Development of Sediment and Nutrient Export Coefficients for US Ecoregions.

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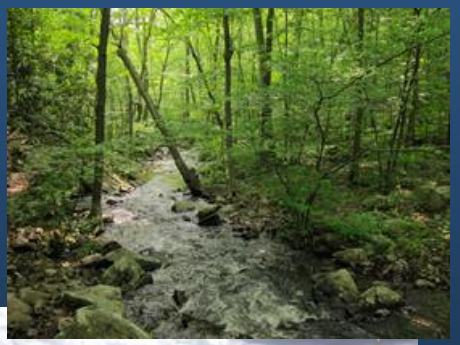
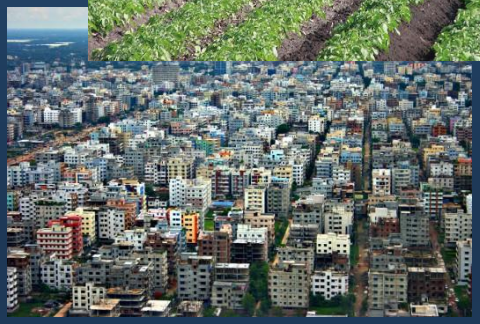
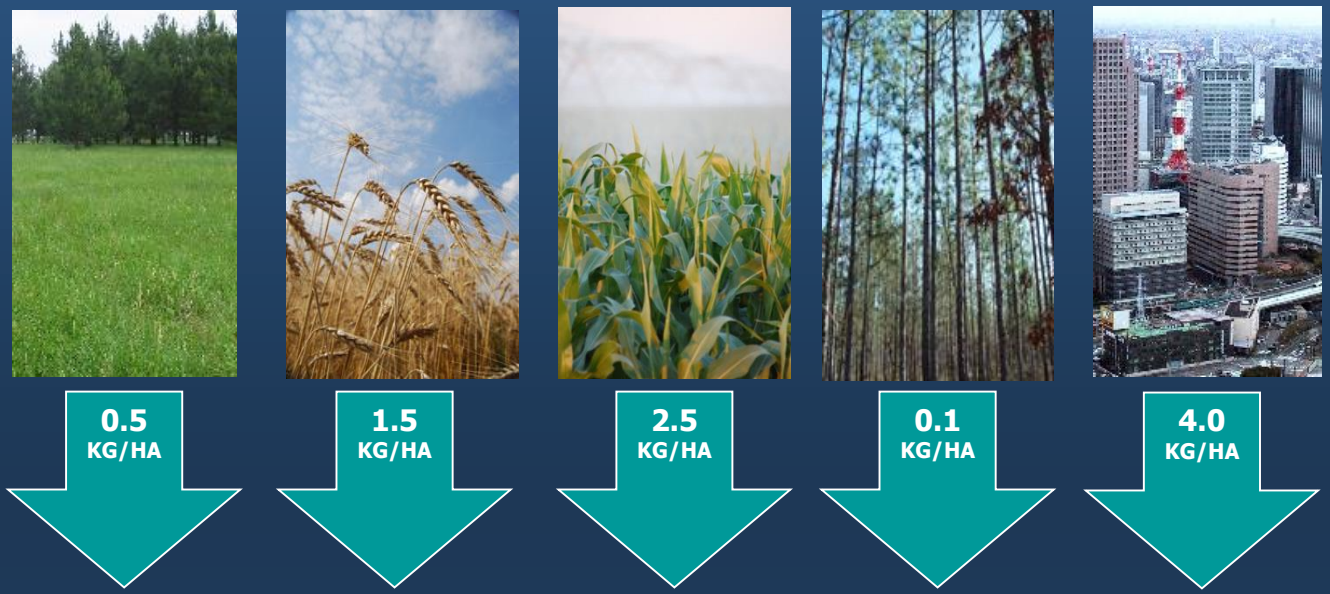
What are Export Coefficients?

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

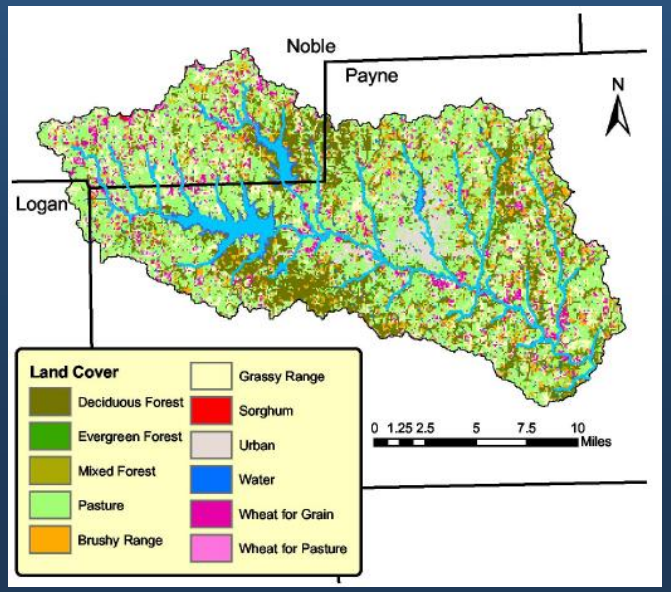

What are Export Coefficients?



- 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
- Area * EC = 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	-	**7350**

Problems

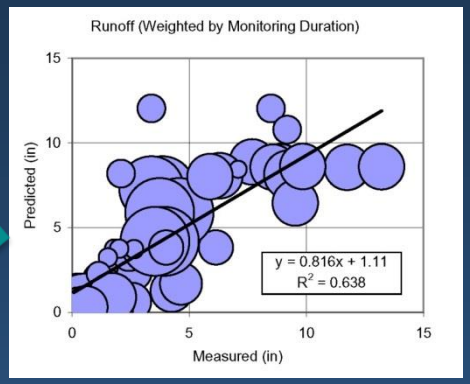
- Edge of field monitoring
  - Expensive
  - Relatively rare
- Vary regionally
  - Climate – Topography - Soils
  - Too little measured data for each region
  - Extreme extrapolation
  - High uncertainty
- Solution
  - Use SWAT to extrapolate limited monitoring data into a much larger dataset

SWAT Based Extrapolation

SWAT Model Template

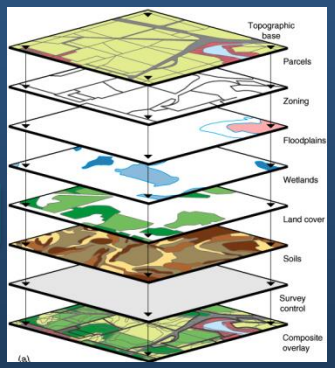
Single Field

Edge of Field Observations



Calibration Validation

Validated SWAT Model Template

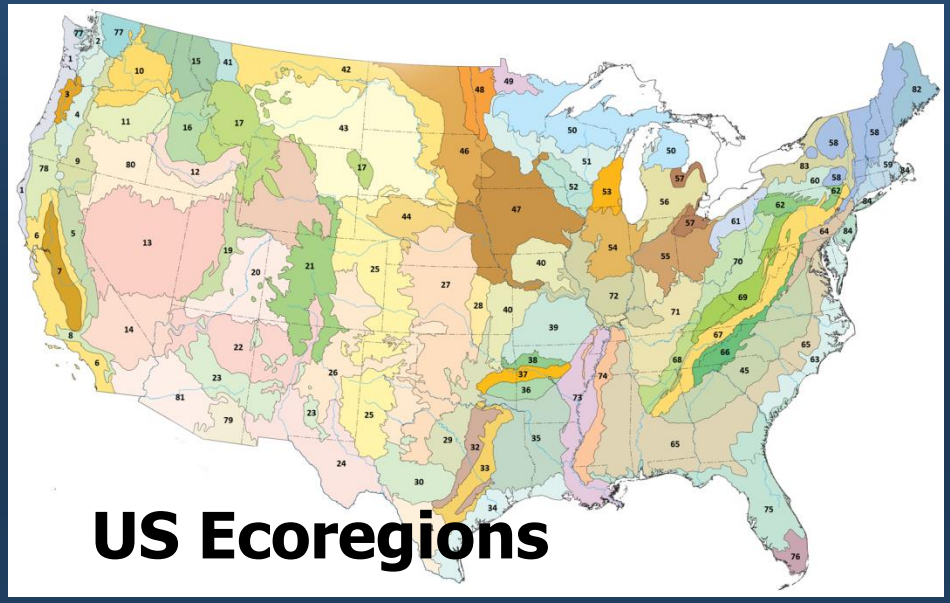


New Location

New Edge of Field Prediction (Sample)

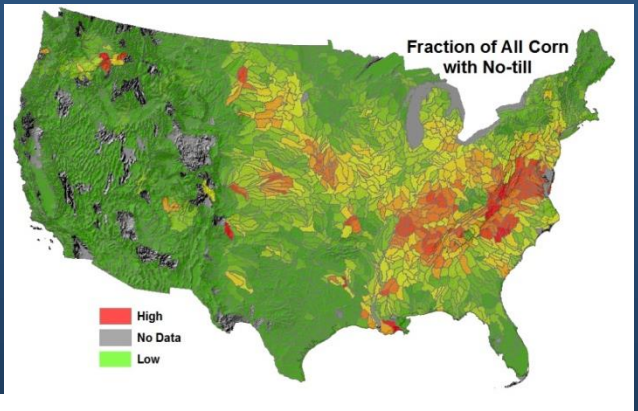
Export Coefficient Database

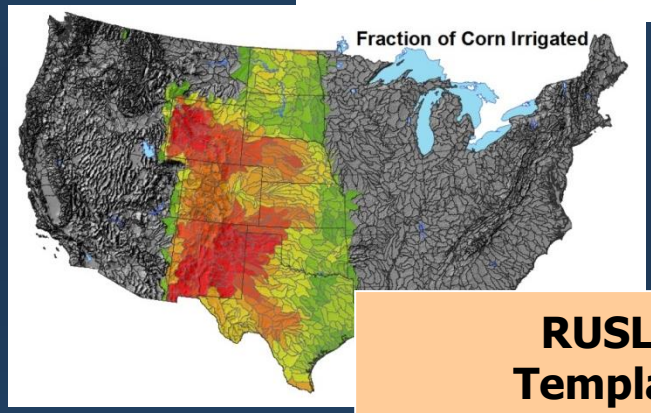
- Library of model predictions
  - National basis
  - Many many samples
  - Consider local conditions
    - Landuse
    - Soils
    - Climate
    - Topography
    - Management
    - Conservation
- Summarize by major landuses for every ecoregion in US



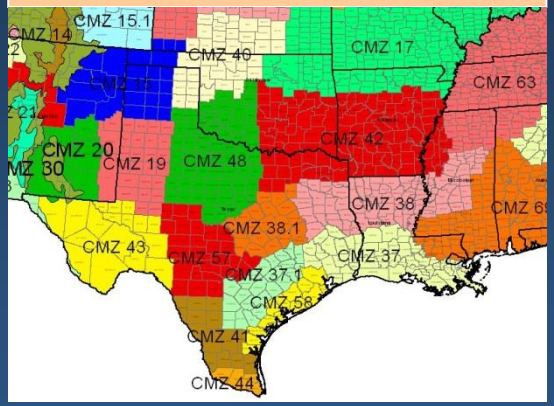
US National Data

- 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



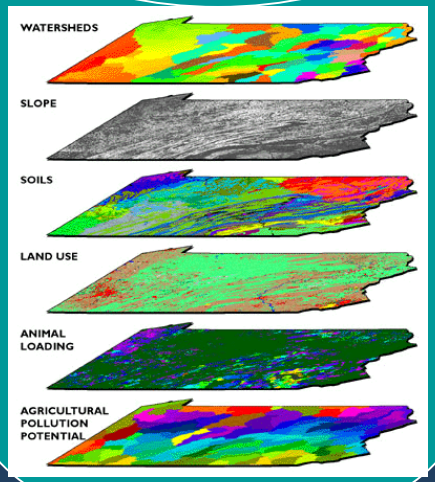


RUSLE2 Templates



Sampling - Overview

National GIS Data



Basis For New SWAT Simulation

Sampling - Details

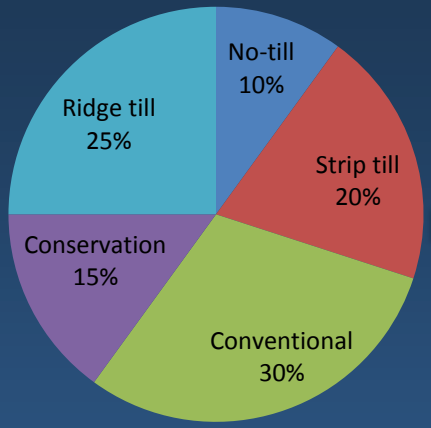
Pick Landuse

Soils
Topography

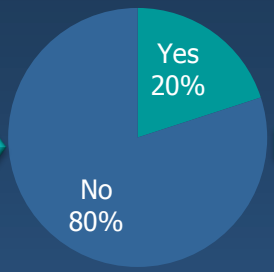
Defined HRU Type
Location
Landuse
Soils
Topography

Management Assignment

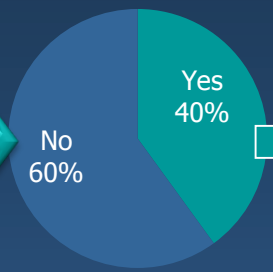
Tillage



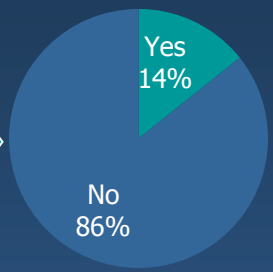
Manure



Tiles



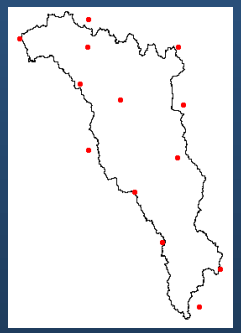
Conservation



Fully Defined Management

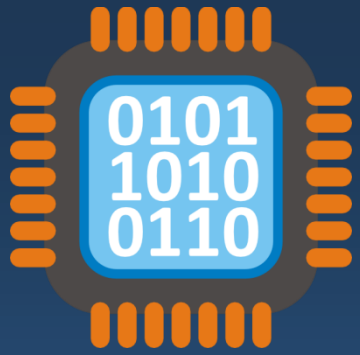
Sampling and Simulation

Select a Nearby Climate Gage



5 year Simulation
Random Start 1955-2010

Build a
SWAT model
Single Field



Execute Model

Store Output
In National Database

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

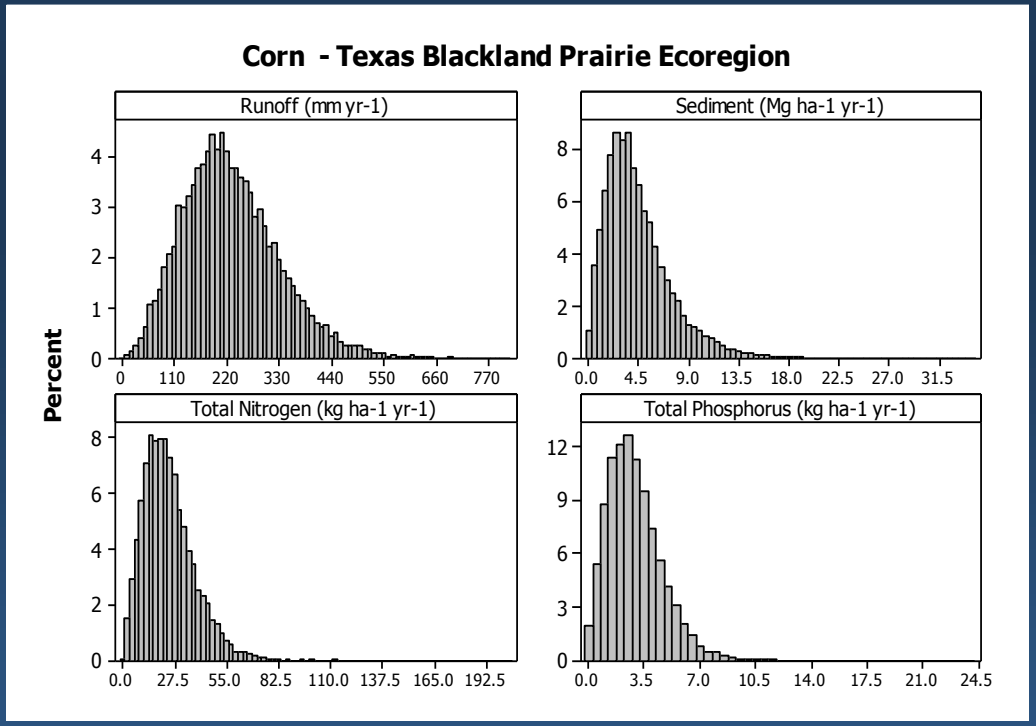
How to Use it

Simulation Library

Extraction Tool Database Query

QUERY Corn Blackland Prairie Ecoregion

13,036 Samples



Ecoregion Summaries

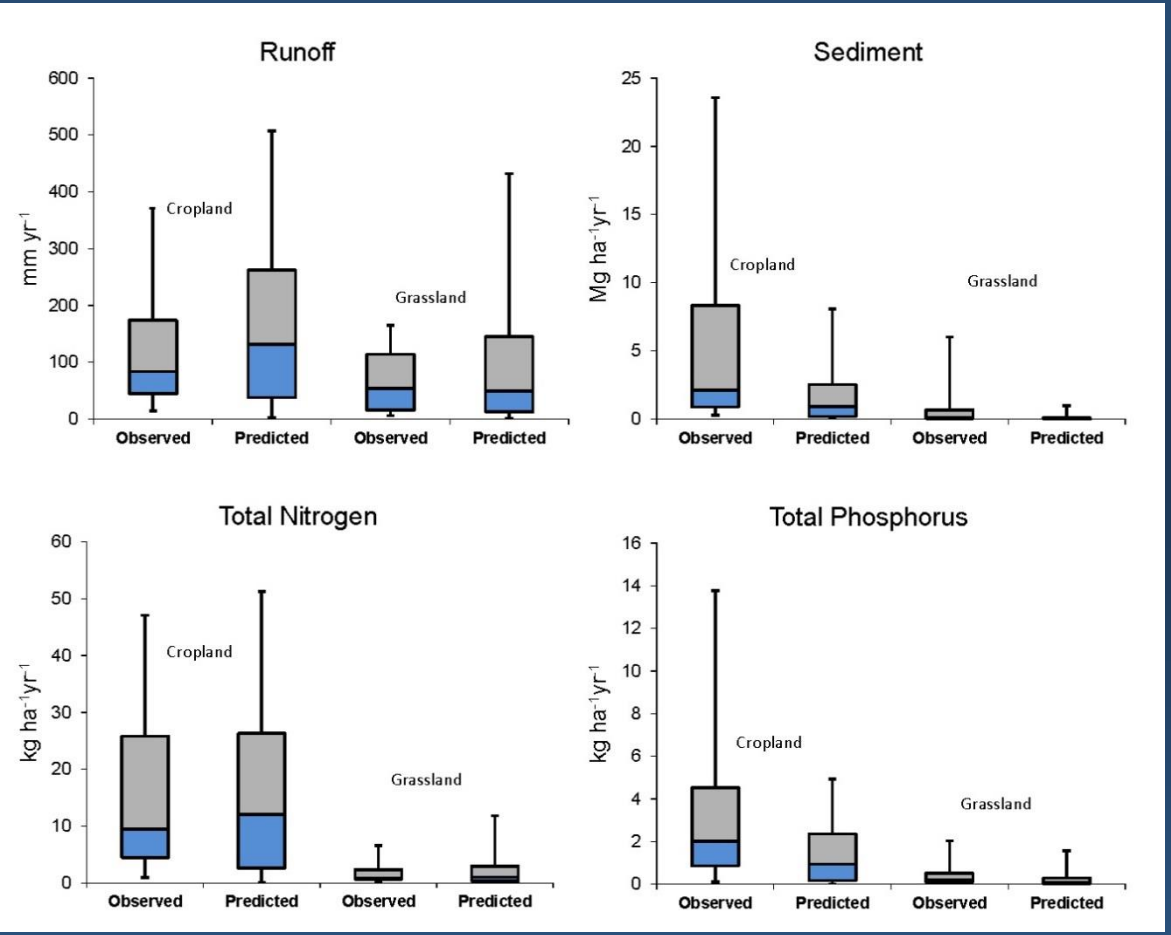
Cultivated Cropland

Ecoregion	n	Total Nitrogen	Total Phosphorus
		(kg ha^{-1} yr^{-1})	(kg ha^{-1} yr^{-1})
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^{th} and 90^{th} percentiles).

Validation
Compare to Monitoring Data

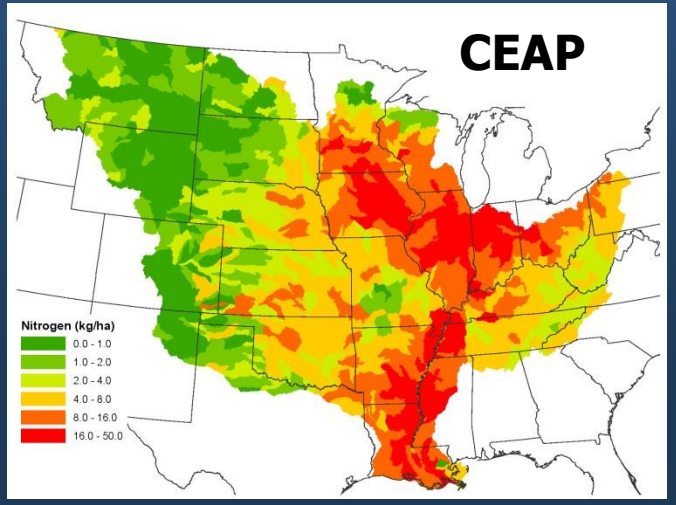
- Measured edge of field loads
  - Grassland 95 observations
  - Cropland 91 observations
- Looking for distributional overlap

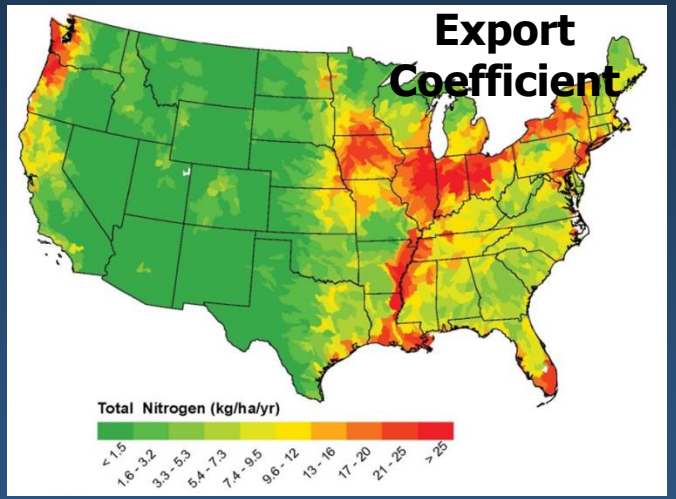


Applications

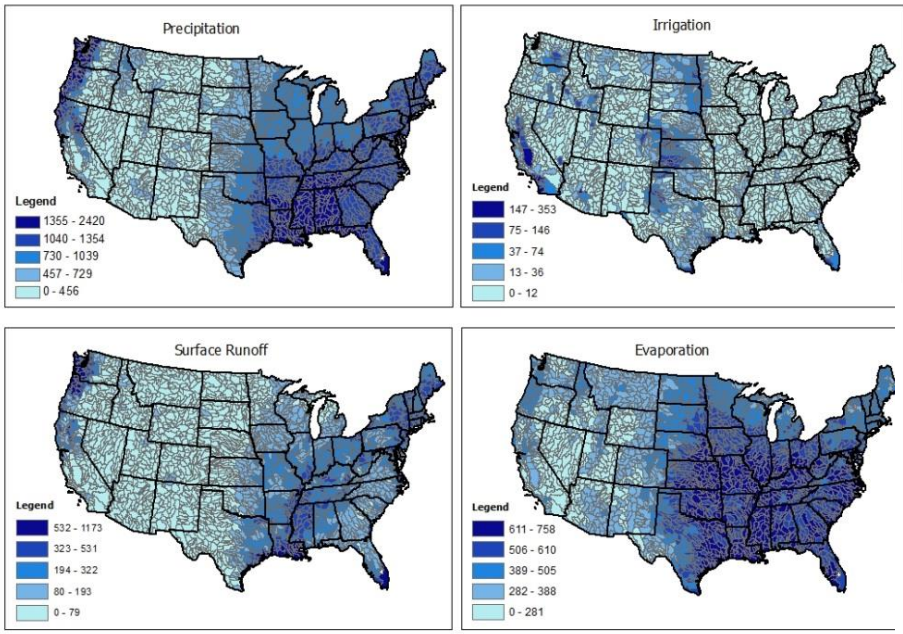
Large Scale Compare with CEAP

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



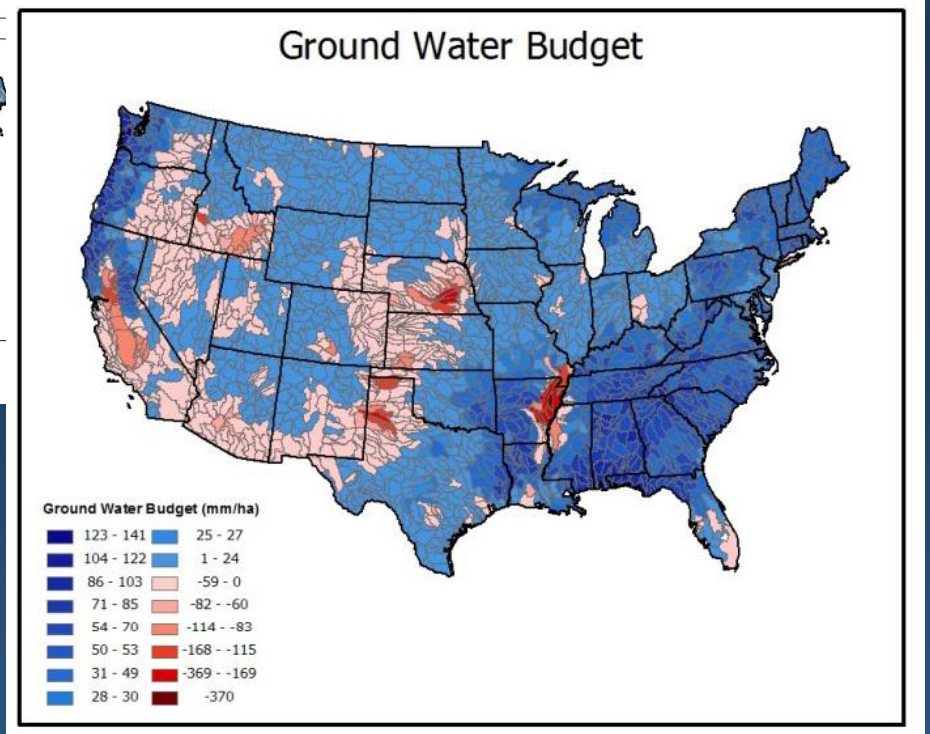


National Water Balance



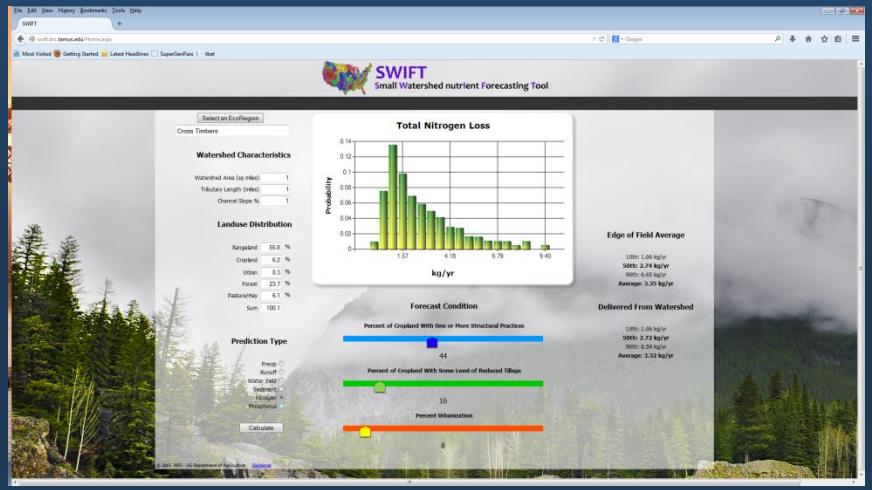
- Areas of groundwater depletion

- Full Water Balance



Small Watershed nutrIent Forecasting Tool

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



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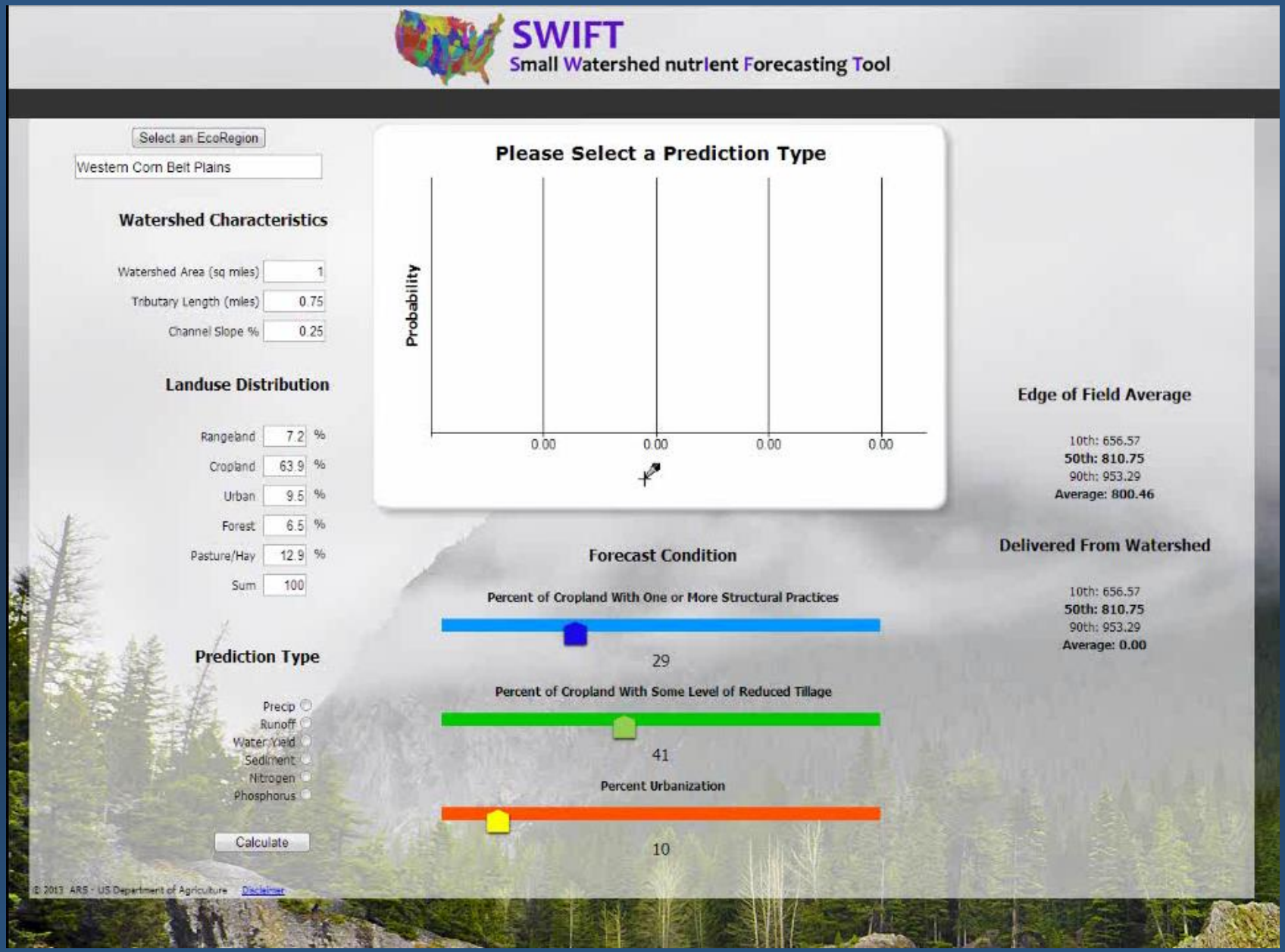

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Questions?

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