HYDROLOGICAL MODELING OF THE SANTA FE RIVER BASIN: TWO STAR-CROSSED MODELS

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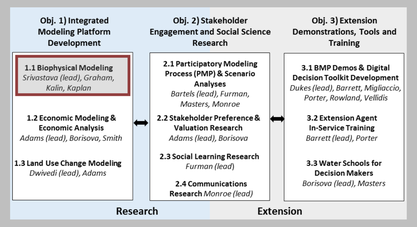
FACETS Floridan Aquifer Collaborative Engagement for Sustainability

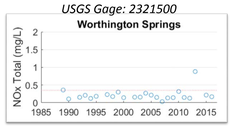


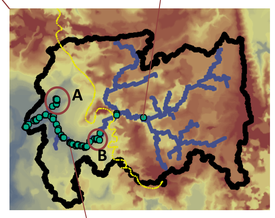
REGIONAL WATERSHED MODELING OBJECTIVES

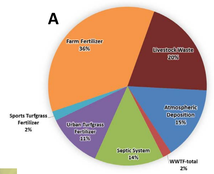
- Couple a surface and groundwater model to adequately represent the unique hydrology of the Santa Fe River basin (*Phase I*)
- To quantify how changing climate, land use and management practices impact water quality and quantity, and to assess tradeoffs among water quantity, quality, and economic sustainability (*Phase II*)

THE SANTA FE RIVER BASIN

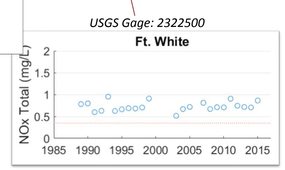
Figure 1: Location of the Santa Fe River basin and subsequent nutrient loading sources and concentrations for springs and rivers.

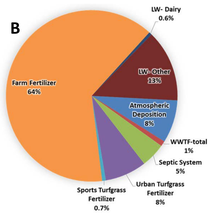


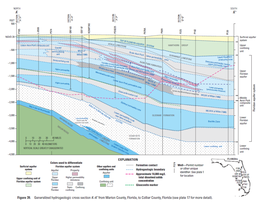




Nutrient contribution sources courtesy of Florida DEP BMAP Report. Estimates obtained via NSILT







- Surficial Aquifer
- Intermediate Aquifer System
- **Floridan Aquifer System** (FAS)
  - Springs and rivers

Figure 2: Stratigraphic framework for principal aquifers within the basin boundaries. Image courtesy FDEP - www.floridadep.gov

HYDROLOGICAL MODELING APPROACH

Couple a surface and groundwater flow model using the Soil and Water Assessment Tool (SWAT) and MODFLOW

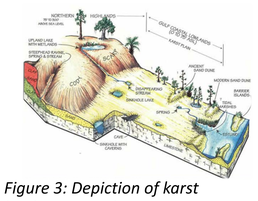


Figure 3: Depiction of karst landscapes and processes. Image courtesy www.waltonoutdoors.com

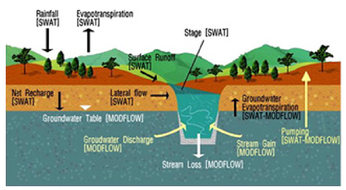


Figure 4: SWAT-MODFLOW hydrological tasks. Image courtesy of www.floridanwater.org

SURFACE WATER MODELING: SOIL AND WATER ASSESSMENT TOOL (SWAT)

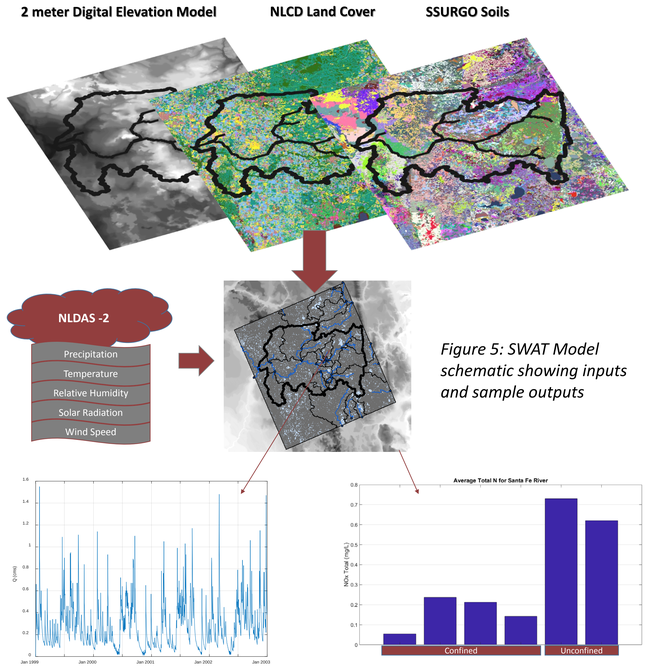


Figure 5: SWAT Model schematic showing inputs and sample outputs

Soil & Water Assessment Tool SWAT

USDA United States Department of Agriculture National Institute of Food and Agriculture

The SWAT model enables us to

- Assess different weather/climate scenarios
- Evaluate alternative land use/water management practices
- Simulate surface water quality
- Quantify nutrient leaching to the aquifer
- Estimate changes in stream discharge over time

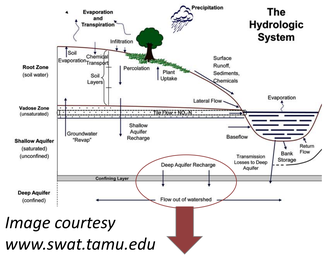


Image courtesy www.swat.tamu.edu

GROUNDWATER MODELING: MODFLOW

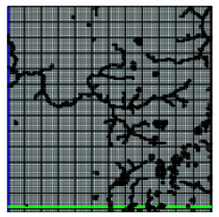


Figure 6: MODFLOW Grid showing river cells and discretization

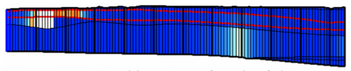


Figure 7: Vertical layering of each of the 7 stratigraphic units

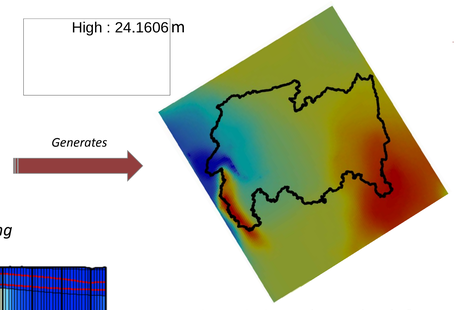


Figure 8: Groundwater levels from Floridan Aquifer System (layer 3)

The MODFLOW-RT3D model enables us to:

- Capture the heterogeneity of the geologic system
  - 7 layers
  - Highly variable permeability
- Simulate water and nitrate exchange between river and aquifer
- Predict groundwater levels and nitrate concentrations through time in different layers

North Florida SouthEast Georgia (NFSEG) Groundwater Flow Model

Figure 9: Boundaries of the NFSEG (dark outline) and the location of our clipped model

- Developed by the St. Johns Water Management District (SJWMD) and Suwannee River Water Management District (SRWMD)
- Simulates regional groundwater flow for the extent of the FAS in order to assess the impacts of water resource management decisions (Pumping, MFL's)

Clipping the NFSEG model

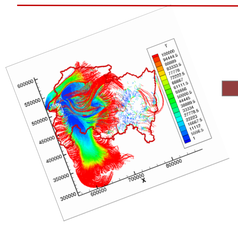


Figure 10: Particle tracking to establish groundwater flow boundaries into the Santa Fe River basin

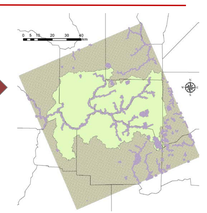


Figure 11: Results of the groundwater flow boundaries which out SWAT model domain was clipped to match as well

PRELIMINARY RESULTS: COUPLING

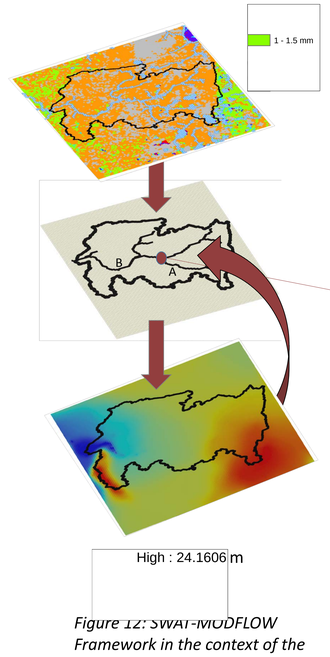


Figure 12: SWAT-MODFLOW Framework in the context of the Santa Fe River Basin

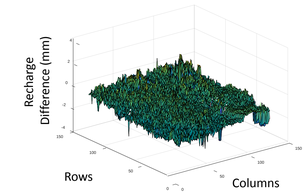


Figure 13: Difference between average recharge for the year (2009) simulated in SWAT-MODFLOW and NFSEG

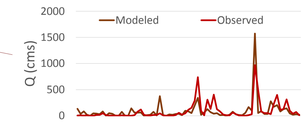


Figure 14: Observed and simulated (monthly) discharge at 02320700 gaging station.

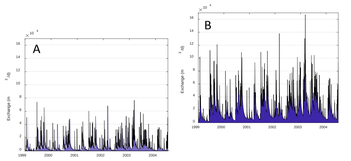


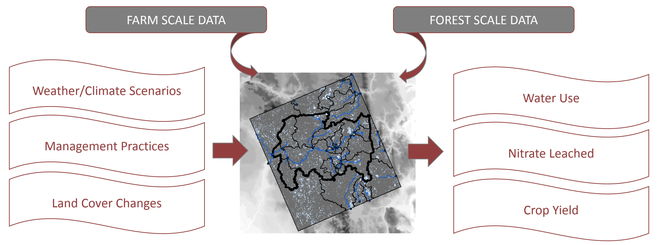
Figure 15: Surface and groundwater exchange for select sites on the confined (A) and unconfined (B)

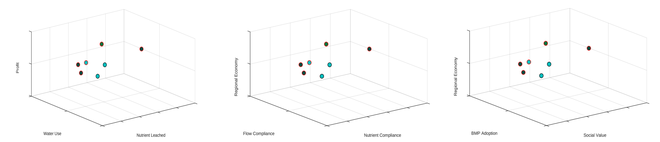
FUTURE WORK

PHASE I

- Model has been coupled and data generated
- Continue calibration and validation of coupled model

PHASE II





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USDA United States Department of Agriculture National Institute of Food and Agriculture

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Colorado State University