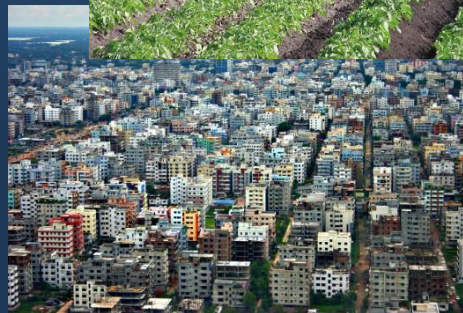
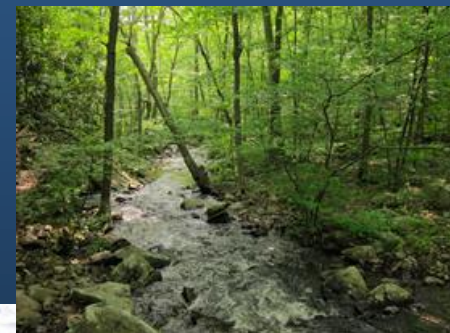


# Development of Sediment and Nutrient Export Coefficients for US Ecoregions.

**Mike White**  
**USDA/ARS**  
**Temple Texas**

# What are Export Coefficients?

- History
  - Predates models
  - Date to 1970's
  - Eutrophication linked to landuse
- Initiated monitoring studies for nutrients



# What are Export Coefficients?



0.5  
KG/HA



1.5  
KG/HA



2.5  
KG/HA



0.1  
KG/HA

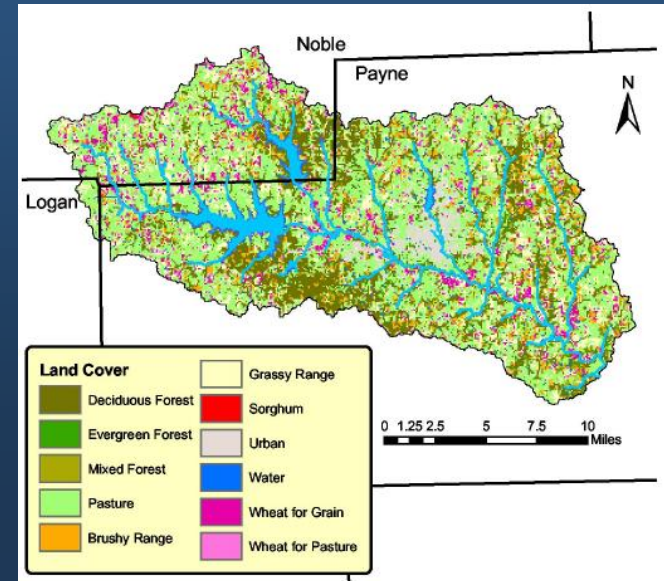


4.0  
KG/HA

- Estimated mass loss per unit area per year
  - By Landuse
  - Derived from intensive edge of field monitoring
  - Widely used.....Still

# Example Use Watershed Load

- Easy to apply
- $\text{Area} * \text{EC} = \text{Load}$



landuse	Area (ha)	Export Coeff (kg/ha/yr)	Load (kg/yr)
Forest	3500	0.1	350
Urban	500	4	2000
Corn	1000	2.5	2500
Grassland	5000	0.5	2500
Total Watershed	10000	-	<b>7350</b>

# Problems

- Edge of field monitoring
  - Expensive
  - Relatively rare
- Vary regionally
  - Climate – Topography - Soils
  - Too little measured data for each region
  - Extreme extrapolation
  - High uncertainty
- Solution
  - Use SWAT to extrapolate limited monitoring data into a much larger dataset

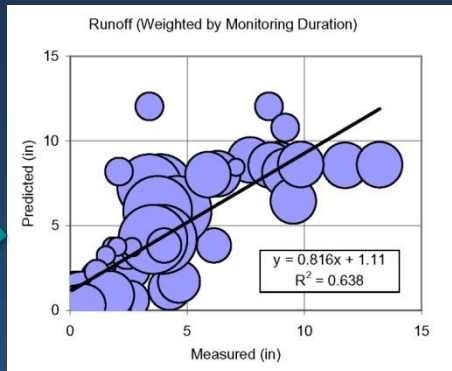


# SWAT Based Extrapolation

SWAT Model  
Template  
Single Field

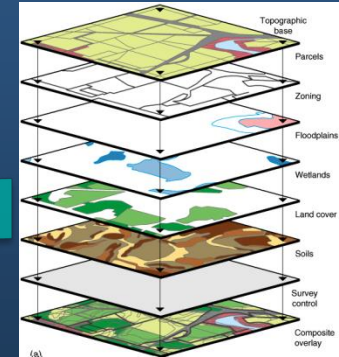


Edge of Field  
Observations



Calibration  
Validation

Validated  
SWAT Model  
Template



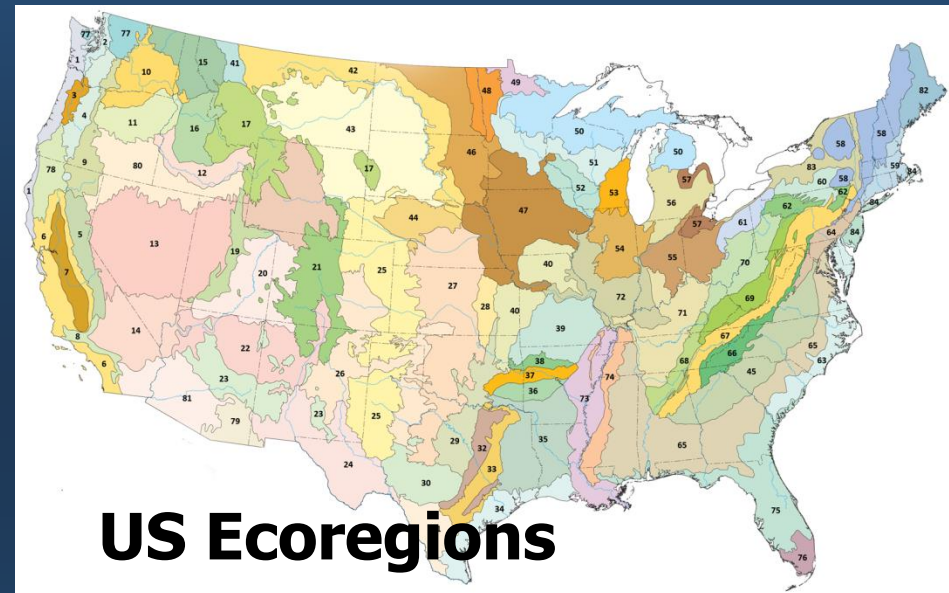
New  
Location



New Edge  
of Field  
Prediction  
(Sample)

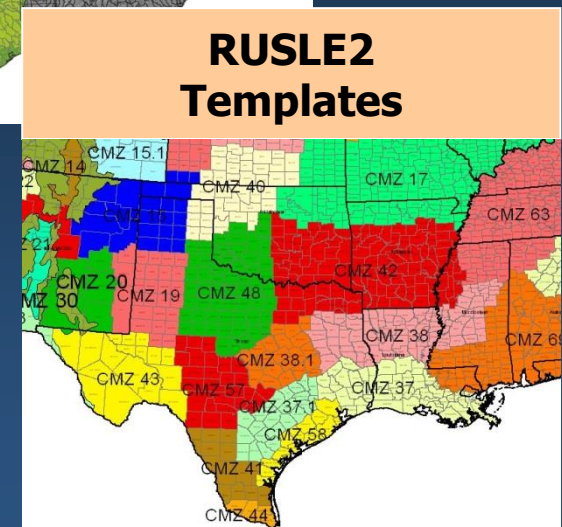
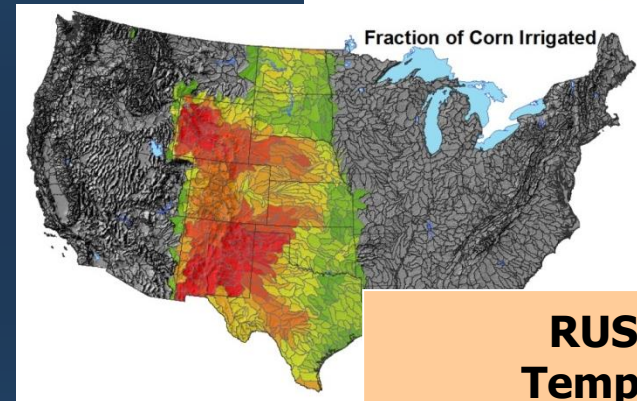
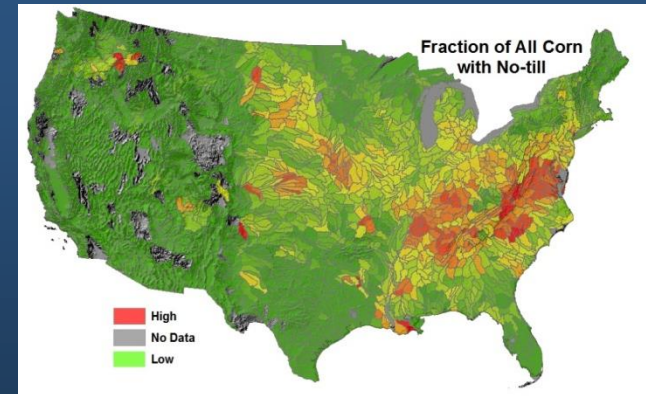
# Export Coefficient Database

- Library of model predictions
  - National basis
  - Many many samples
  - Consider local conditions
    - Landuse
    - Soils
    - Climate
    - Topography
    - Management
    - Conservation
- Summarize by major landuses for every ecoregion



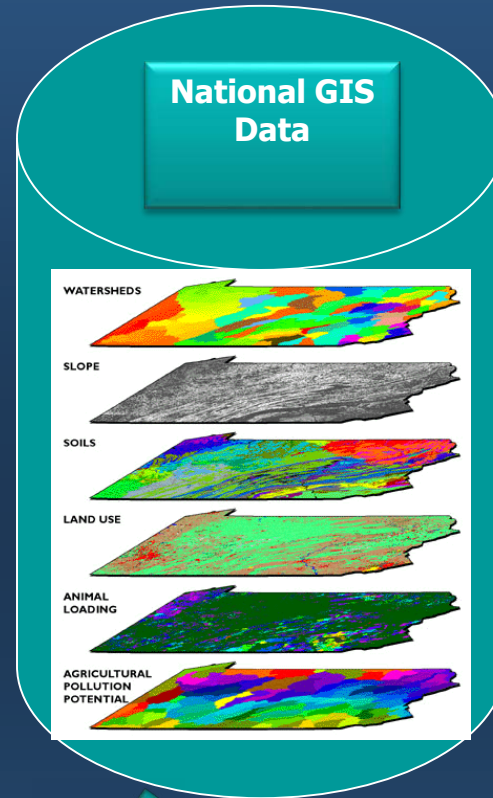
# US National Data

- Existing National Data
  - Landuse - NLCD – CDL
  - Soils - STATSGO
  - Topography – NED
- Seamless Climate Data
  - 20,000 stations (1950-2010)
- Irrigation & Fertilization
  - Ag Census
- Conservation Practices
  - CEAP Survey 18,000
- Management
  - US RUSLE2 - 20,000 templates





# Sampling - Overview

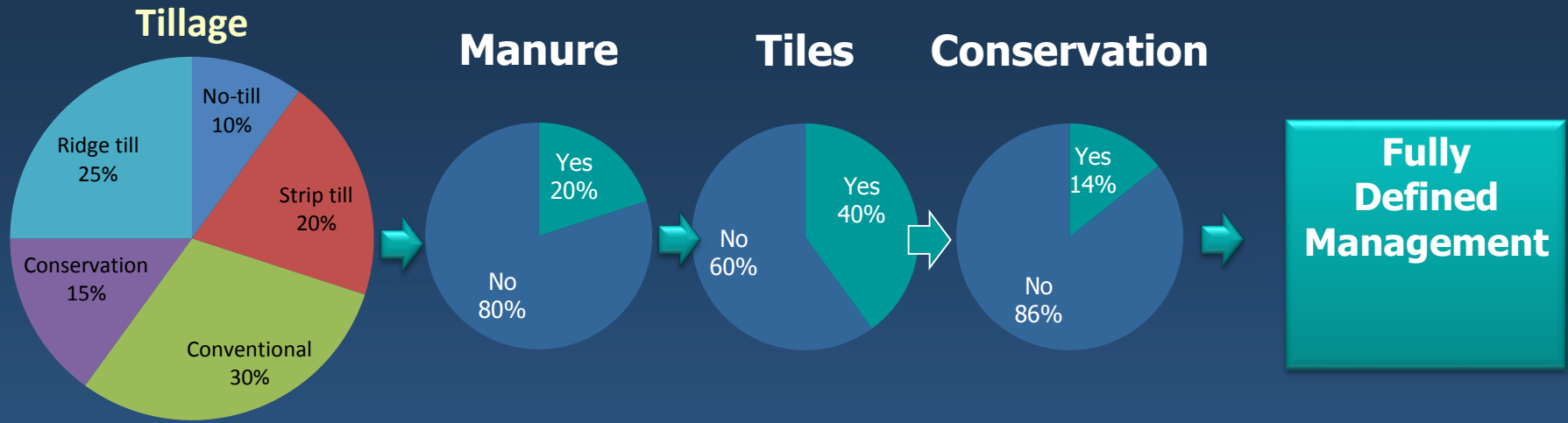


**Basis For New  
SWAT  
Simulation**

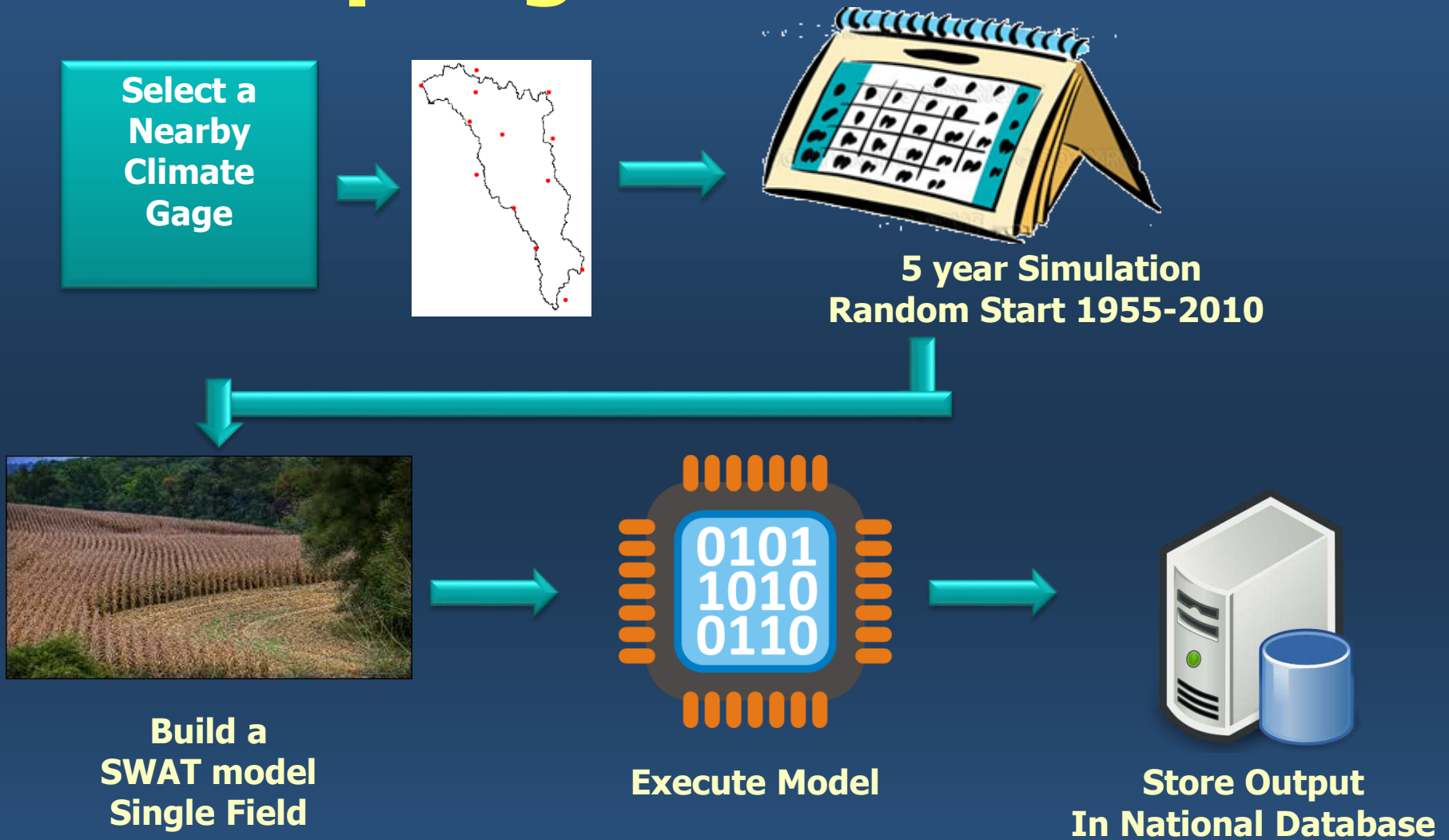
# Sampling - Details



## Management Assignment



# Sampling and Simulation



# One Down, Millions to go

- More samples is better
  - Provide EC distribution
- Computationally Intense
  - Windows Cluster
  - 250 cores
  - 5 days
- Current National Database
  - 45 million simulations/samples
  - 1 for each 22 ha in the US



# How to Use it

Simulation  
Library

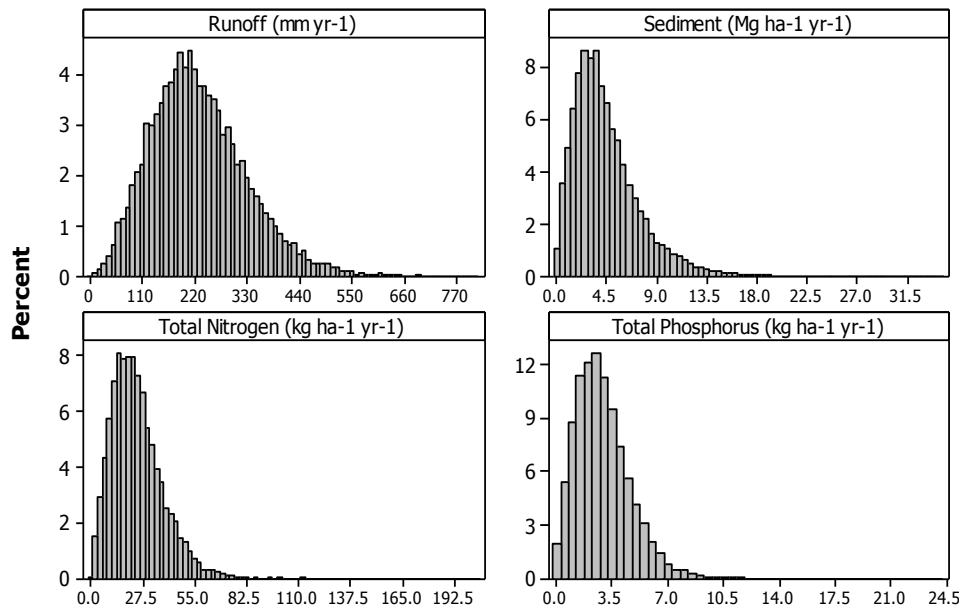


Extraction  
Tool  
Database  
Query

QUERY  
Corn  
Blackland  
Prairie  
Ecoregion

13,036  
Samples

**Corn - Texas Blackland Prairie Ecoregion**



# Ecoregion Summaries

## Cultivated Cropland

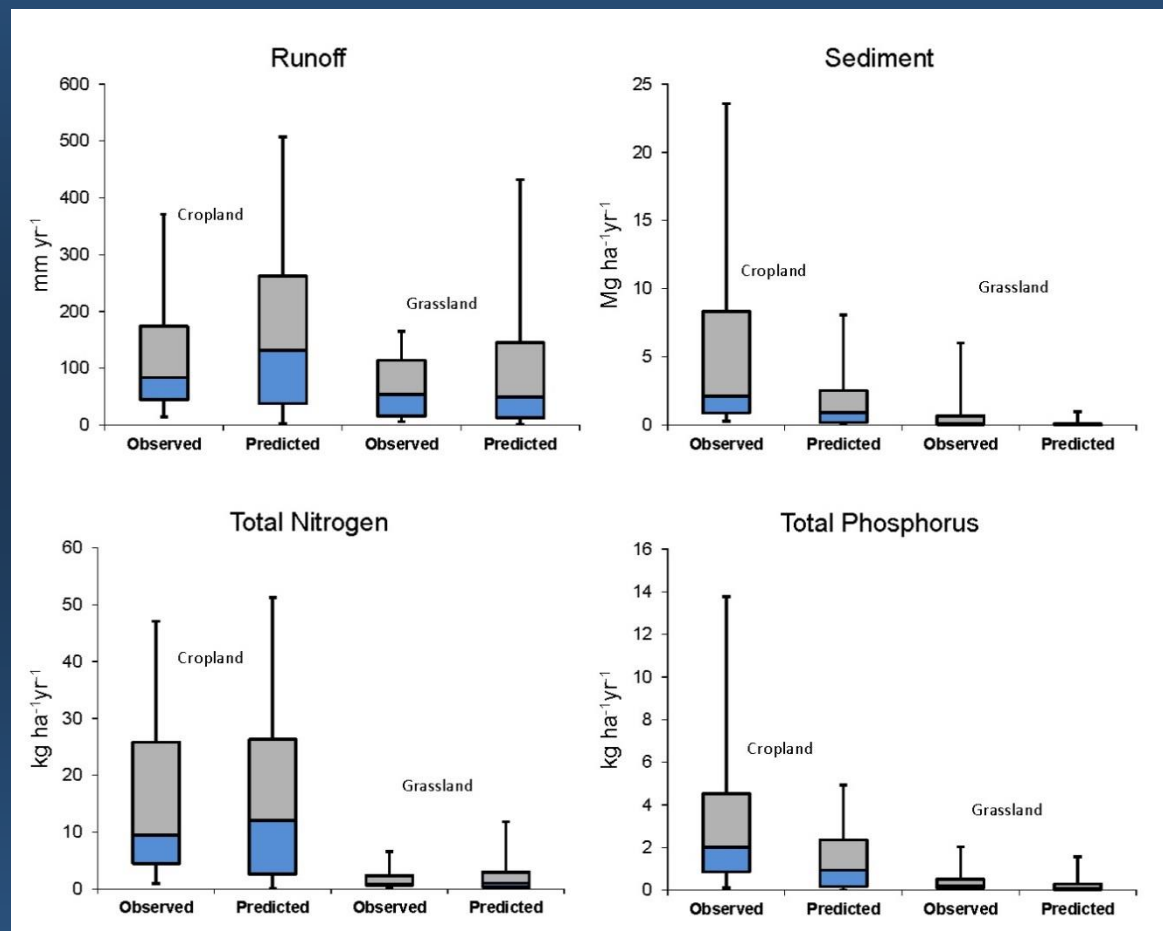
Ecoregion	n	Total Nitrogen (kg ha <sup>-1</sup> yr <sup>-1</sup> )	Total Phosphorus (kg ha <sup>-1</sup> yr <sup>-1</sup> )
Arizona/New Mexico Mountains	719	0.547 (0.019-5.22)	0.024 (0-0.303)
Arizona/New Mexico Plateau	1666	0.421 (0.061-2.44)	0 (0-0.043)
Arkansas Valley	4889	23.2 (7.33-48.8)	2.15 (0.372-5.05)
Atlantic Coastal Pine Barrens	4851	10.1 (5.23-39.4)	0.448 (0.075-3.8)
Blue Mountains	6515	1.87 (0.026-25.7)	0.106 (0-2.75)
Blue Ridge	3893	27.9 (10.7-63.6)	2.89 (0.749-7.35)
Boston Mountains	878	22.7 (9.43-52.1)	2.17 (0.555-5.44)
Canadian Rockies	2797	0.24 (0.014-2.46)	0.012 (0-0.199)
Cascades	877	32.7 (1.26-165)	3.11 (0.014-18.3)
Central Appalachians	1934	56.8 (16.8-97.3)	6.48 (1.05-11.4)
Central Basin and Range	5887	0.982 (0.034-13.5)	0.021 (0-1.39)
Central California Valley	41116	1.51 (0.008-13.5)	0.022 (0-1.22)
Central Corn Belt Plains	269810	28 (11.4-48.8)	2.45 (0.501-4.47)
Central Great Plains	584648	2.03 (0.188-11.7)	0.188 (0.011-1.23)
Central Irregular Plains	139179	26.7 (10.8-53.6)	2.69 (0.912-5.73)
Chihuahuan Deserts	2822	0.04 (0.003-1.02)	0.002 (0-0.089)
Coast Range	292	46.3 (8.76-224)	4.84 (0.462-26.2)
Colorado Plateaus	2473	0.452 (0.019-5.95)	0.029 (0-0.564)

Median value with range (10<sup>th</sup> and 90<sup>th</sup> percentiles).

# Validation

## Compare to Monitoring Data

- Measured edge of field loads
  - Grassland 95 observations
  - Cropland 91 observations
- Looking for distributional overlap

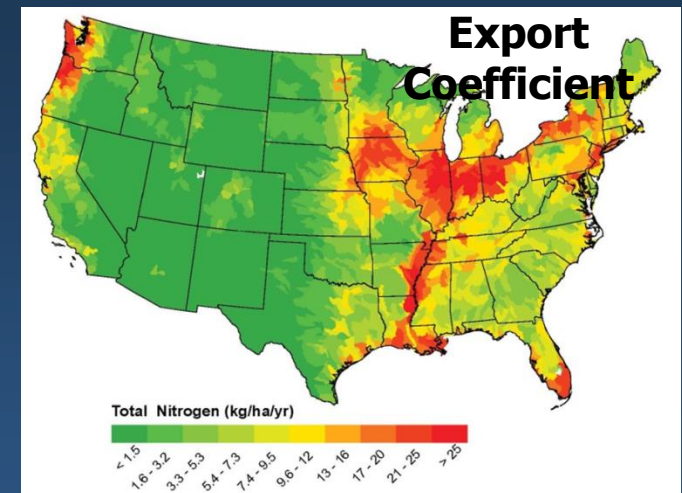
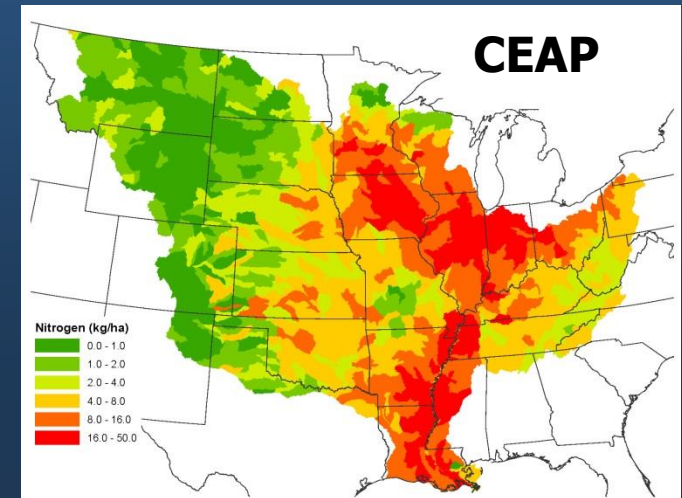


# Applications

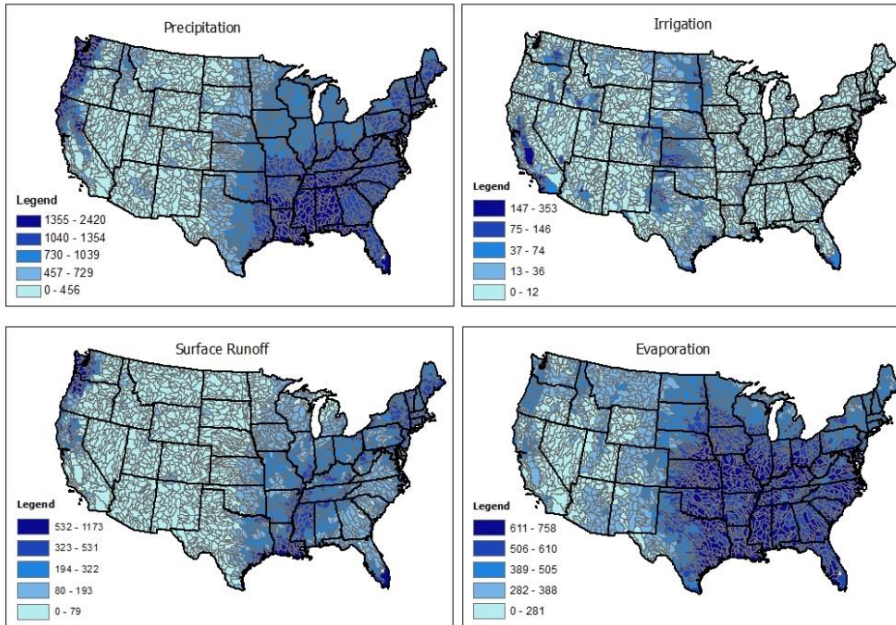


# Large Scale Compare with CEAP

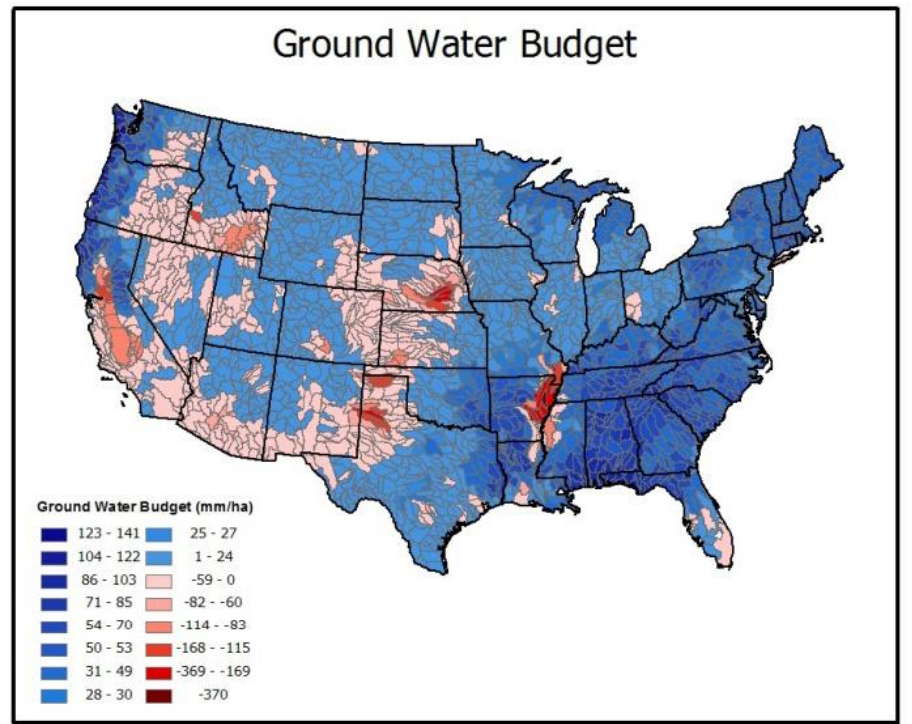
- Proper distributional sampling
  - Extract at differing spatial scales
    - Watershed – HUC 8
    - County
- Compare to CEAP
  - Similar trends



# National Water Balance



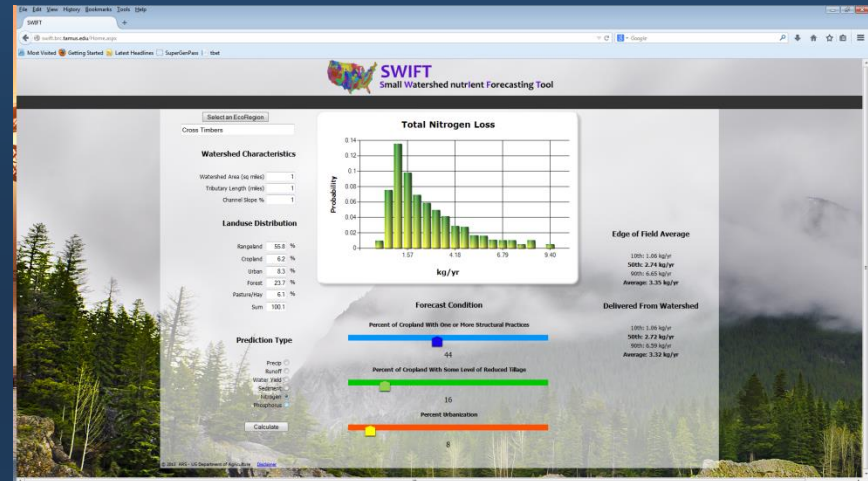
- Areas of groundwater depletion



- Full Water Balance

# Small Watershed nutrIent Forecasting Tool

- Simple web based tool
- Predict nutrient and sediment loads
- Couples EC and delivery ratio concepts



<http://swift.brc.tamus.edu/>



Select an EcoRegion

Western Corn Belt Plains

**Watershed Characteristics**

Watershed Area (sq miles)   
 Tributary Length (miles)   
 Channel Slope %

**Landuse Distribution**

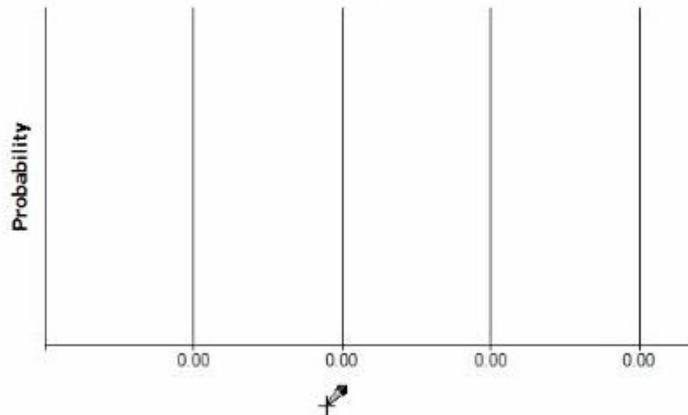
Rangeland  %  
 Cropland  %  
 Urban  %  
 Forest  %  
 Pasture/Hay  %  
 Sum

**Prediction Type**

- Precip
- Runoff
- Water Yield
- Sediment
- Nitrogen
- Phosphorus

Calculate

**Please Select a Prediction Type**



**Edge of Field Average**

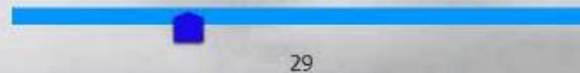
10th: 656.57  
**50th: 810.75**  
 90th: 953.29  
**Average: 800.46**

**Delivered From Watershed**

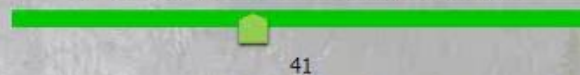
10th: 656.57  
**50th: 810.75**  
 90th: 953.29  
**Average: 0.00**

**Forecast Condition**

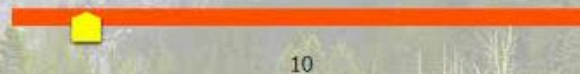
Percent of Cropland With One or More Structural Practices



Percent of Cropland With Some Level of Reduced Tillage



Percent Urbanization



# Questions?

[mike.white@ars.usda.gov](mailto:mike.white@ars.usda.gov)