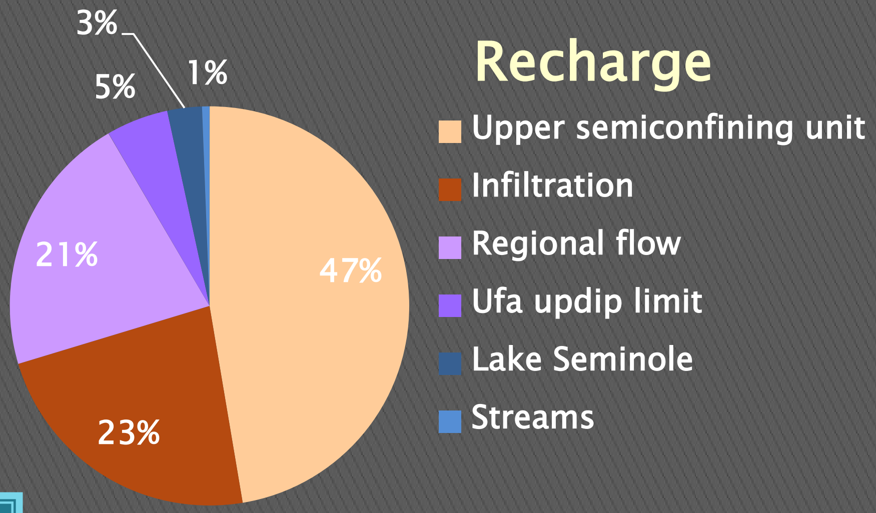
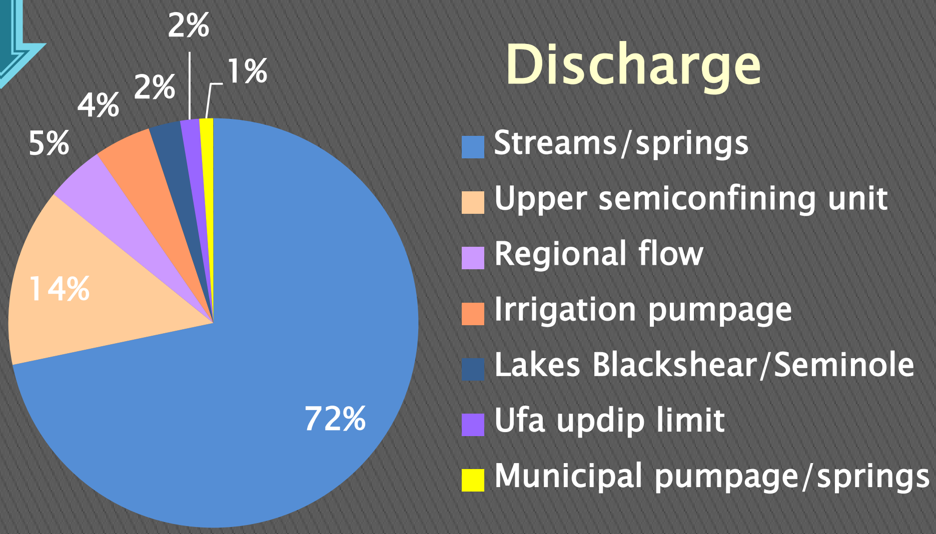
Groundwater Budget

MODFLOW Model Characteristics

- **Aquifer Layers** – Upper semiconfining unit, Upper Floridan aquifer
- **Boundaries** – Regional flow boundaries, lakes, streams, wells
- **Hydrologic Properties** – Hydraulic conductivity, specific storage/yield
- **Modular Program**





Percentages from Jones & Torak, 2006, Nov. 1999 Calibrated Steady-State Model

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Flow Boundaries

(Model Grid spacing 0.5 km, 56,589 active cells)

- **Constant Head Boundary (CHB)** – Updip limit of Upper Floridan aquifer (324 cells)
- **General Head Boundary (GHB)**
  - o Adjoining parts of Upper Floridan aquifer (621 cells)
  - o Lakes Seminole, Worth, Blackshear (884, 60, & 243 = 1,187 cells)
- **Rivers (RIV)** – major, perennial streams (1,087 cells)
- **Streams, springs (DRN)** – minor, ephemeral streams and springs (3,709 cells)

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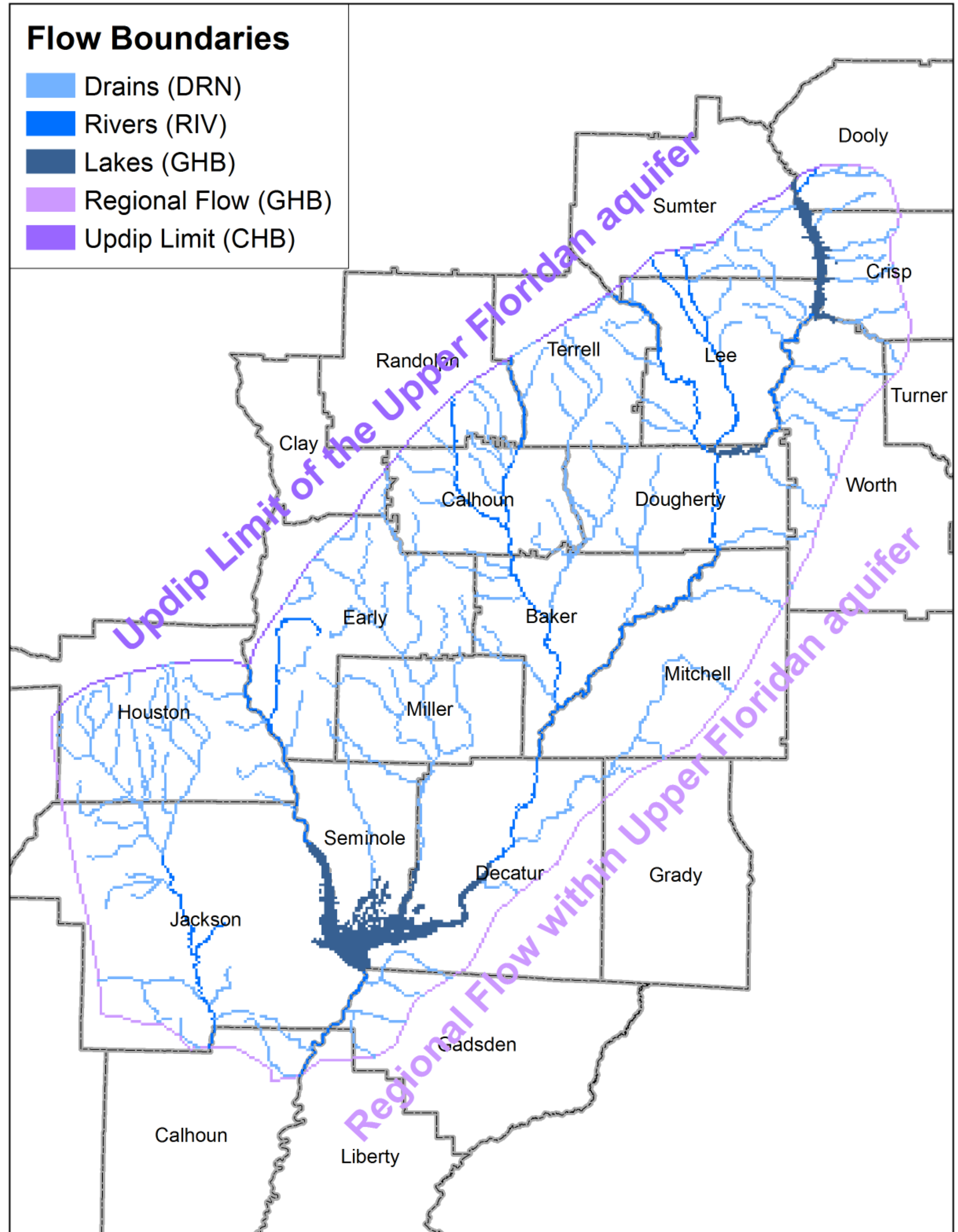
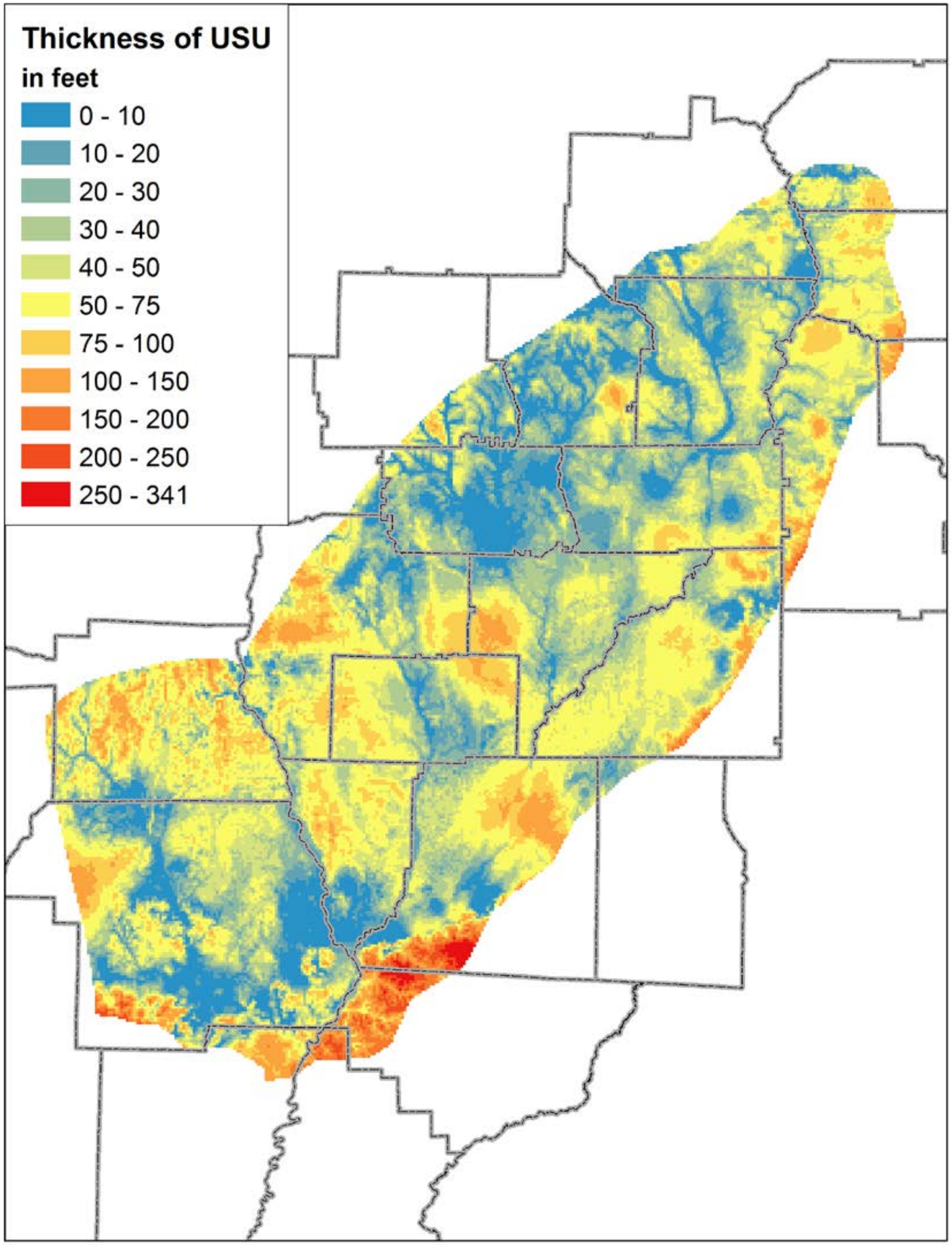


Upper Semiconfining Unit

- **Model Layer 1**
- **Thickness (DIS)** – Difference between DEM and Top of UFla
- **Where 'thin' (<30 ft) (LPF)**
  - o No water table aquifer
  - o K similar to UFa
- **Where 'thick' (>30 ft) (LPF)**
  - o Water table aquifer
  - o K smaller than UFa
- **Recharge Package (RCH)** – specified flux from PRMS model applied to layer 1
- **All lakes and streams (GHB, RIV, DRN)** – applied to layer 1



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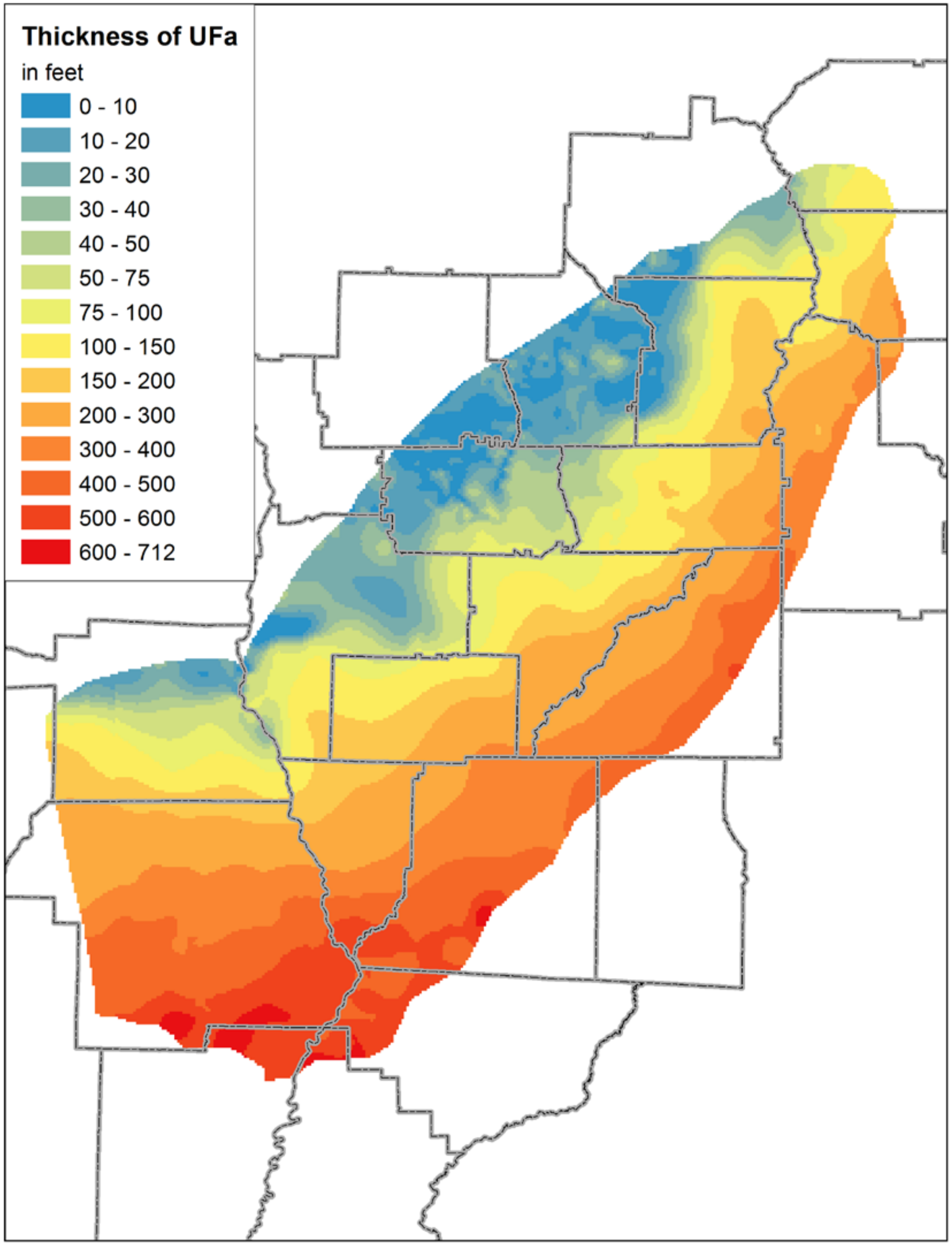
Upper Floridan Aquifer

- **Model Layer 2**
- **Thickness (DIS)** – Difference between Top and Bottom of UFa
- **Aquifer Properties (LPF)** – Horizontal and Vertical Hydraulic Conductivity and Specific Storage/Yield collected from published data
- **Upper Floridan aquifer Updip Limit (CHB) & Regional Flow (GHB)** – boundaries applied to layer 2
- **Pumping (WEL)** – All agricultural, municipal, and industrial pumping from layer 2



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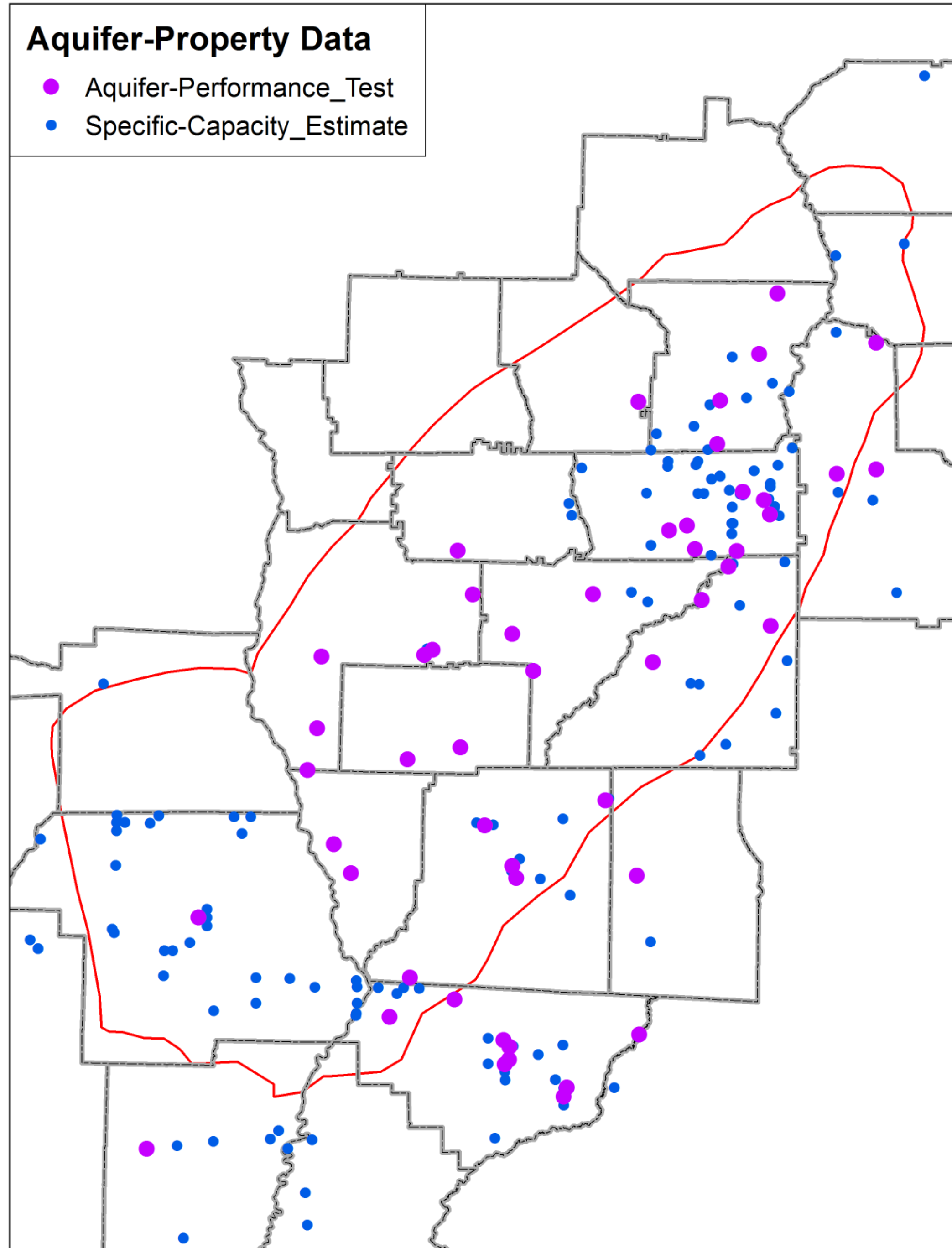
Upper Floridan Aquifer

- **Model Layer 2**
- **Aquifer Property Data (LPF)**
  - o 51 Multi-well aquifer-performance tests (blue circles) – more reliable; yield hydraulic conductivity (K) and storage coefficient (S) values
  - o 140 Estimates from single-well specific-capacity data (small green circles) – less reliable, depend on guessed value of “formation factor;” only yields K estimates



Groundwater Pumping

- **Agricultural** – highly variable by season & weather (~4 to >800 Mgd in Jones & Torak, 2006)
  - **Georgia** – comprehensive ag metering program (GSWCC), spatially distributed monthly estimates of irrigated depth, apply depth to irrigated acreage within each model cell
  - **Florida, Alabama** – need estimates of irrigated acreage with each model, apply average depth from Georgia
- **Municipal & Industrial (M&I) –** nearly steady (~30 Mgd in Jones & Torak, 2006), estimated from Water Use Reports

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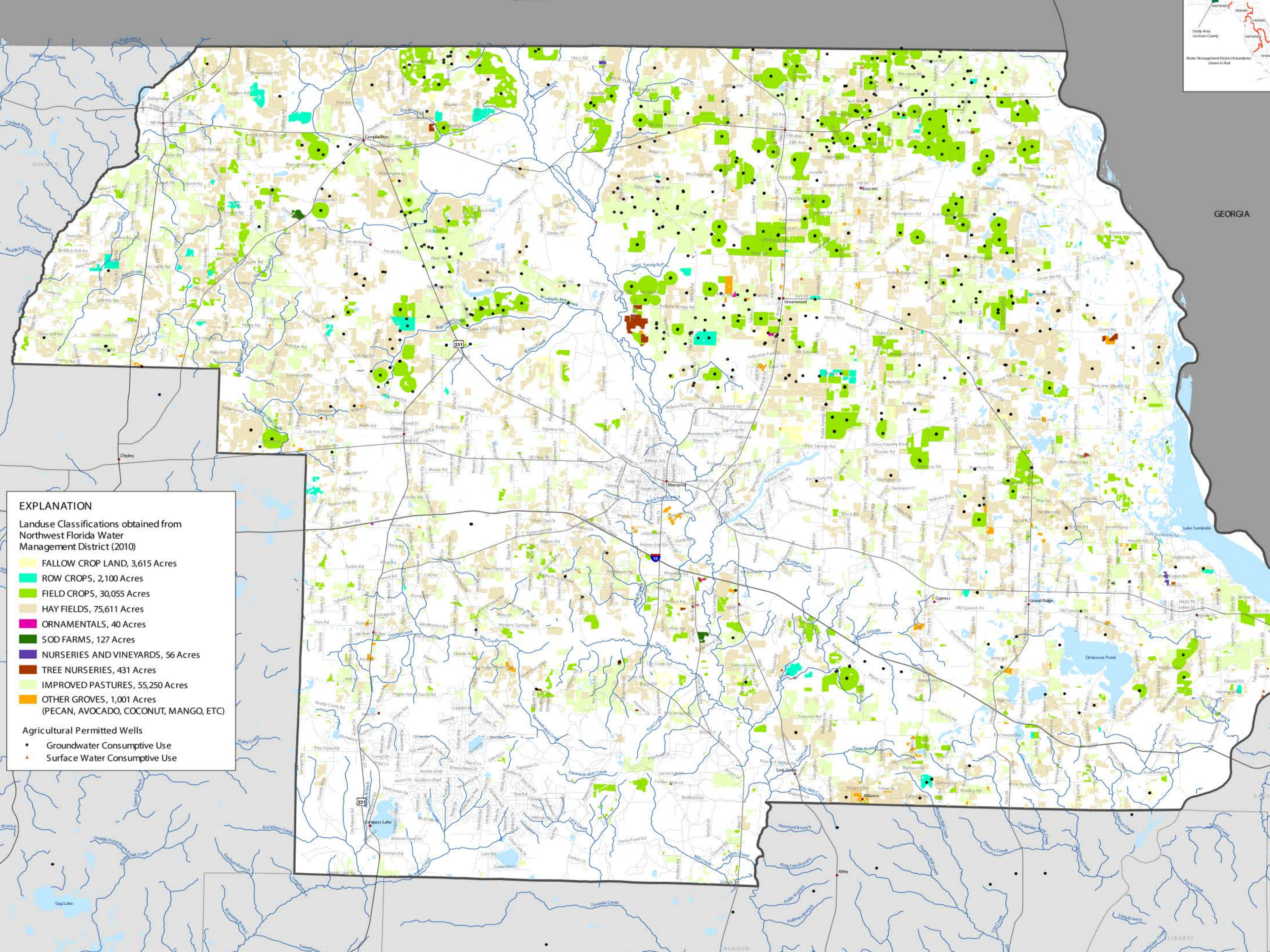
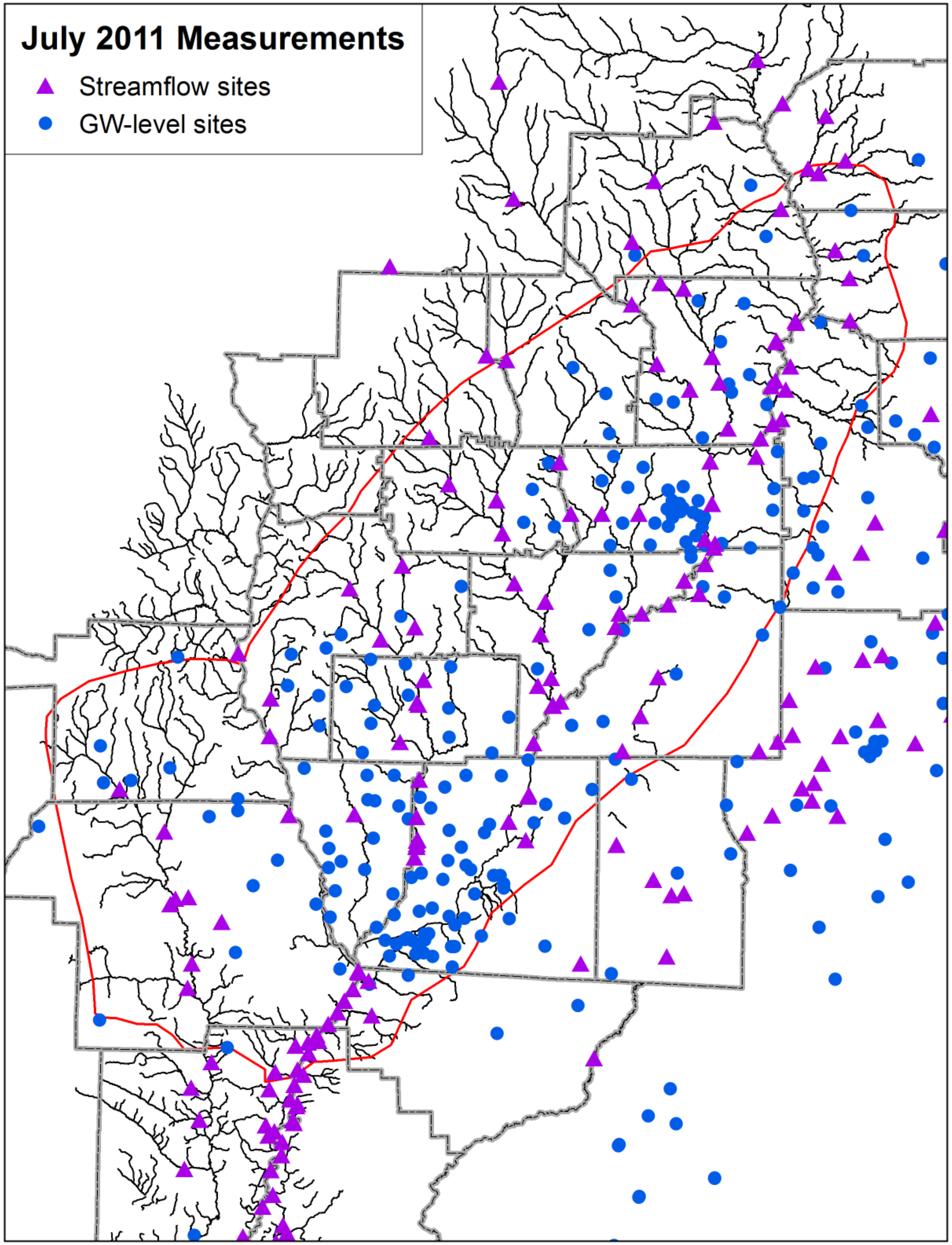
Jackson County historical acreage totals – USDA

- 1997 acres irrigated totaled 17,872, of which cotton and peanuts combined for 69 %
- 2002 acres irrigated totaled 13,374, of which cotton and peanuts combined accounted for 55 %
- 2007 acres irrigated totaled 20,275, of which cotton and peanuts combined accounted for 68 %
- 2012 acres irrigated data not available as of April 30, 2014
- This slide and next from Rich Marella, USGS Florida WSC


EXPLANATION
Landuse Classifications obtained from Northwest Florida Water Management District (2010)
FALLOW CROP LAND, 3,615 Acres
ROW CROPS, 2,100 Acres
FIELD CROPS, 30,055 Acres
HAY FIELDS, 75,611 Acres
ORNAMENTALS, 40 Acres
SOD FARMS, 127 Acres
NURSERIES AND VINEYARDS, 56 Acres
TREE NURSERIES, 431 Acres
IMPROVED PASTURES, 55,250 Acres
OTHER GROVES, 1,001 Acres
(PECAN, AVOCADO, COCONUT, MANGO, ETC)
Agricultural Permitted Wells
Groundwater Consumptive Use
Surface Water Consumptive Use
GEORGIA
Lake Seminole
Marianna
Greenwood
Campbellton
Bascom
Grand Ridge
Cypress
Alliance
Chipley
Altha
Compass Lake
Ocheesee Pond

Model Calibration

- **Steady-State Conditions – July 2011**
- **USGS Scientific Investigations Report 2012-5179** – Thoroughly documents hydrologic conditions in lower ACF during exceptional drought
- **178 groundwater levels in the Upper Florida aquifer** (blue circles)
- **111 streamflows** (violet triangles) – during drought, change in streamflow from upstream to downstream gage is due to stream-aquifer flow



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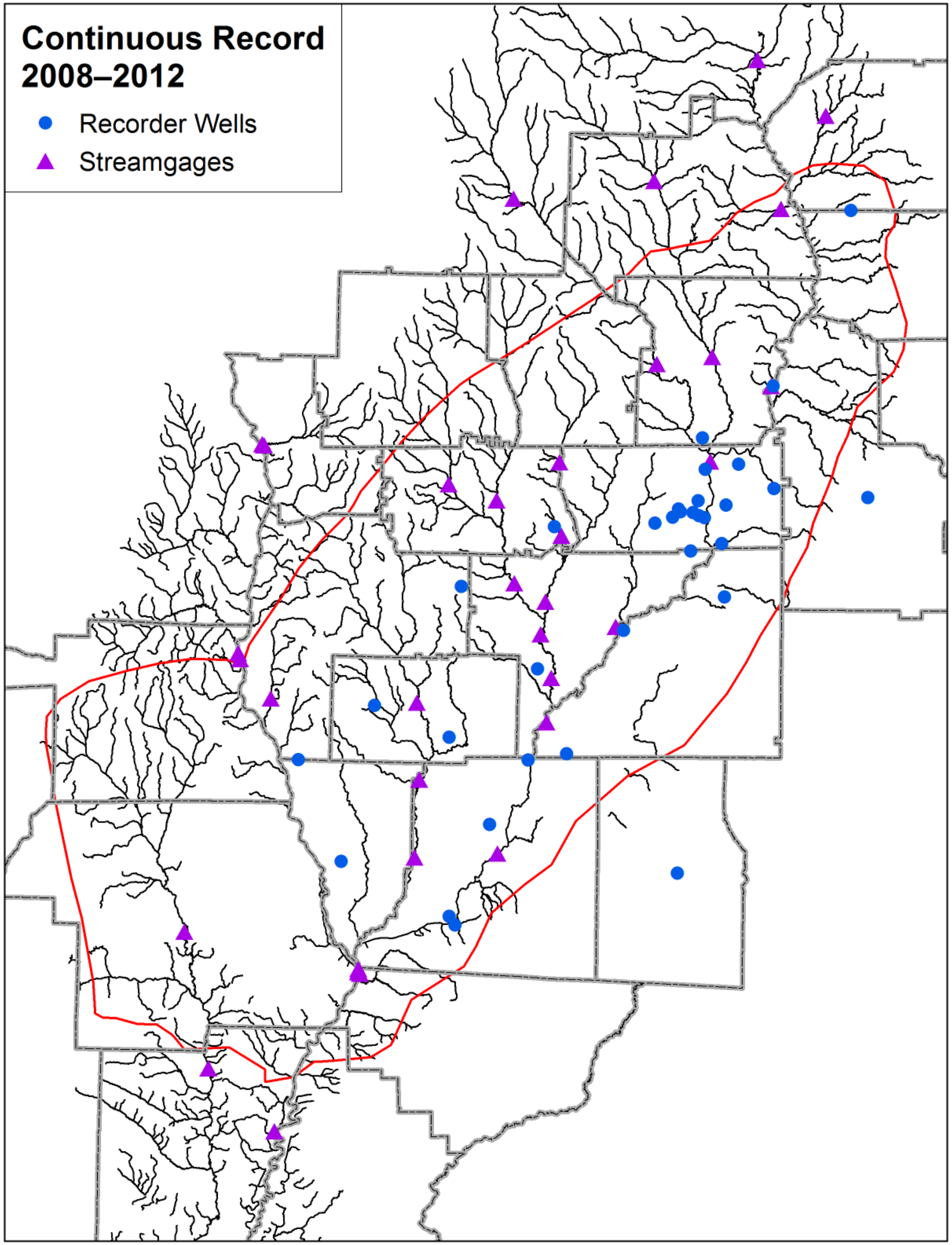
Model Calibration

- **Transient Conditions – January 2008–December 2012**
- **33 USGS recorder wells** – (blue circles)
- **35 USGS streamgaging stations** – (violet triangles)
- **Monthly average GW level & stage** – monthly model stress periods



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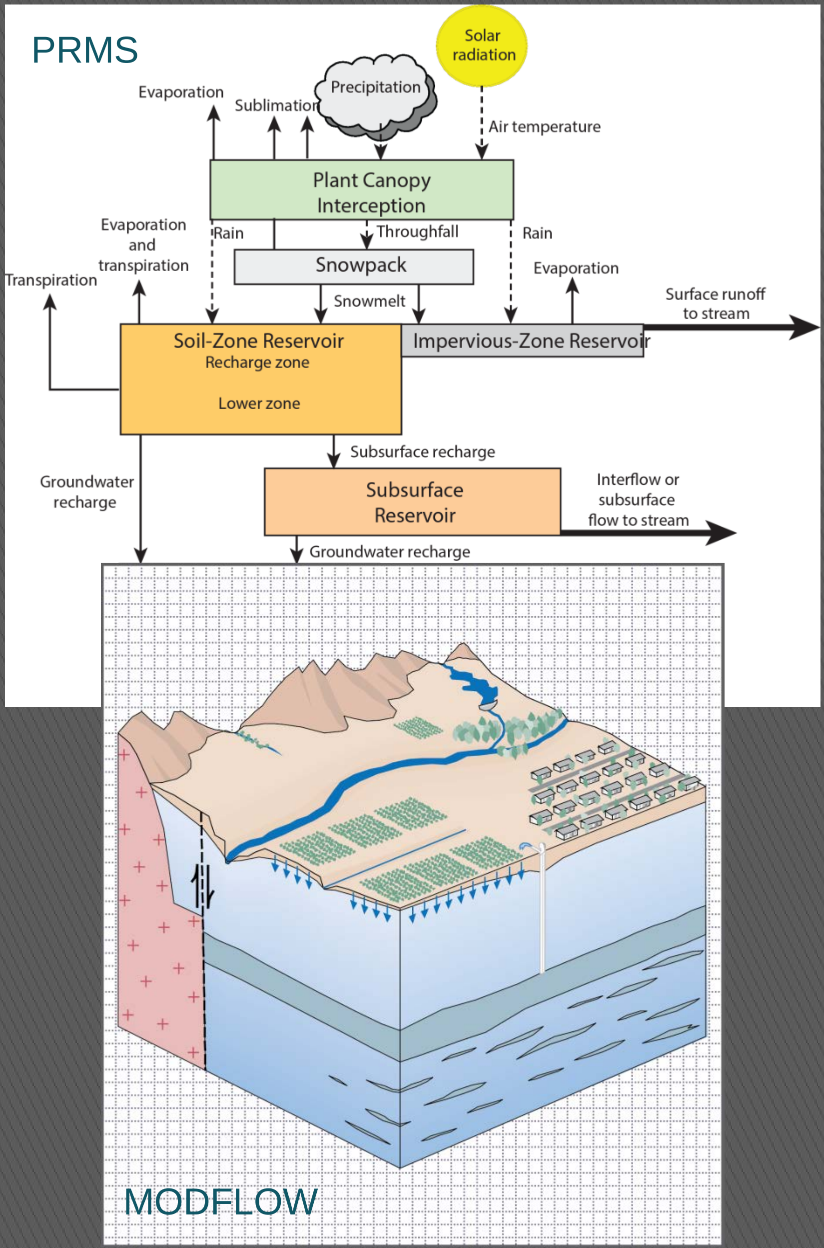
Coupling MODFLOW and PRMS Models

- **Recharge from PRMS is initially applied to layer 1 of MODFLOW** – downward pointing arrows at bottom of PRMS model
- **Discharge from MODFLOW model to streams and lakes will then be compared to results from PRMS**
- **Iterate as needed to achieve desired match**



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Groundwater Model Products

- **Hydrologic Budget** – GW components from MODFLOW model, combined with budget components from the PRMS model, will provide comprehensive budget for entire hydrologic system in the lower ACF

- **Model Documentation** – thorough documentation of model developments and publicly accessible model archive

- **Linkage methodology** – methods employed to link PRMS and MODFLOW models will be published, possibly as a journal article

- **Replace existing model** – new MODFLOW model will replace Jones & Torak 2006 model as the “active” USGS model of the lower ACF

Groundwater Model Enhancements

- **Convert to GS-Flow model** – Add the unsaturated-zone-flow package (UZF) and the streamflow-routing package (SFR). In a GS-Flow model, groundwater modeling is dominant, PRMS used only for atmospheric recharge
- **Include deeper aquifers underlying the Upper Floridan** – pumping from the Claiborne, Clayton and the Cretaceous aquifers is about 33% of groundwater use in the lower ACF, and increasing
- **Extend model east into Ochlockonee Basin** – GW levels in parts of Worth, Tift, and Cook Counties in steady decline for 40+ years; no long-term monitor wells in Colquitt, Brooks, and Thomas Counties

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