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Floridan Aquifer Collaborative Engagement for Sustainability

GA Regional Biophysical Modeling
Simple Scenarios

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GA Regional Modeling Team
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Results represent work in progress and are not yet peer reviewed. They are based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2017-68007-26319. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

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

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UF Water Institute UNIVERSITY of FLORIDA

Recall: management practices

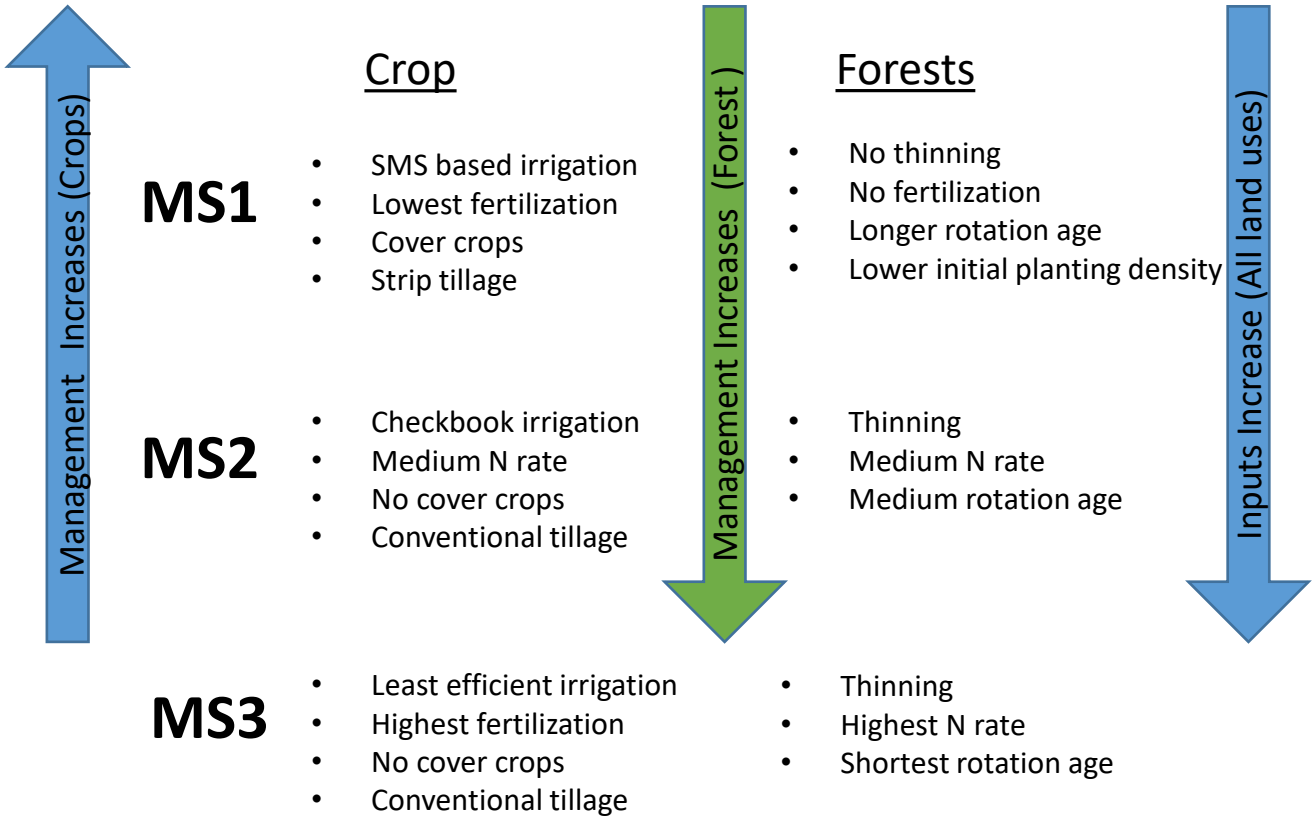
Current Production Systems

CROPS
- Cotton-cotton-peanut
- Corn-cotton-peanut

FORESTS
- Longleaf
- Loblolly
- Slash pine

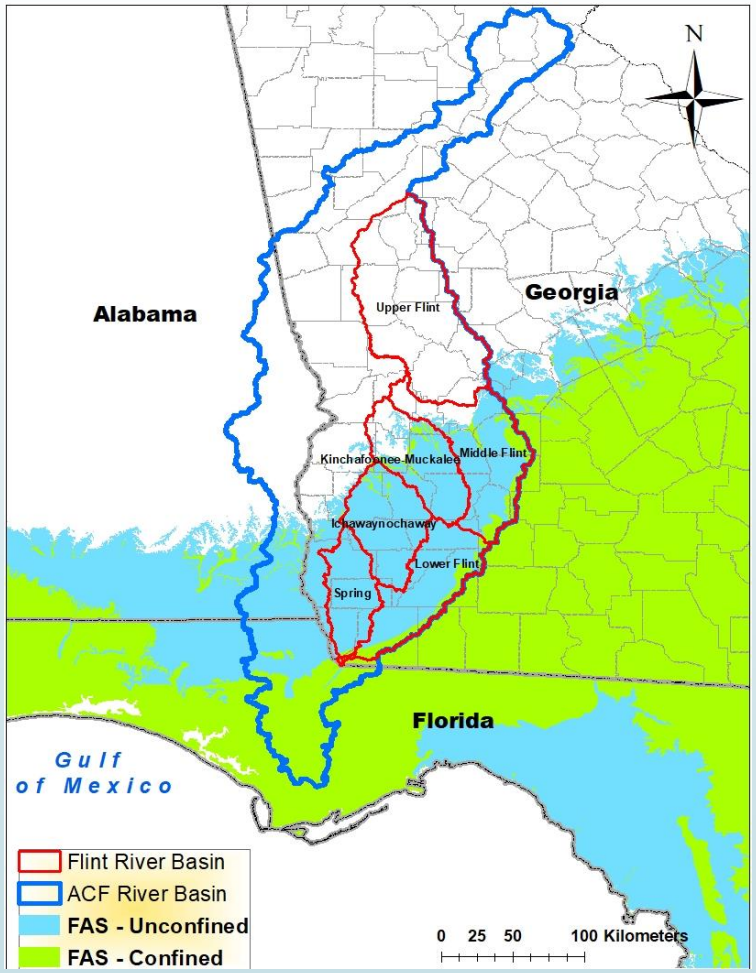
GEORGIA

Management System Summaries

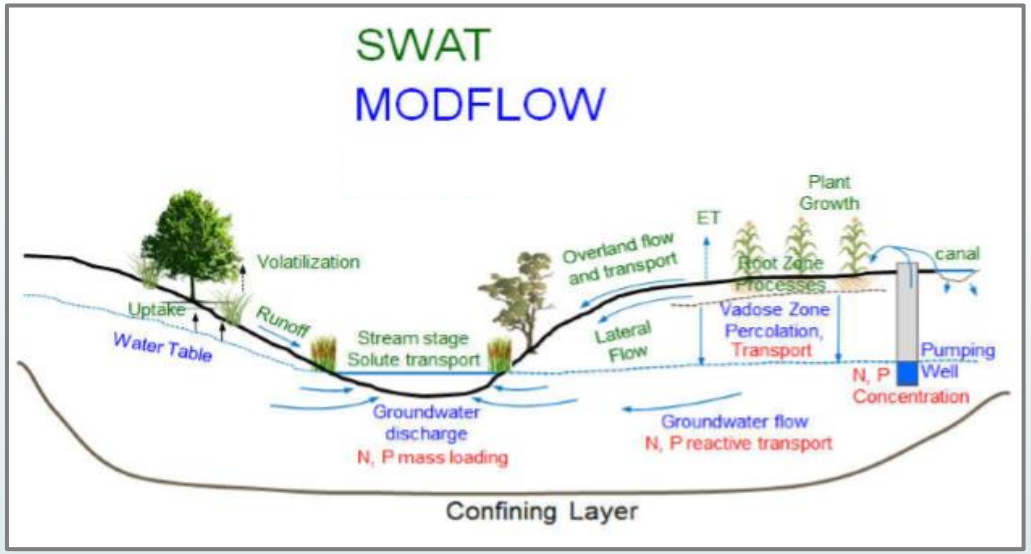


Georgia – Regional Scale Modeling

Region of interest



Regional Biophysical Modeling Framework



Soil and Water Assessment Tool (SWAT)

Simulates hydrology and water quality

- Land surface
- Soil
- Surface water

MODFLOW

- Groundwater hydrology
- Interaction between ground and surface water

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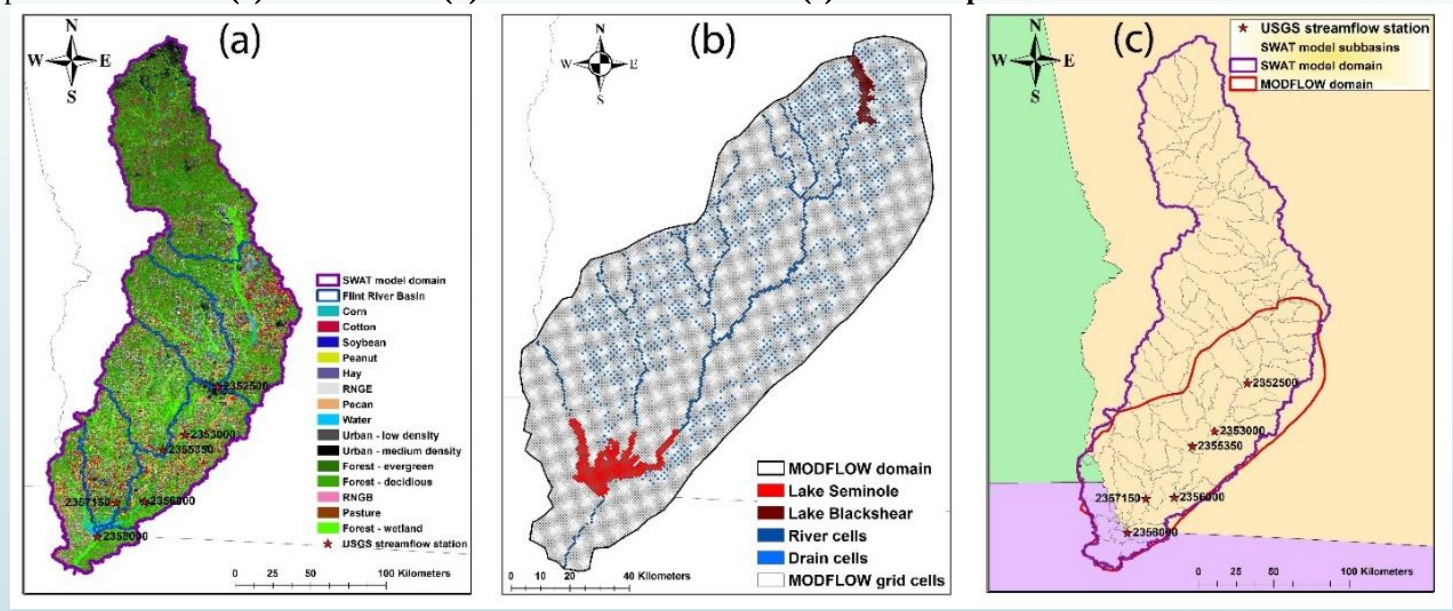
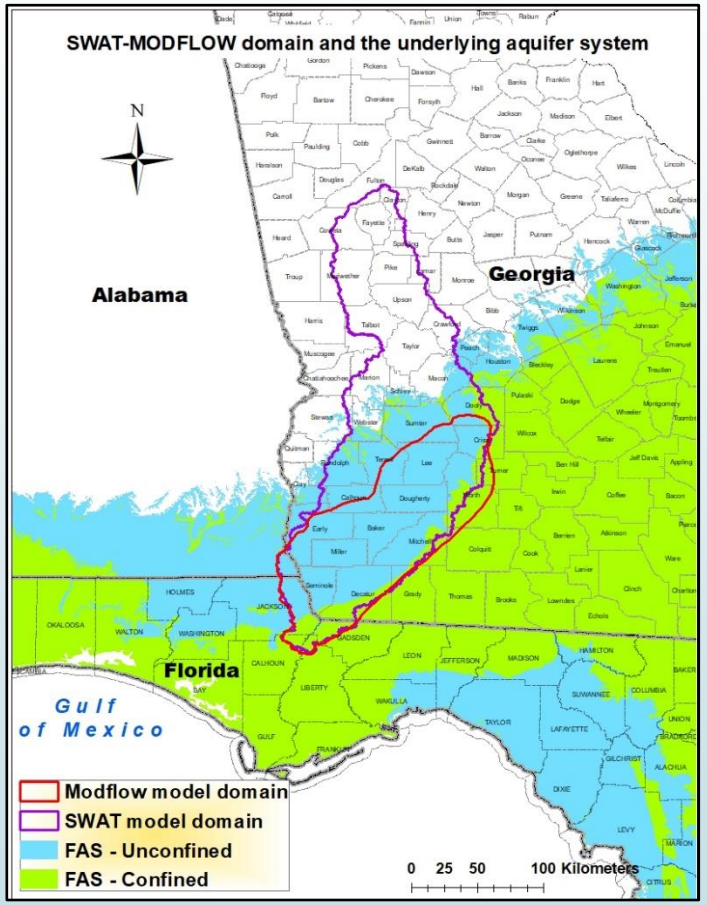
Regional Modeling Domain

SWAT-MODFLOW model that simulates the surface- and groundwater processes of the lower Flint River Basin.

Spatial extent of the **(a) SWAT model (b) the MODFLOW domain (c) the overlap of the SWAT and MODFLOW domain**





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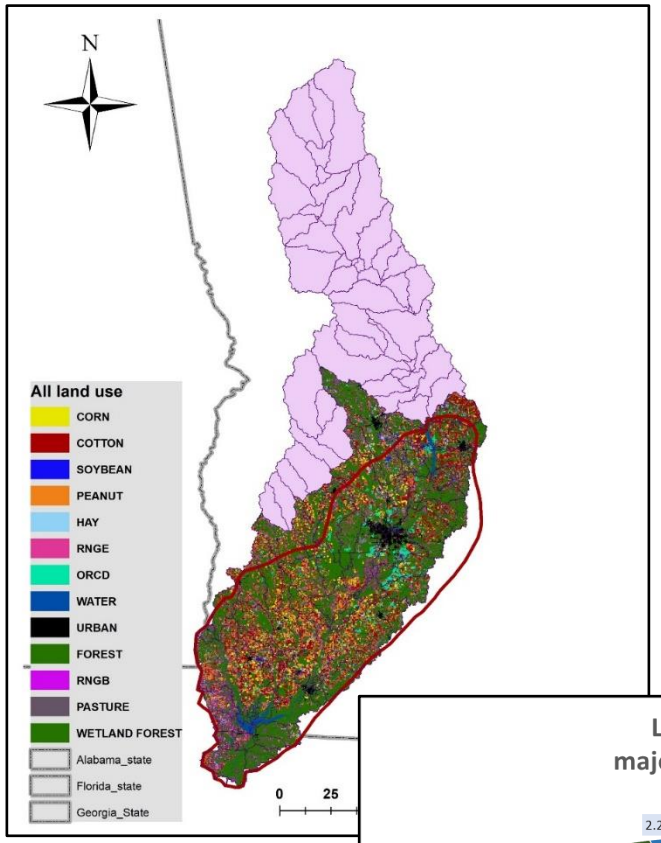
Simple scenarios: Development and Evaluation

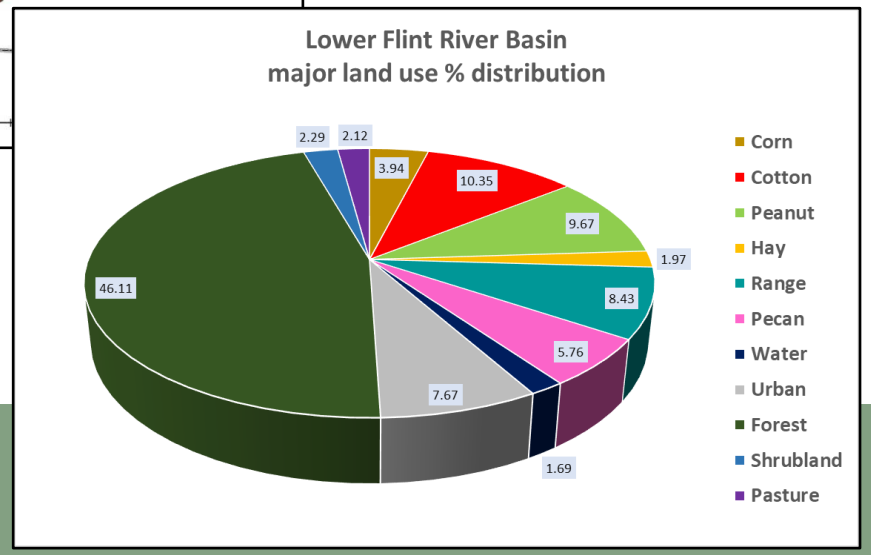
Land use in the region



Simple scenarios

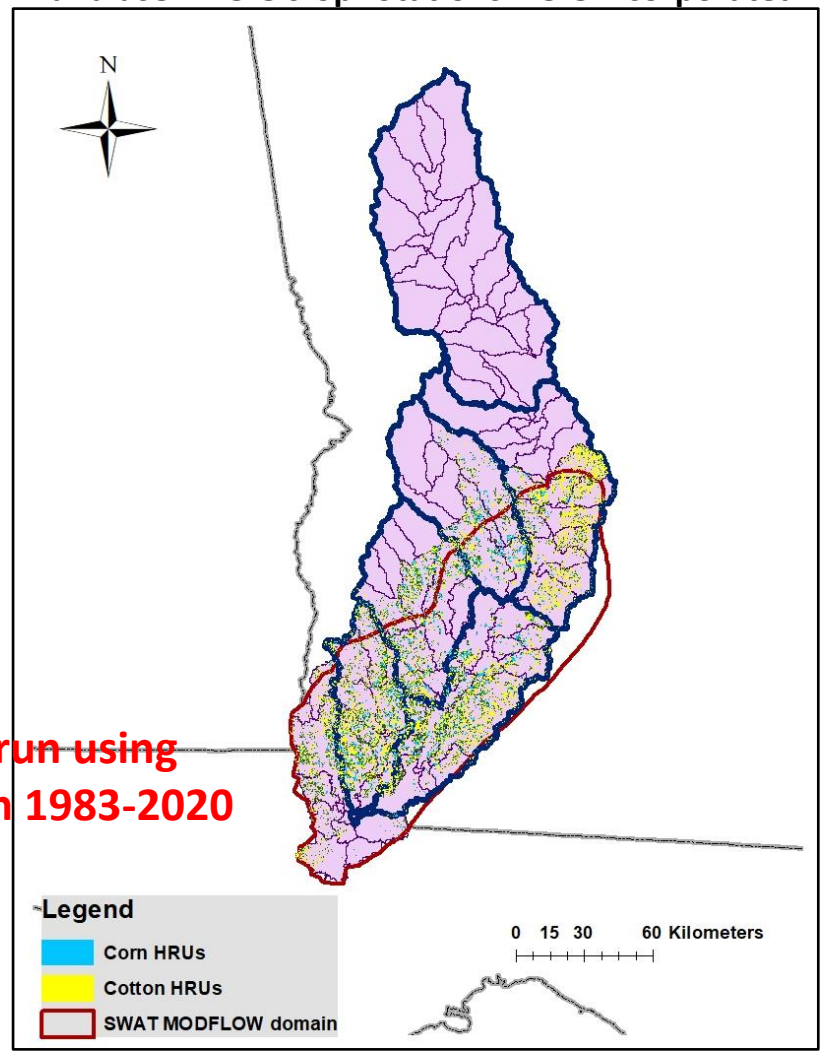
Scenario	Land use	Management Systems
All Ag MS1 **Row crops:** corn-cotton-peanut cotton-cotton-peanut **Forest:** Loblolly	2011 Land use	All row crops use MS1, Forests MS1
All Ag MS2 **Row crops:** corn-cotton-peanut cotton-cotton-peanut **Forest:** Loblolly	2011 Land use	All row crops use MS2, Forests MS1
All Ag MS3 **Row crops:** corn-cotton-peanut cotton-cotton-peanut **Forest:** Loblolly	2011 Land use	All row crops use MS3, Forests MS1

Note: Hay and pasture is not simulated in GA



Each scenario was run using historical climate from 1983-2020

Land use where crop rotations were incorporated



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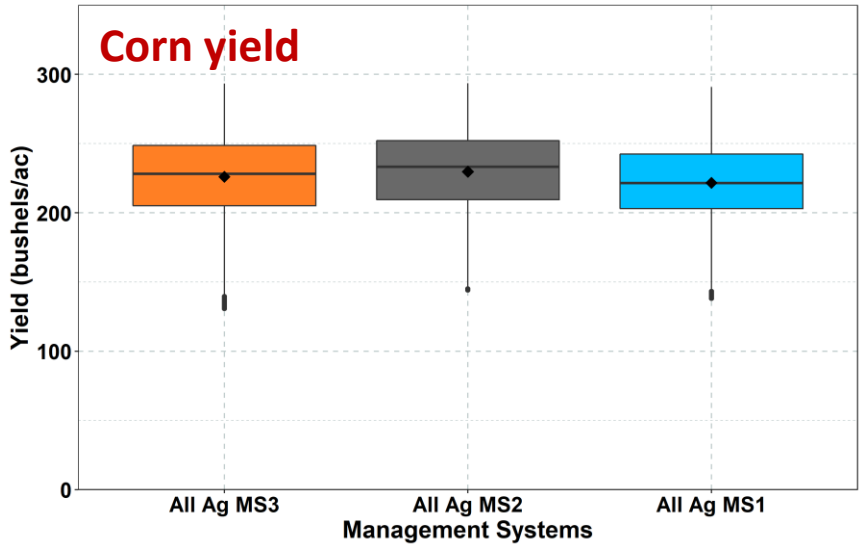
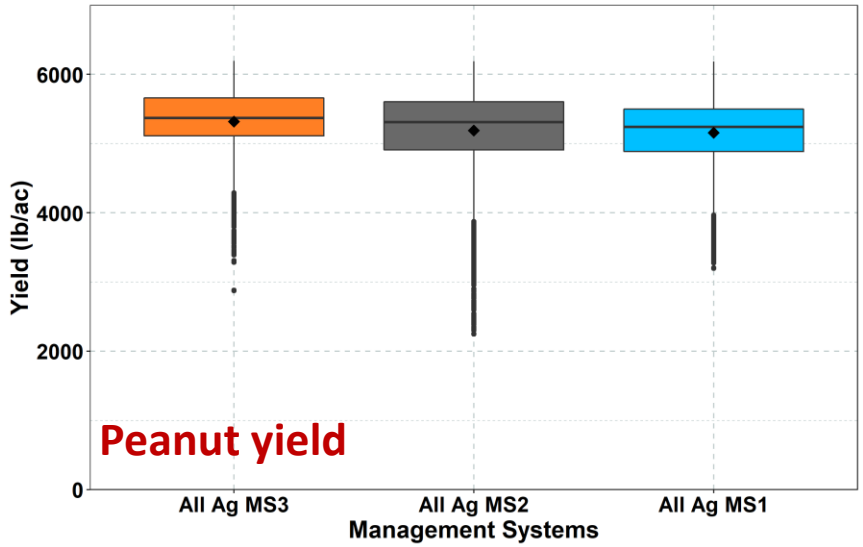
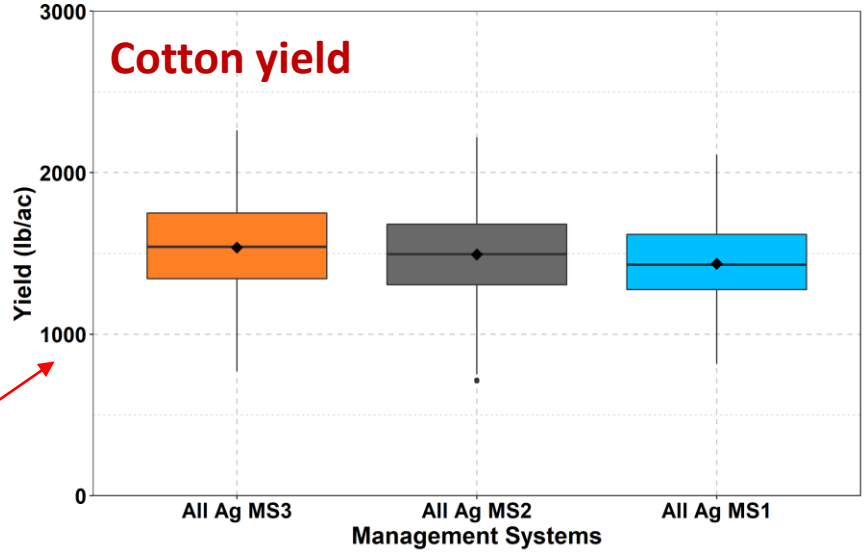
Findings – Crop Yields





Small but statistically significant differences



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Findings: Aquifer pumping

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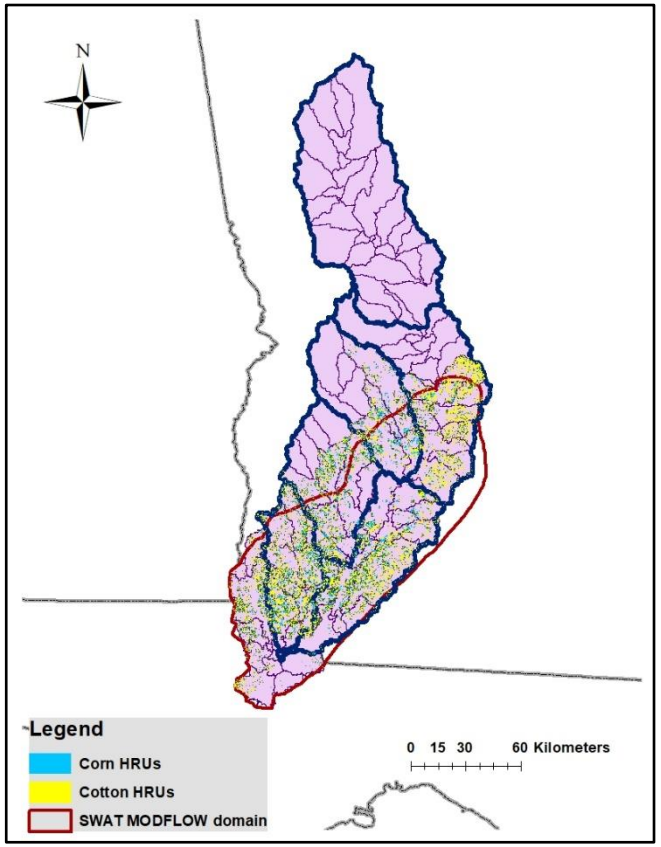
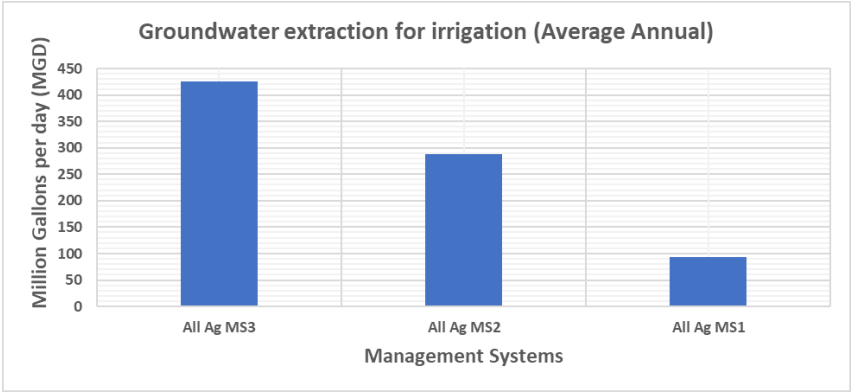
Irrigated HRUs in the model

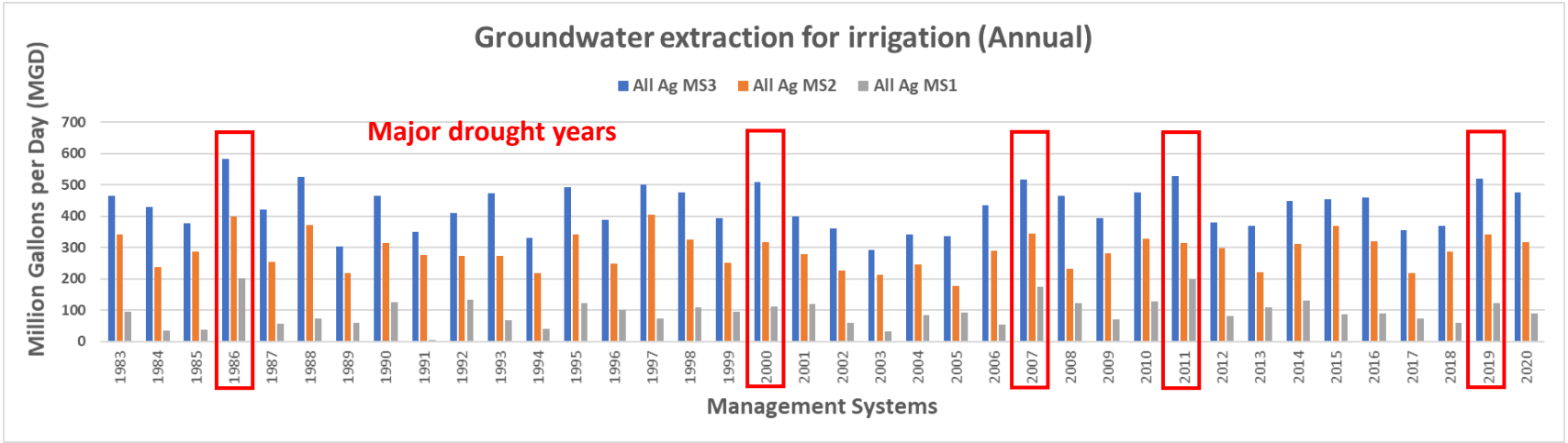


Average annual pumping for irrigation from 1983 - 2020



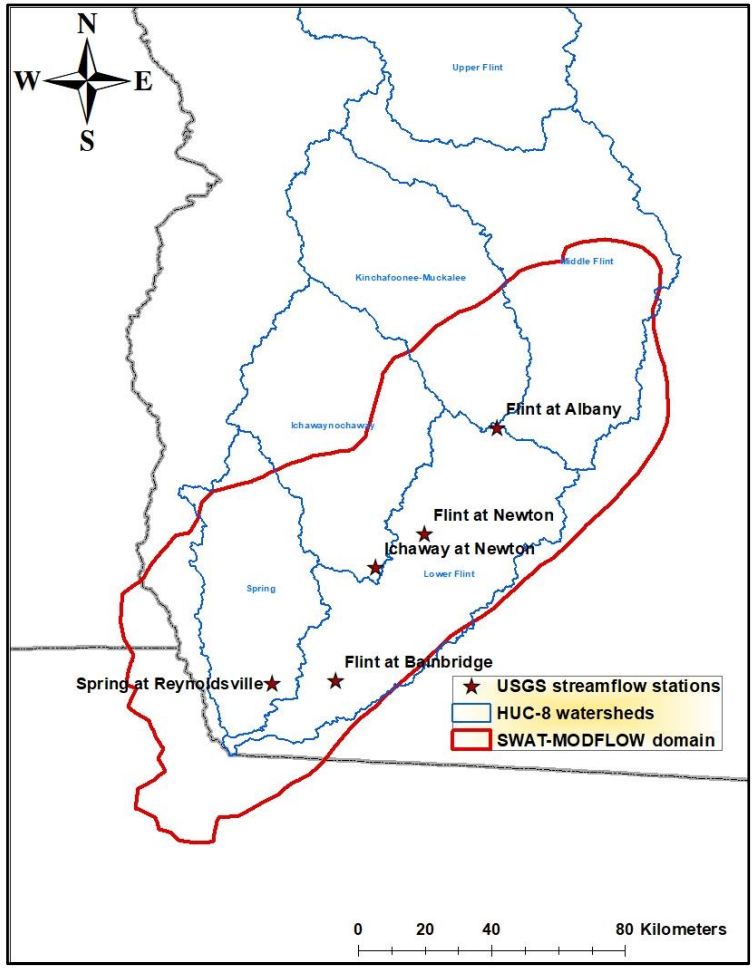
Groundwater pumpage ranged from close to 100 MGD in MS1 to more than 400 MGD in MS3

Pumpage was over 500 MGD in major drought years in MS3

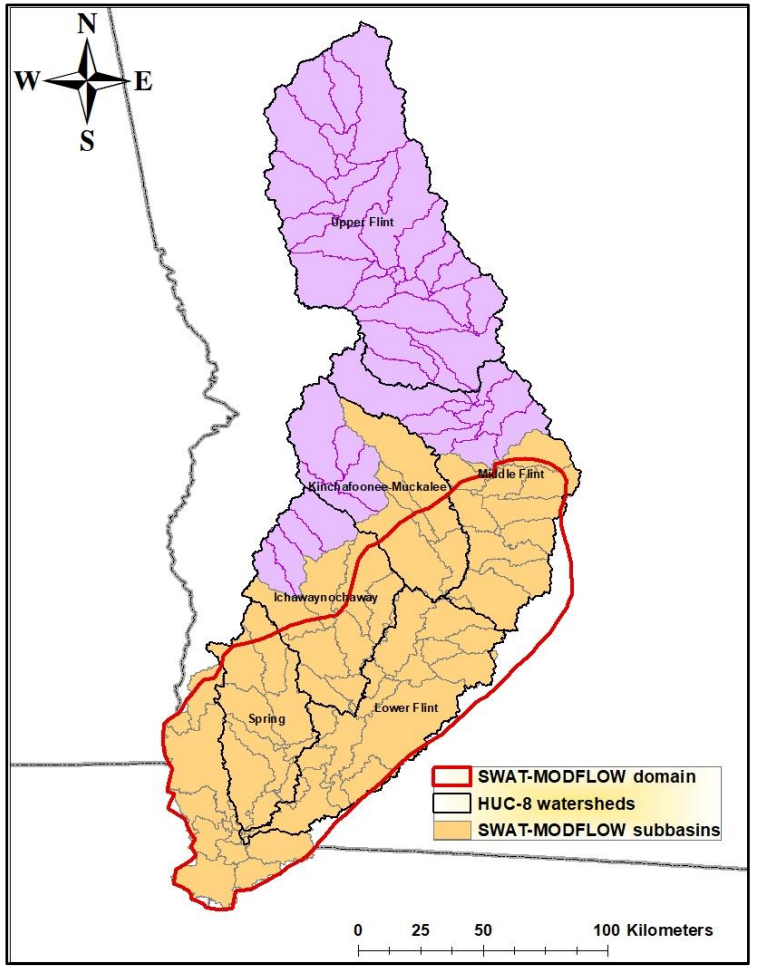


Approach: Evaluation – Water Quantity

Flow evaluation at important USGS stations



Spatial evaluation



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Understanding - Water Budget

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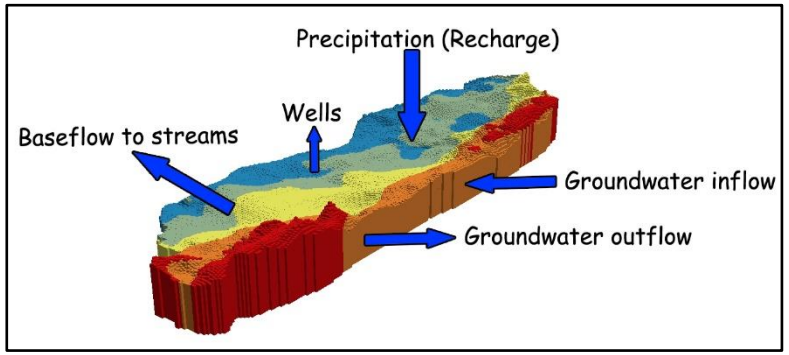
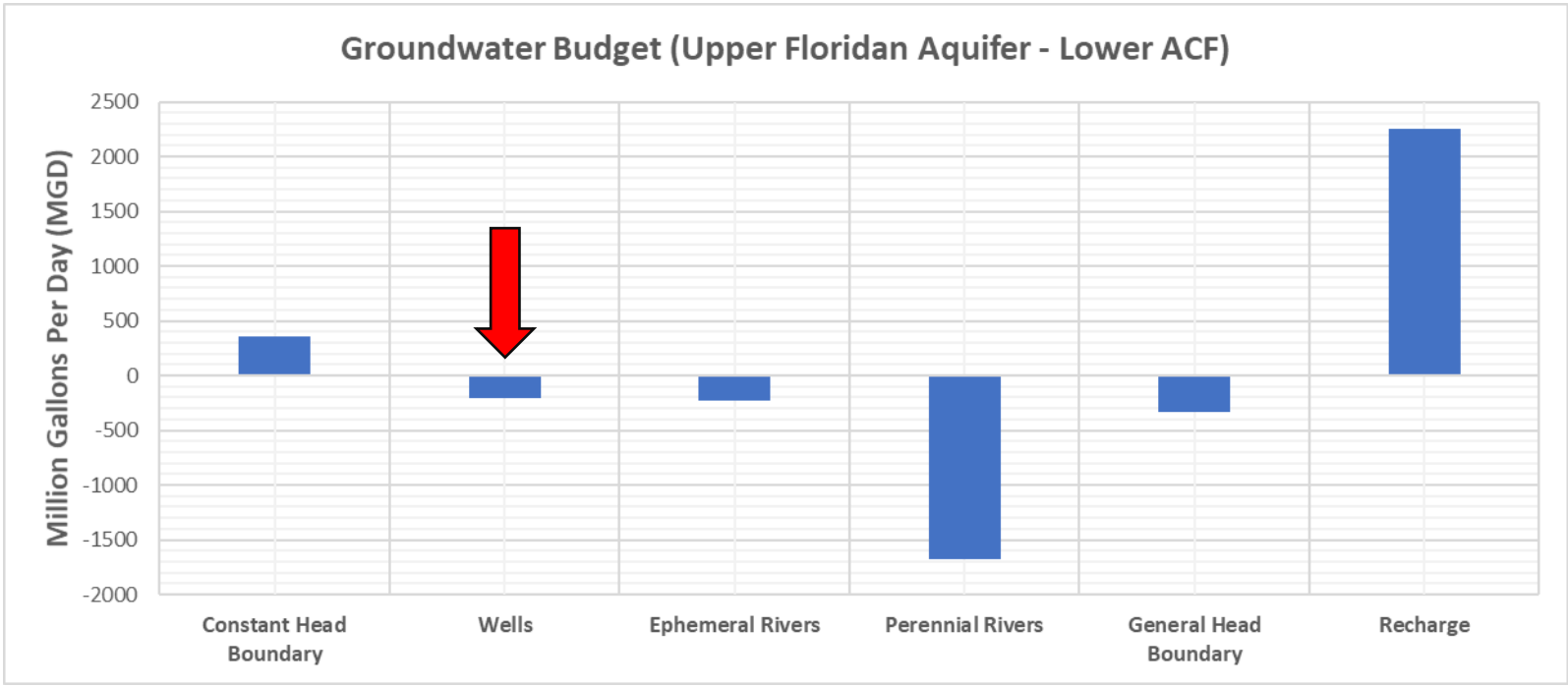
Groundwater budget of the aquifer system

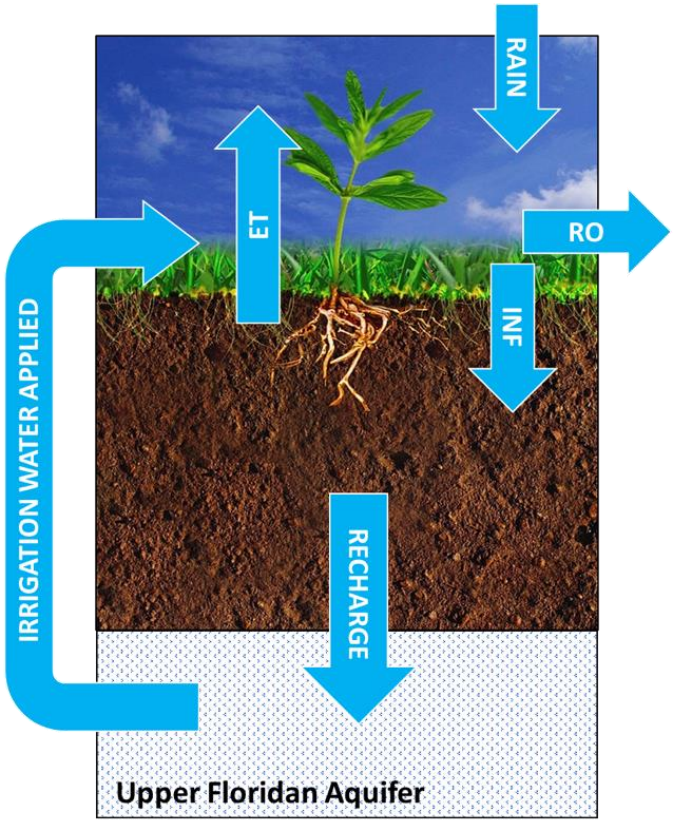


Important note: Groundwater pumpage is a small component of the overall water budget



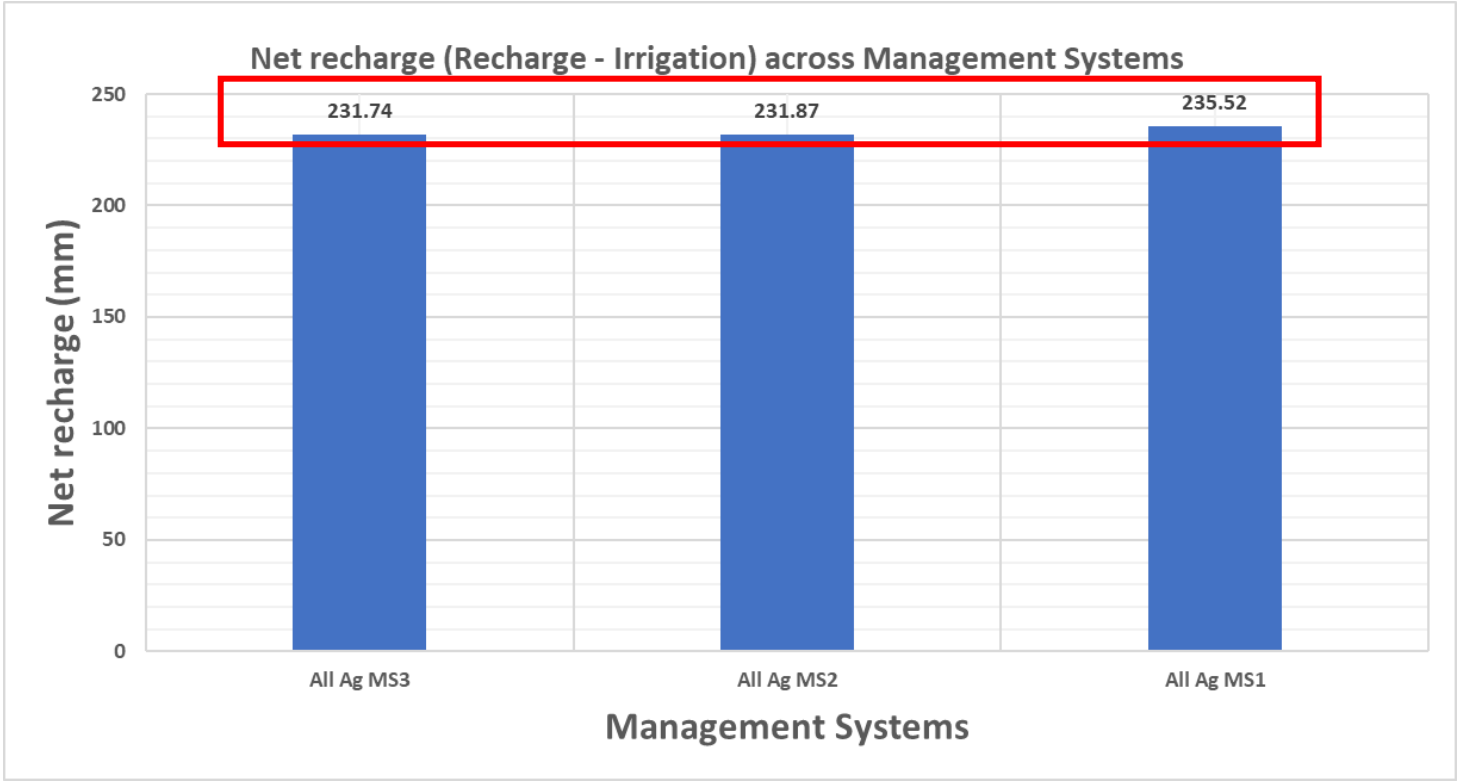
Findings: Net recharge

Net recharge = Recharge - Irrigation



Annual average net recharge was slightly higher for MS1

All Ag MS1 has lower irrigation but same precipitation as the other two scenarios



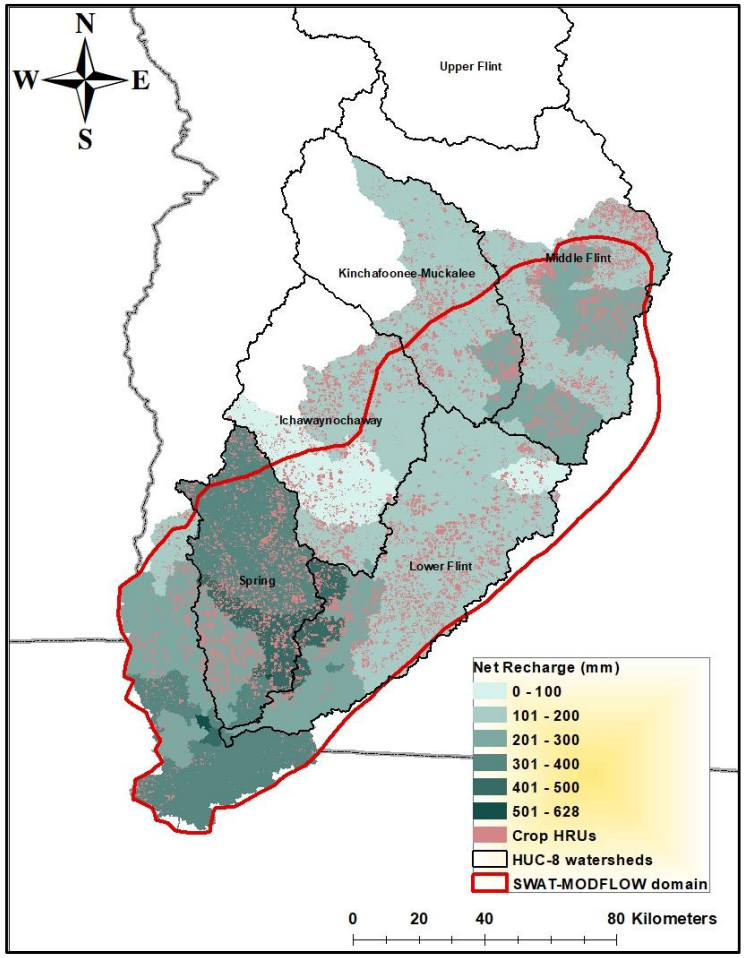
Findings: Net recharge
(Spatial evaluation)

These FACETS results represent work in progress and are not suitable for public distribution.

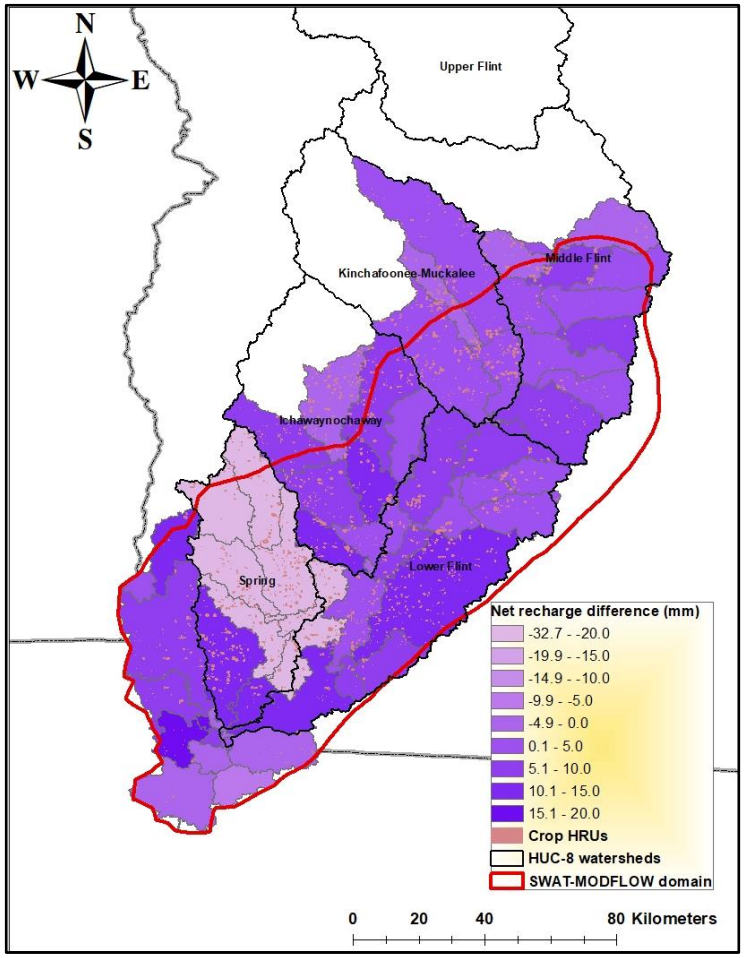
Spring watershed seems to have a different trend than other watersheds in the study region

The difference, however, is close to or less than an inch across the three Management Systems

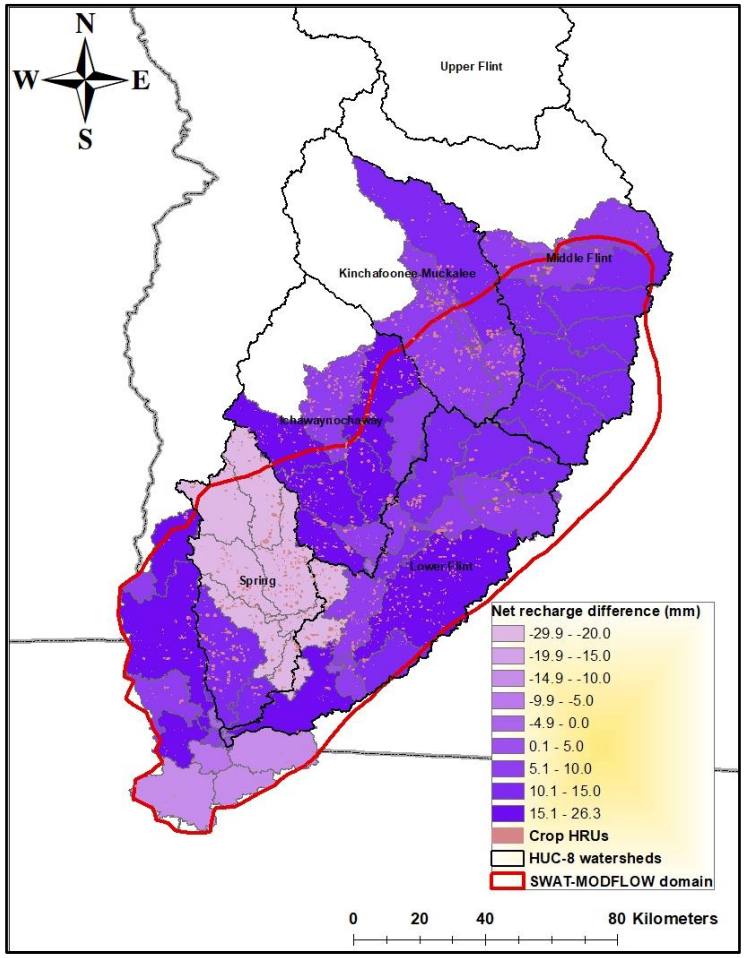
Net recharge (All Ag MS3)



Difference in net recharge (MS2 – MS3)



Difference in net recharge (MS1 – MS3)



Findings: GW levels

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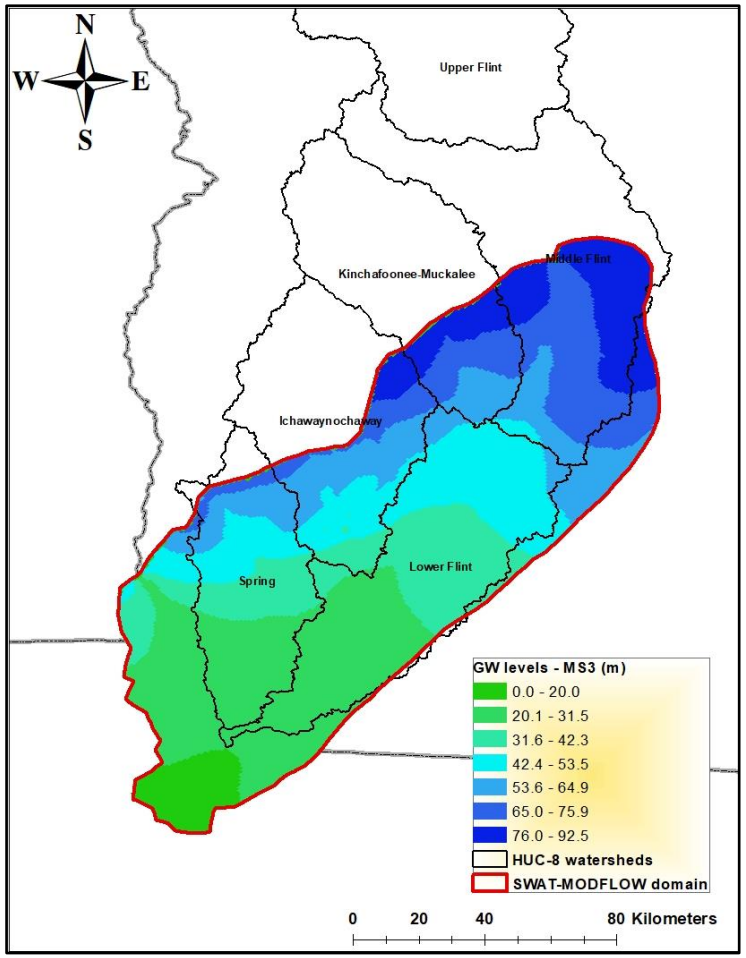
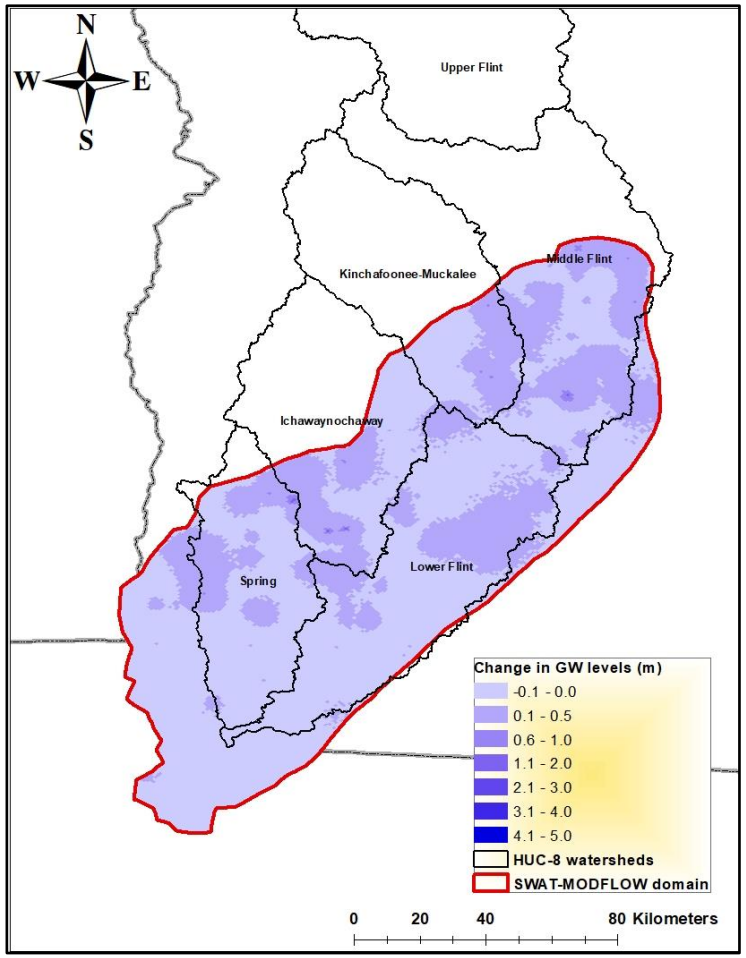
Average annual GW levels were slightly lower for MS2 and MS3 when compared to MS1 GW levels

Certain areas in Spring, Ichawaynochaway, and Middle Flint were identified as sensitive to groundwater pumpage for irrigation

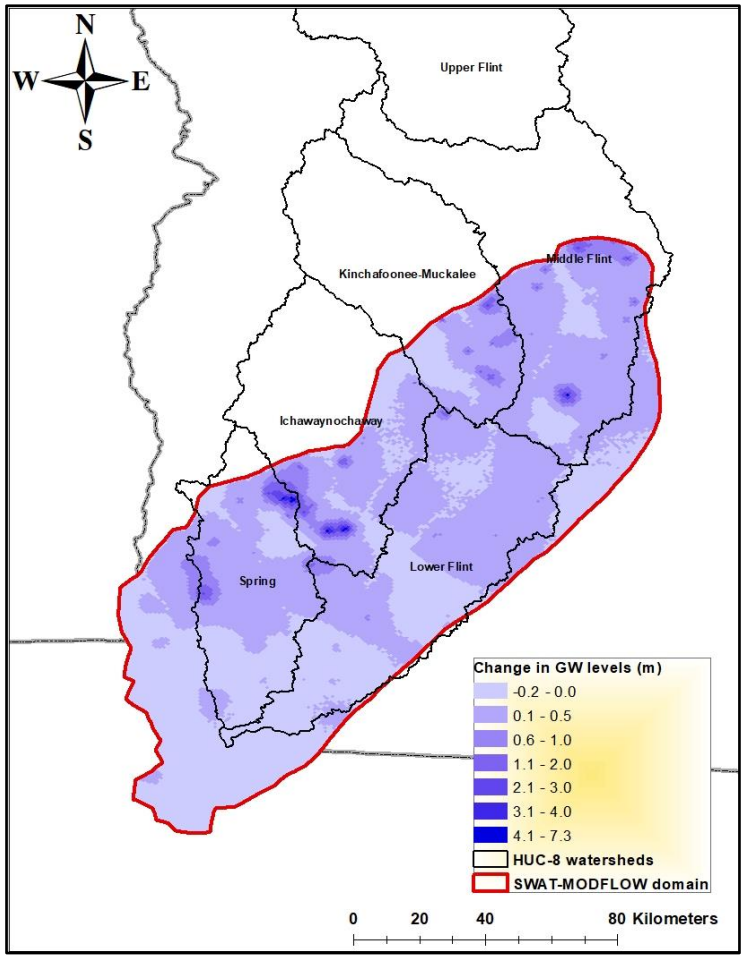
GW levels (All Ag MS3)



Difference in GW levels (MS2 – MS3)



Difference in GW levels (MS1– MS3)



Findings: Streamflow

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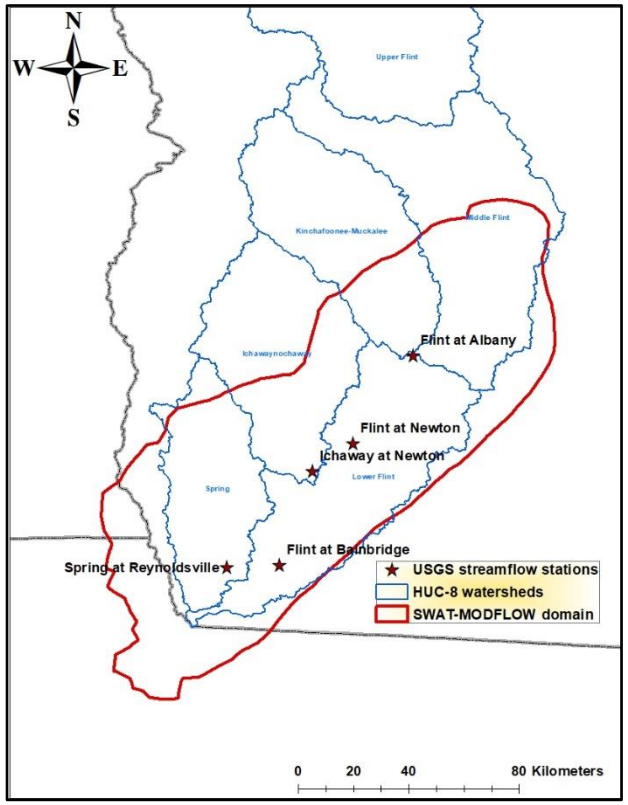
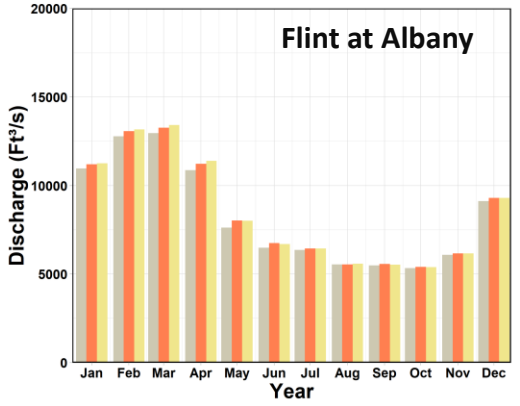
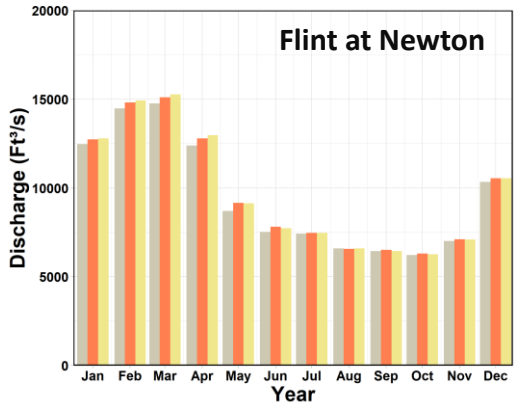
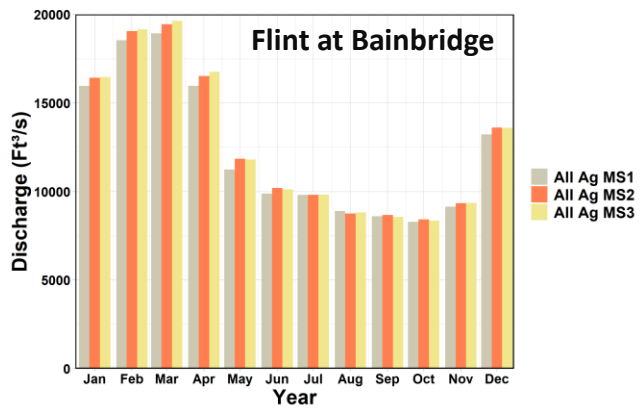
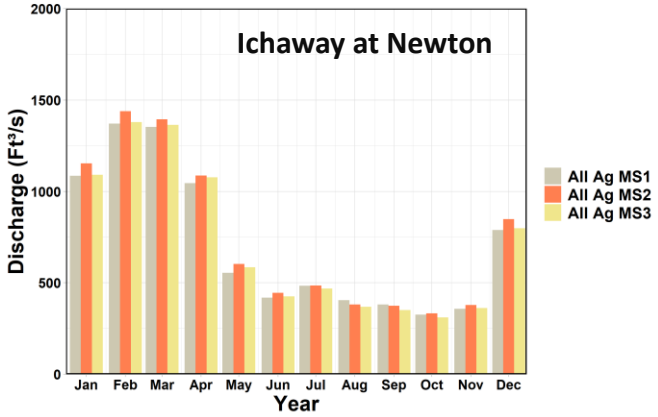
Average monthly streamflow

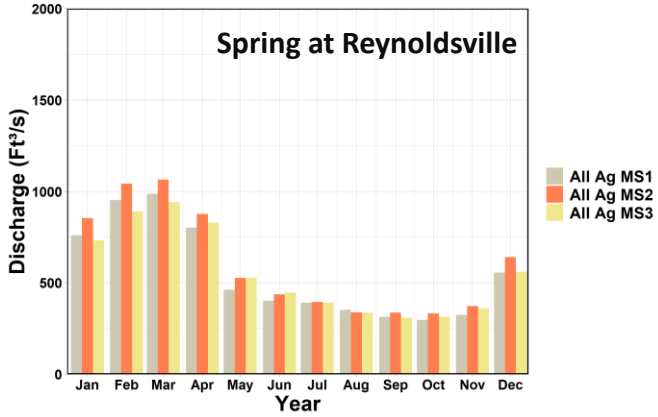








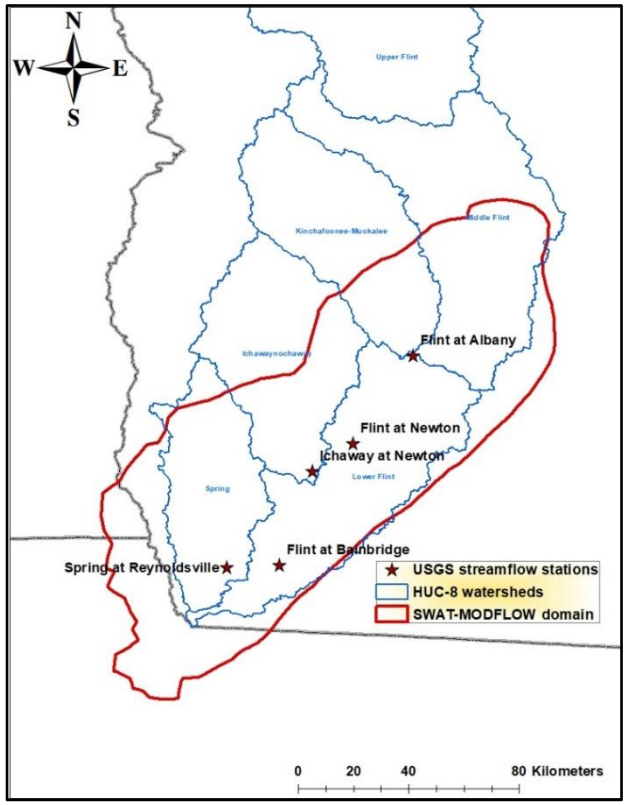


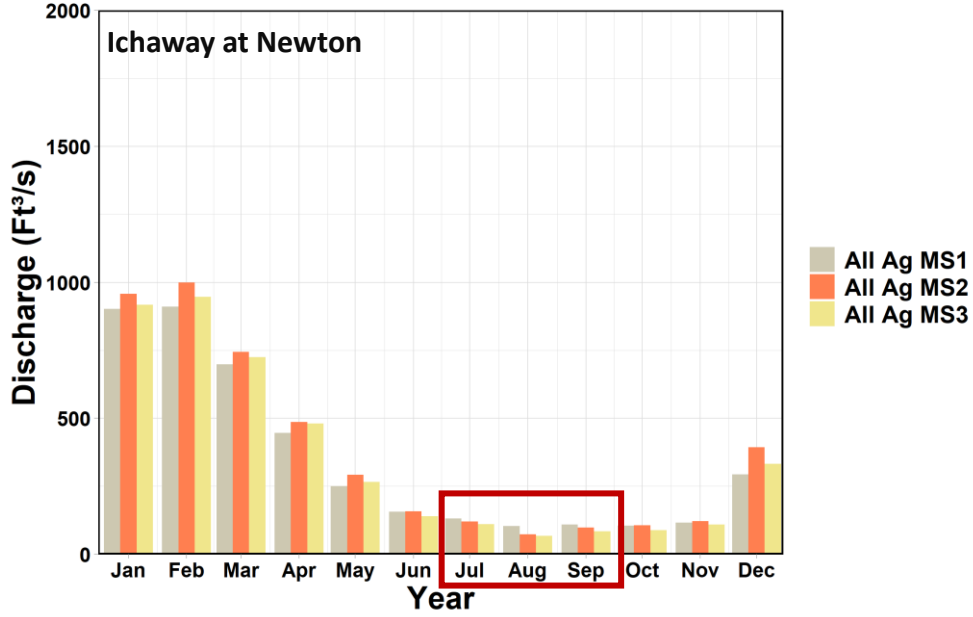


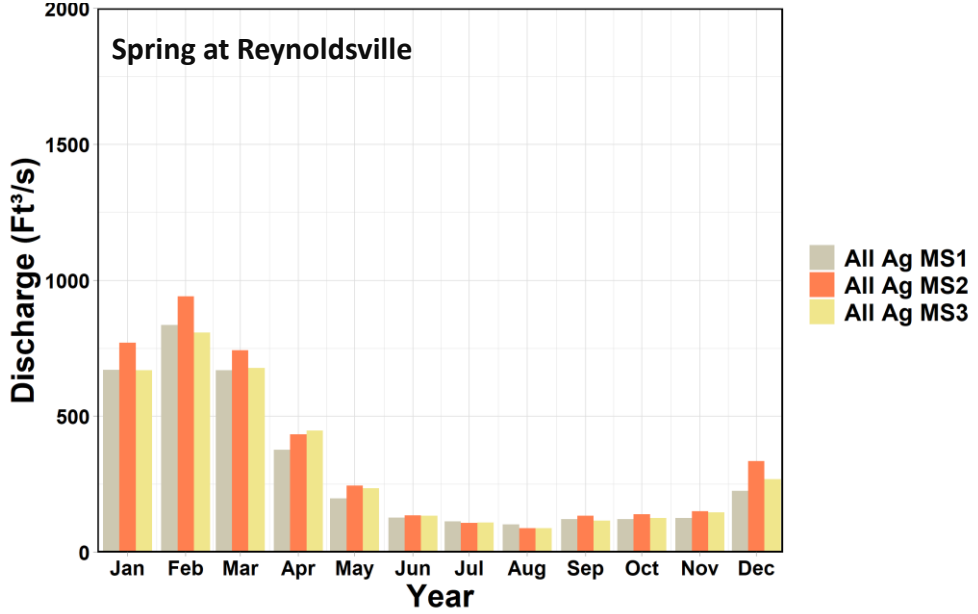
Evaluation of monthly averaged flows (over the whole simulation period) showed similar flows between the three scenarios.

Findings: Streamflow

Evaluating change in flow across Management Systems for drought years







MS1 had higher average monthly streamflow during the drought years – especially at Ichaway at Newton.

Findings: Streamflow

Evaluating differences in drought years

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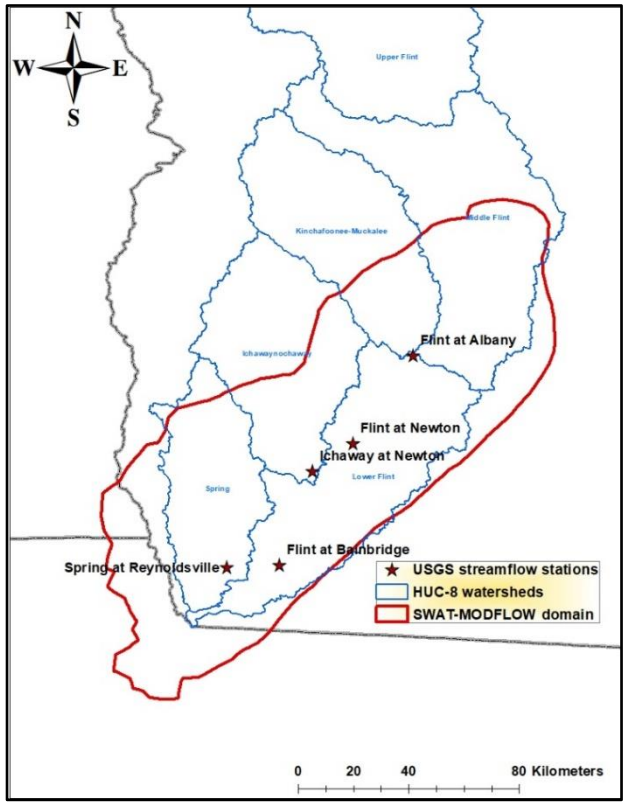
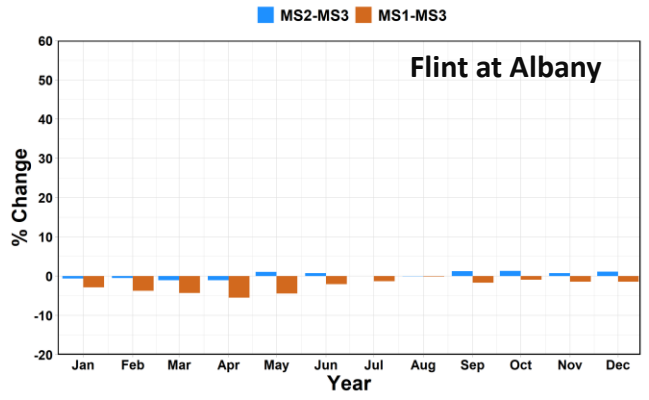
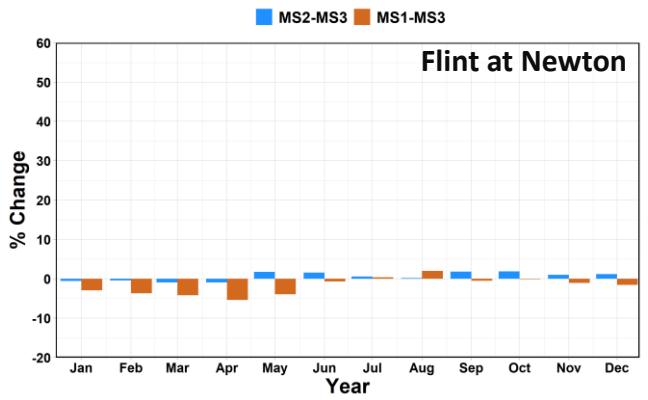
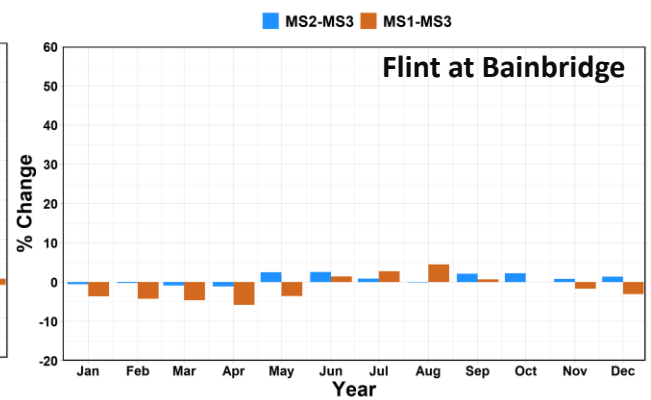
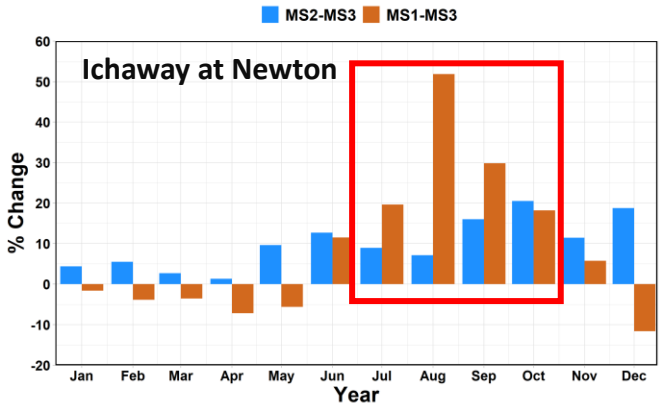
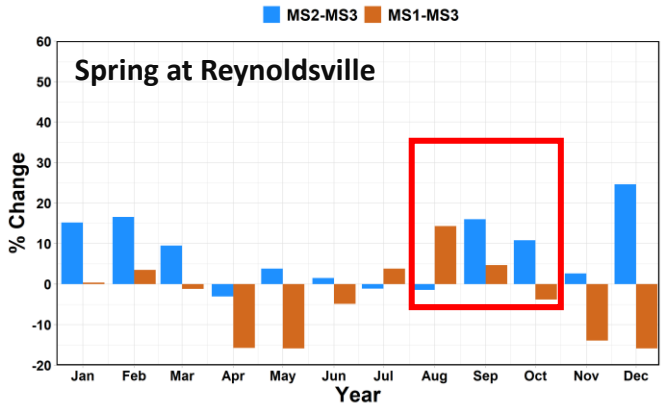










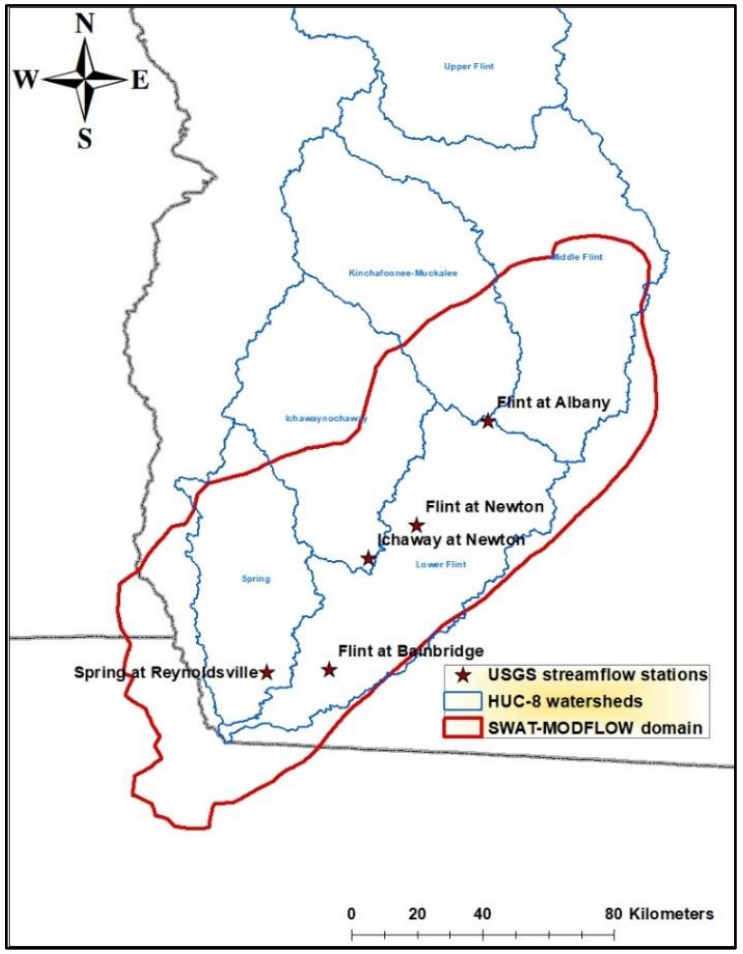


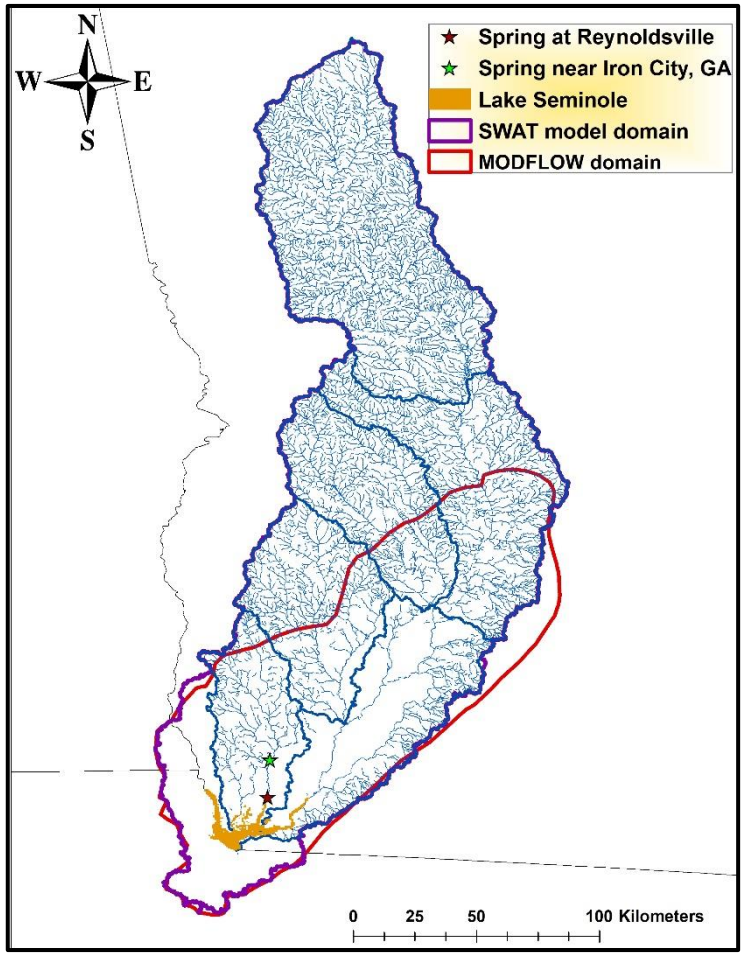
Evaluation of change in streamflow showed **minimal change along the Flint River** (less than 5%).

Increase in streamflow, especially at the end of the growing season, in the tributary streams was predicted when changed from MS3 to MS2 and MS1.

Improvement to model development based on feedback

Spring at Reynoldsville station – Lake Seminole impact





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Economic Modeling Framework -IMPLAN

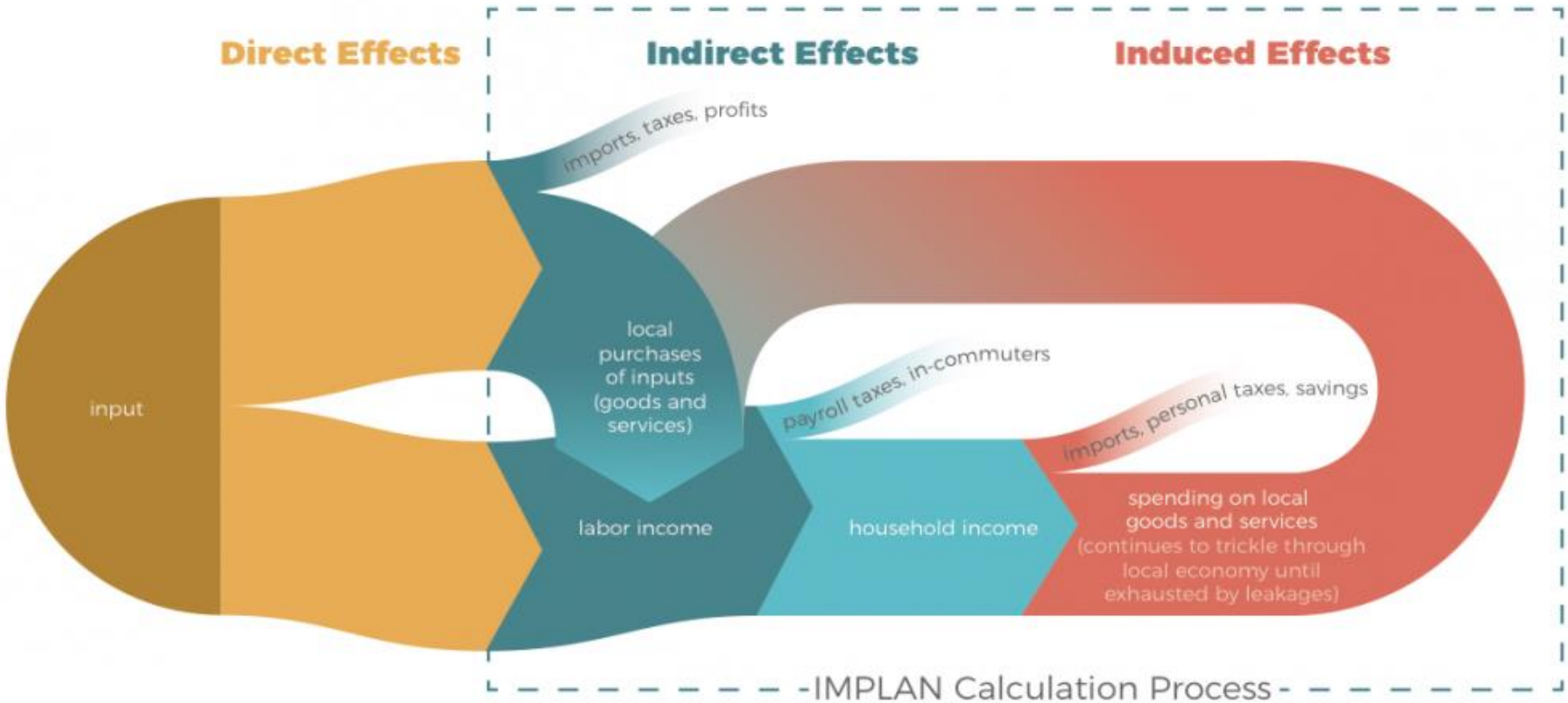
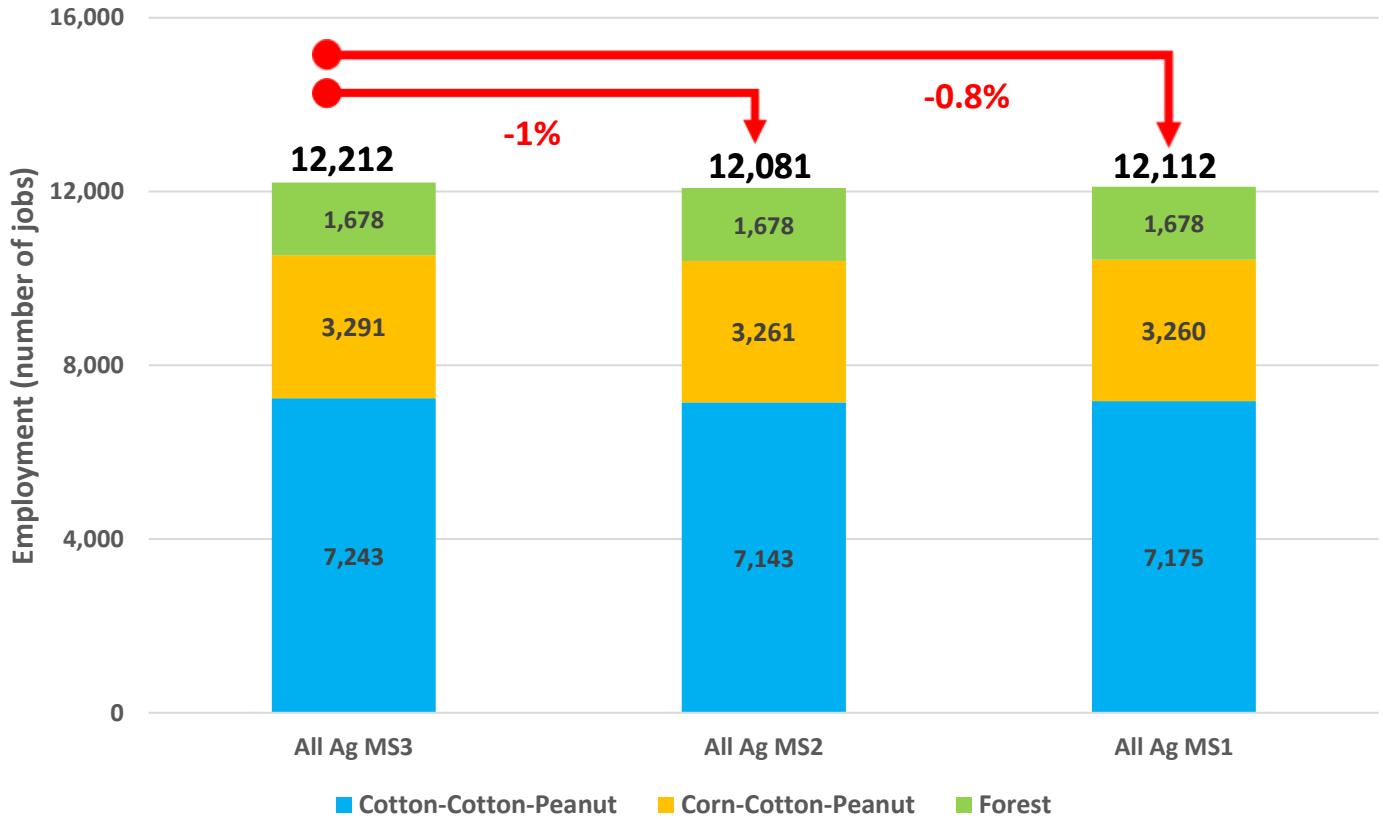


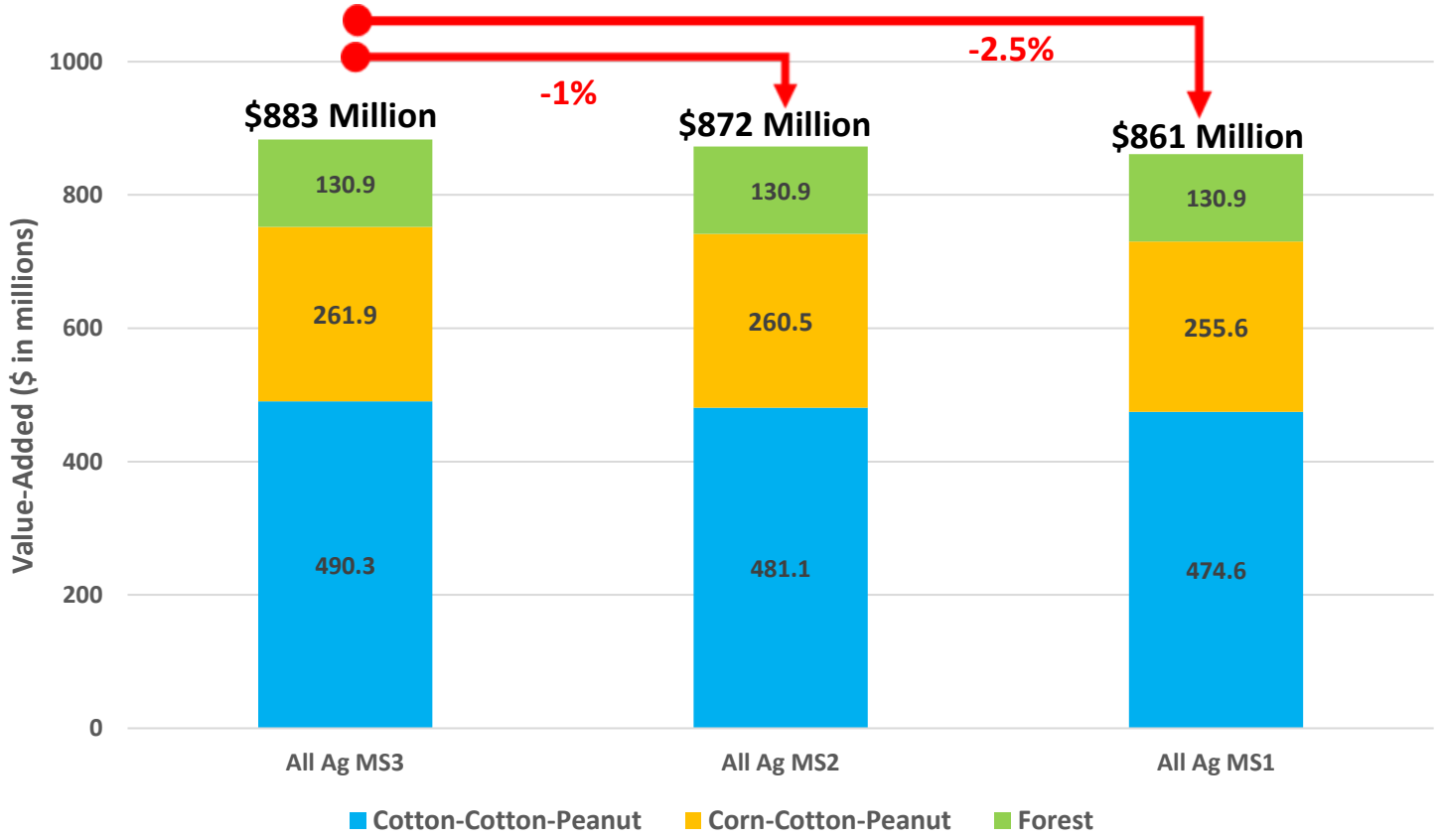
Figure: Flowchart showing direct, indirect and induced impacts estimated by IMPLAN within a regional economy

Georgia Simple Scenarios: Regional Economy (Employment)



- Cotton-Cotton-Peanut rotation showed higher negative impact for change from MS3 to MS2 compared to MS3 to MS1.
- Forest-based contribution estimated only for loblolly pine MS1.

Georgia Simple Scenarios: Regional Economy (Value-Added)



- Negative impact on value added as production changes from MS3 to MS2 and MS1.
- Forest-based contribution estimated only for loblolly pine MS1.
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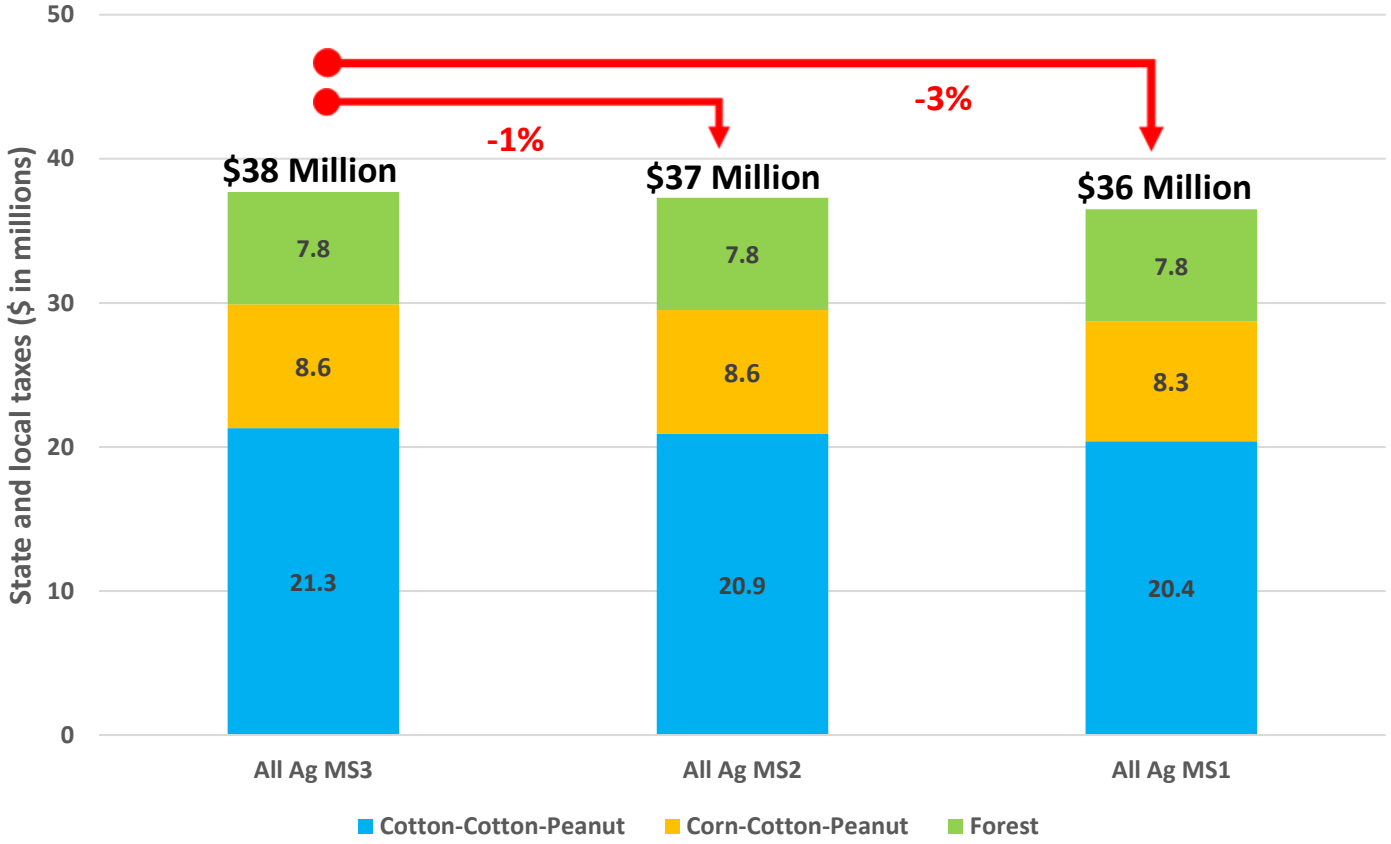
Georgia Simple Scenarios: Regional Economy (State and local taxes)

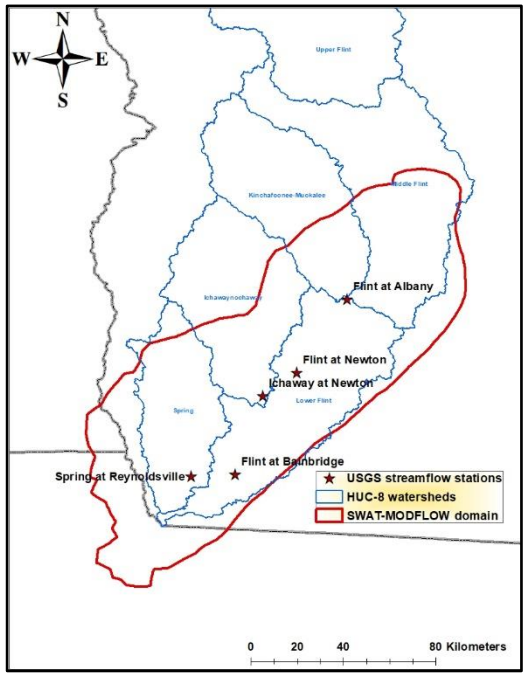


- Negative impact on state and local taxes generation as production changes from MS3 to MS2 and MS1.
- Forest-based contribution estimated only for loblolly pine MS.

Summary

These FACETS results represent work in progress and are not suitable for public distribution.

- **Aquifer Pumping**
  - All Ag MS3 had the highest groundwater pumping for irrigation use.
- **Evaluation of net recharge**
  - showed that there was minimal differences – especially when evaluated for the whole basin.
- **Evaluation of GW levels**
  - showed there was minimal difference between MS3 and MS2.
  - Comparison between MS3 and MS1 identified critical areas for groundwater level reduction.
- **Evaluation of streamflow**
  - showed minimal impact on the Flint River.
  - Impact on streamflow were significant during drought years in the two tributary streams.
- **Economics**
  - Cotton-Cotton-Peanut rotation showed higher negative impact for change from MS3 to MS2 compared to MS3 to MS1.
  - Negative impact on state and local taxes generation as production changes from MS3 to MS2 and MS1.



Simple scenarios

Scenario	Land use	Management Systems
All Ag MS1 **Row crops:** corn-cotton-peanut cotton-cotton-peanut **Forest:** Loblolly	2011 Land use	All row crops use MS1, Forests MS1
All Ag MS2 **Row crops:** corn-cotton-peanut cotton-cotton-peanut **Forest:** Loblolly	2011 Land use	All row crops use MS2, Forests MS1
All Ag MS3 **Row crops:** corn-cotton-peanut cotton-cotton-peanut **Forest:** Loblolly	2011 Land use	All row crops use MS3, Forests MS1

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