

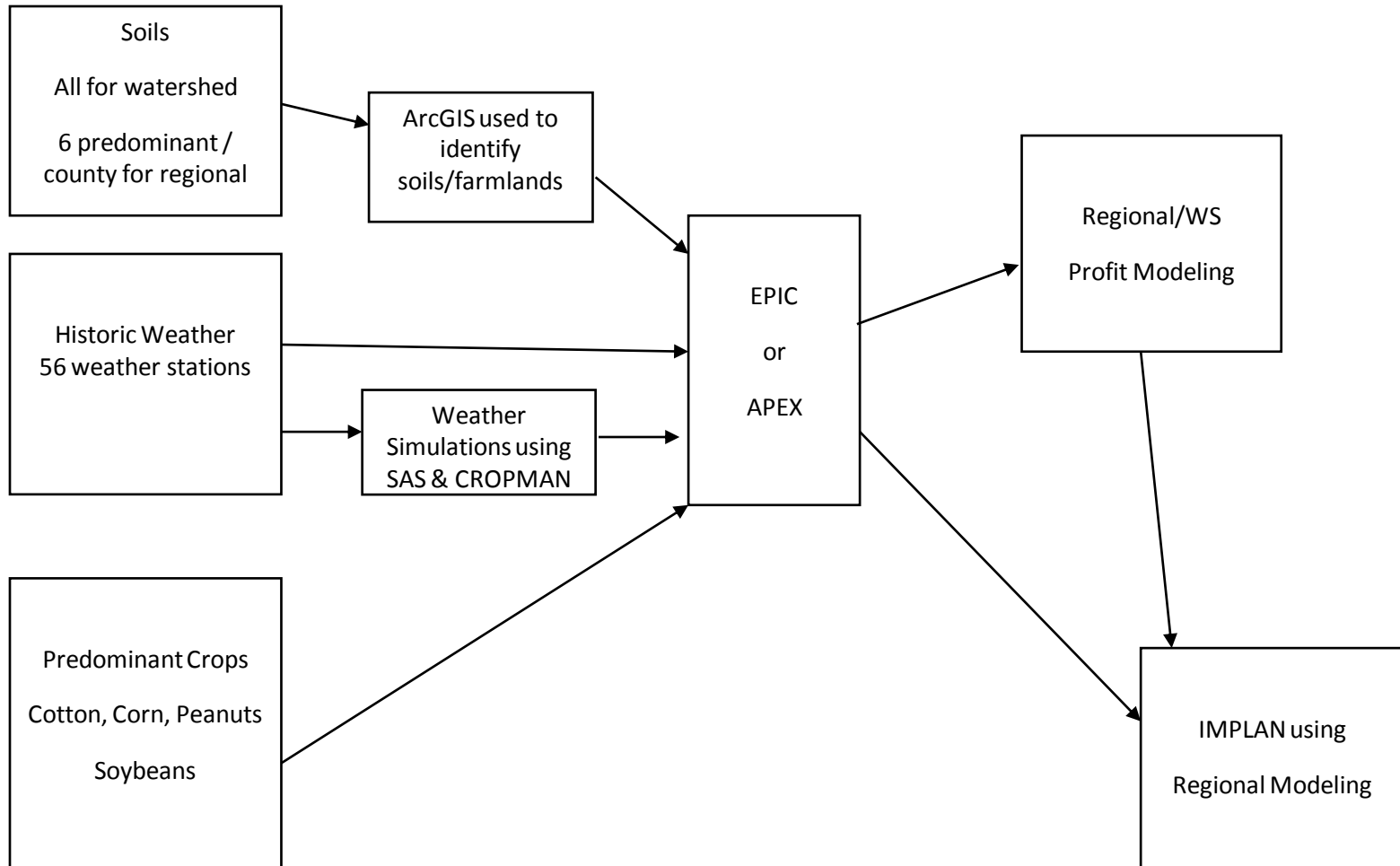
SECC Bioeconomic Modeling Activities

Diane Hite, Jim Novak, Denis
Nadolnyak, Cephias Naanwaab,
Jennings Byrd, and Gbenga Ojumu

Modeling at Two Scales

- Kelly Creek Watershed in SE AL
 - Original modeling examined effects of discrete changes in weather parameters to measure value of forecasts
 - Being expanded to examine cropping systems to include switchgrass and other energy crops, water quality implications
 - Will use optimization model and examine ENSO effects
- Regional modeling
 - An expansion of the value of short term climate forecasts
 - Starting with agricultural production for all of Alabama, will expand to all states covered by SECC

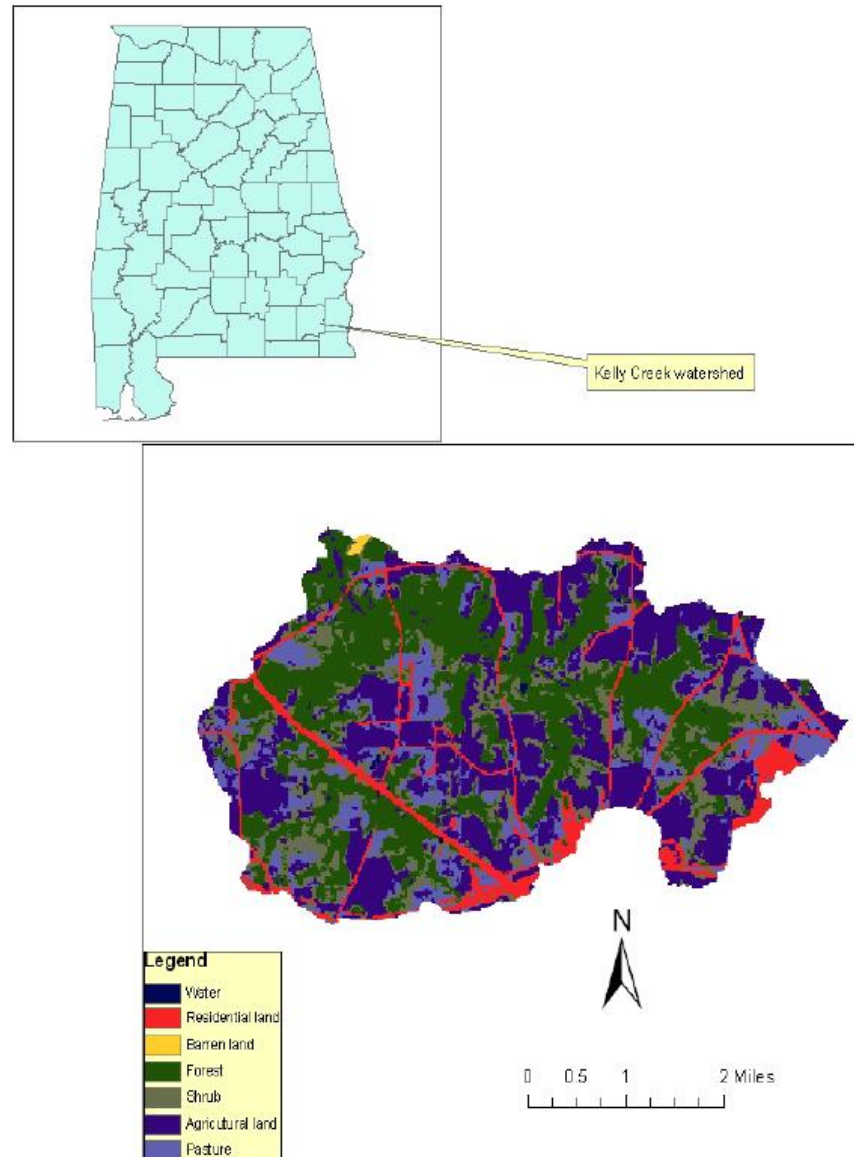
Bioeconomic Modeling Methods



Where we are: Kelly Creek

- Modeling of subwatersheds with different cropping scenarios to incorporate possible energy crop cultivation
 - Outputs are yields, profits, environmental parameters
 - Environmental parameters are runoff of N, P and sediments per hectare
 - Profits are adjusted to reflect farm subsidies
- Outputs are used in a constrained optimization model, model has been calibrated

Kelly Creek watershed and land cover



Optimization Model

$$\max Z = \sum_w \sum_c (P_c Y_{w,c} - OC_c) \cdot X_{w,c}$$

subject to

$$\sum_w \sum_c X_{w,c} \leq TotalLand$$

$$\sum_w \sum_c X_{w,c} \cdot nutrients_{w,c} \leq CurrentValue$$

$$X_{w,c} \geq 0$$

Where

w = sub-watershed, c=crop

P is the crop price in \$/ton

Y is the crop yield in tons/ha

OC are operative costs \$/ha

X is the crop activity level per ha

Where we are going: Optimization Results

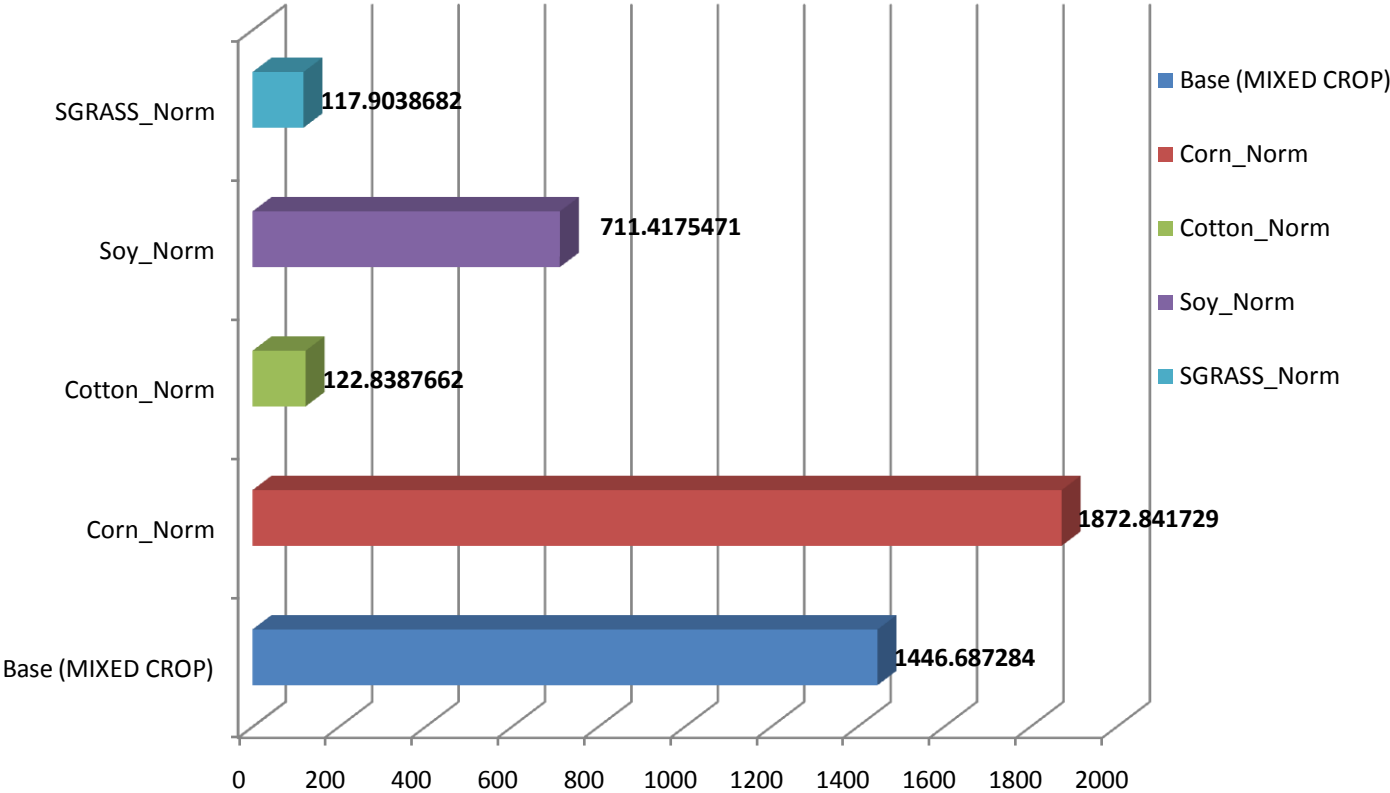
- The model will provide optimal profits and land use under a number of scenarios
 - We will examine impacts of environmental constraints on profits under different crops and ENSO phases
 - Optimal land use will provide insight into suitability of different soil types and terrains for agricultural production

Preliminary Results, Historical Weather

	Total yield (tons)	Sediments (tons)	N in Runoff (tons)	P in Runoff (tons)	N in Sediments Transported (tons)	P in sediments Transported (tons)
Base	192330.10	22.43	5.06	7.69	13.09	12.13
Corn_Norm	20590.44	1.26	5.88	48.15	25.65	16.29
Cotton_Norm	3030.84	50.68	4.85	7.40	21.67	21.15
Soy_Norm	7200.78	19.06	1.92	0.98	18.45	4.17
S grass_Norm	5550.22	14.51	3.33	3.88	9.48	3.84

Preliminary Results, Historical Weather

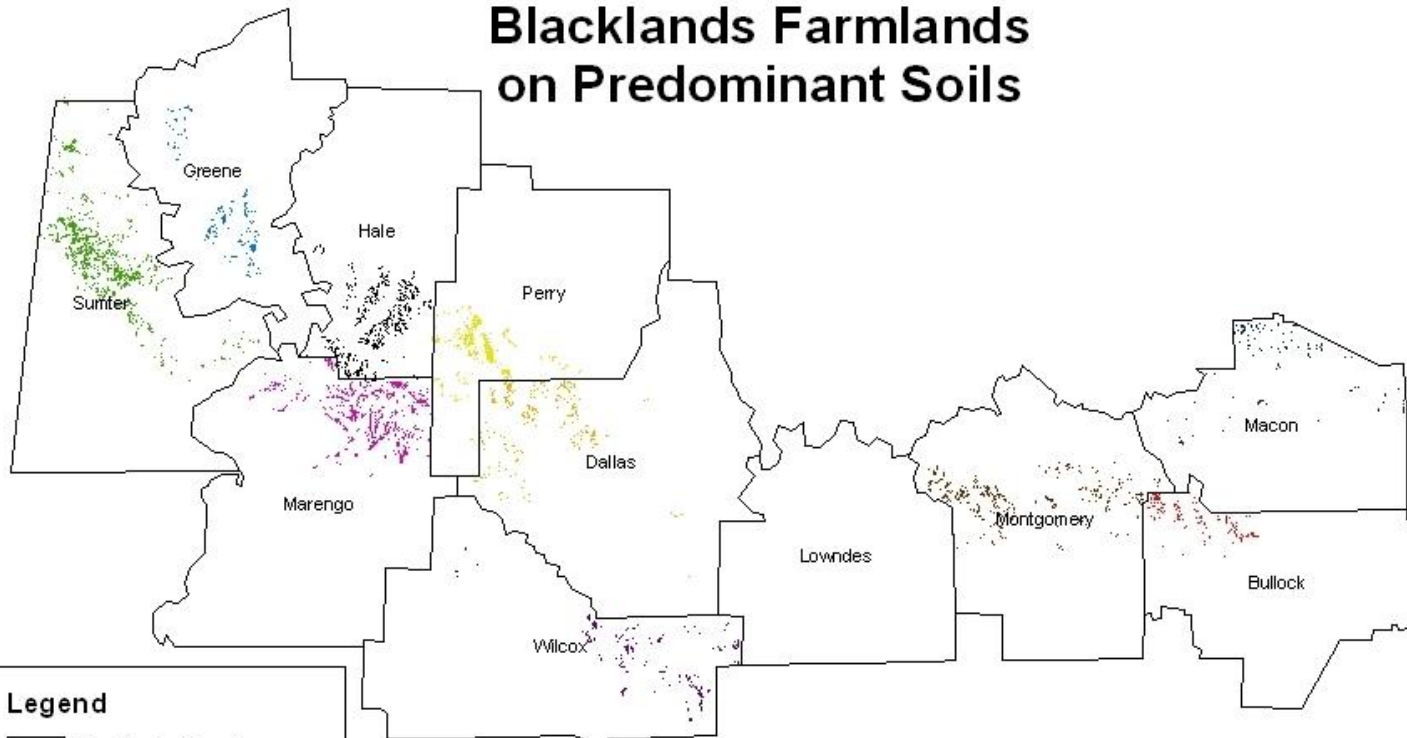
PROFIT/Ha



Where we are: Regional Model

- Incorporates concepts of watershed model at a regional scale
- Multiple-step procedure
 - Identify farmland and soils for each AL county
 - GIS used to overlay SSURGO and GAP files
 - 6 predominant soils are chosen for each county

Blacklands Farmlands on Predominant Soils



Legend

-  Blacklands Counties
-  Bullock: Maytag
-  Dallas: Houston
-  Greene: Sumter
-  Hale: Sumter
-  Macon: Marvyn
-  Marengo: Sucarnoochee
-  Montgomery: Sumter
-  Perry: Okolona
-  Sumter: Demopolis-Kipling
-  Wilcox: Sucarnoochee

0 15 30 60 Miles



Where we are: Regional Model

- Identify management practices for different crops
- Create simulated weather for El Nino, La Nina and Neutral for 56 weather stations
 - Found distributional parameters of events using SAS
- Run EPIC, 4 crops on 6 predominant soils for 25 years to pick up variation
 - Model has been tested for 3 counties for all ENSO phases

Bullock County

Profits for Total Ha of Blanton-Bonifay Loamy Sands, 2 to 8 Percent Slopes

	Corn \$	Cotton Picker \$	Peanuts \$	Soybeans \$
Historical	4,865,999	11,838,516	19,655,405	2,732,850
Elnino	4,919,365	11,116,741	19,971,984	2,713,918
Lanina	4,117,559	7,253,285	17,939,318	2,080,748
Neutral	5,229,422	13,999,337	22,004,649	3,156,090

Aggregate Bullock County 3 Soils

	Corn \$	Cotton Picker \$	Peanuts \$	Soybeans \$
Historical	14,458,679	35,719,642	62,493,374	8,655,985
El Nino	14,699,009	36,024,713	64,568,891	8,969,120
La Nina	13,343,131	22,338,483	65,381,818	8,859,988
Neutral	15,029,782	41,784,595	64,435,267	9,429,548

Where we are going: Regional Model

- EPIC run all 4 crops for 6 soils in all agricultural counties in AL yearly (25 year average)
 - To be repeated for other SECC states & counties after full run through of AL methodology
- Aggregate model of profitability under different events
 - Optimal land use and profits under different ENSO phases
 - Profits will incorporate subsidies

Where we are going: Regional Model

- Use to replicate 'value of forecasts' using ENSO phases rather than deviations from normal
 - Differences in optimal vs historical responses to weather provides measure of forecast value
- Will incorporate crop insurance
 - Evaluate insurance profit impacts with weather forecast 'misses'
 - Examine future impacts of crop insurance considering long term climate trends

Where we are going: Regional Model

- Results from optimal modeling will be fed into IMPLAN
 - Develop multipliers associated with improved profits when crop systems and land use are optimized
 - Multipliers: economic spillover effects on other economic sectors associated with profitability changes in a given sector.
 - Capture increased expenditures on local goods and services when agricultural profits increase as a result of better weather forecasts
 - Provides broad measure of the overall benefits of climate forecasts

Questions?
Comments?
Input?