

Rapid National Model Assessments to Support US Conservation Policy Planning

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USDA-ARS

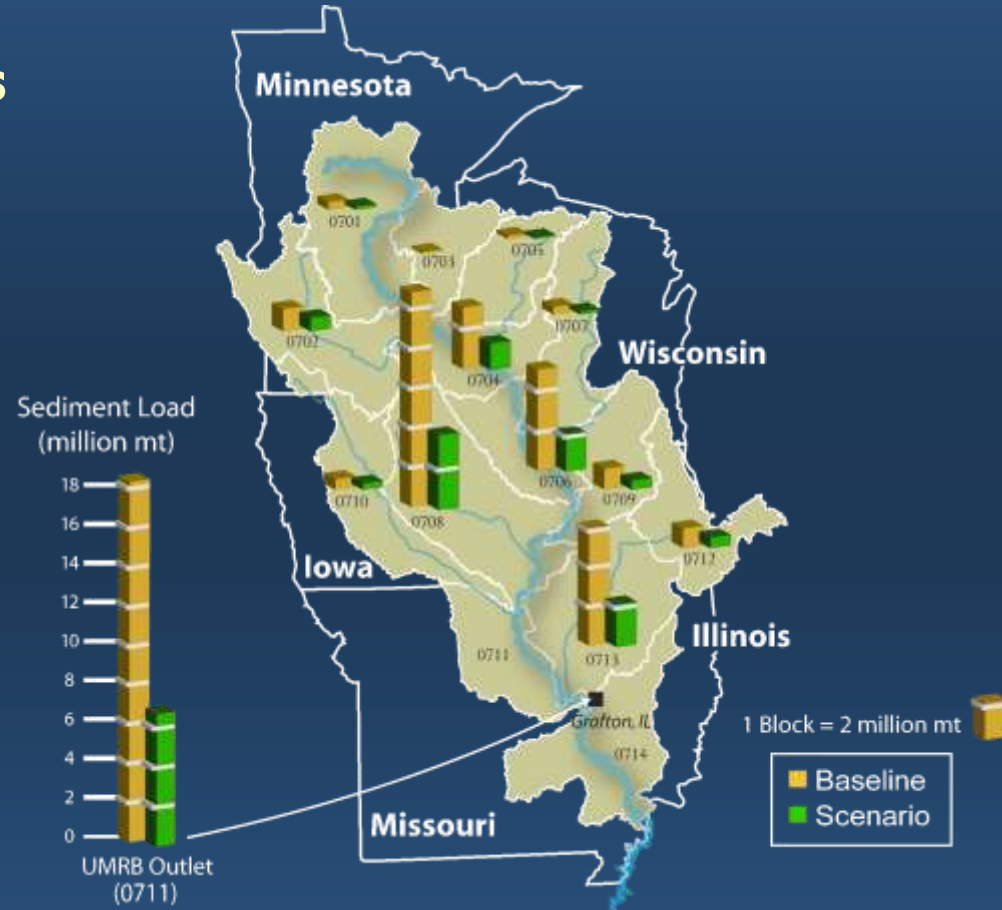
Grassland, Soil and Water Research Laboratory, Temple, TX

Topics

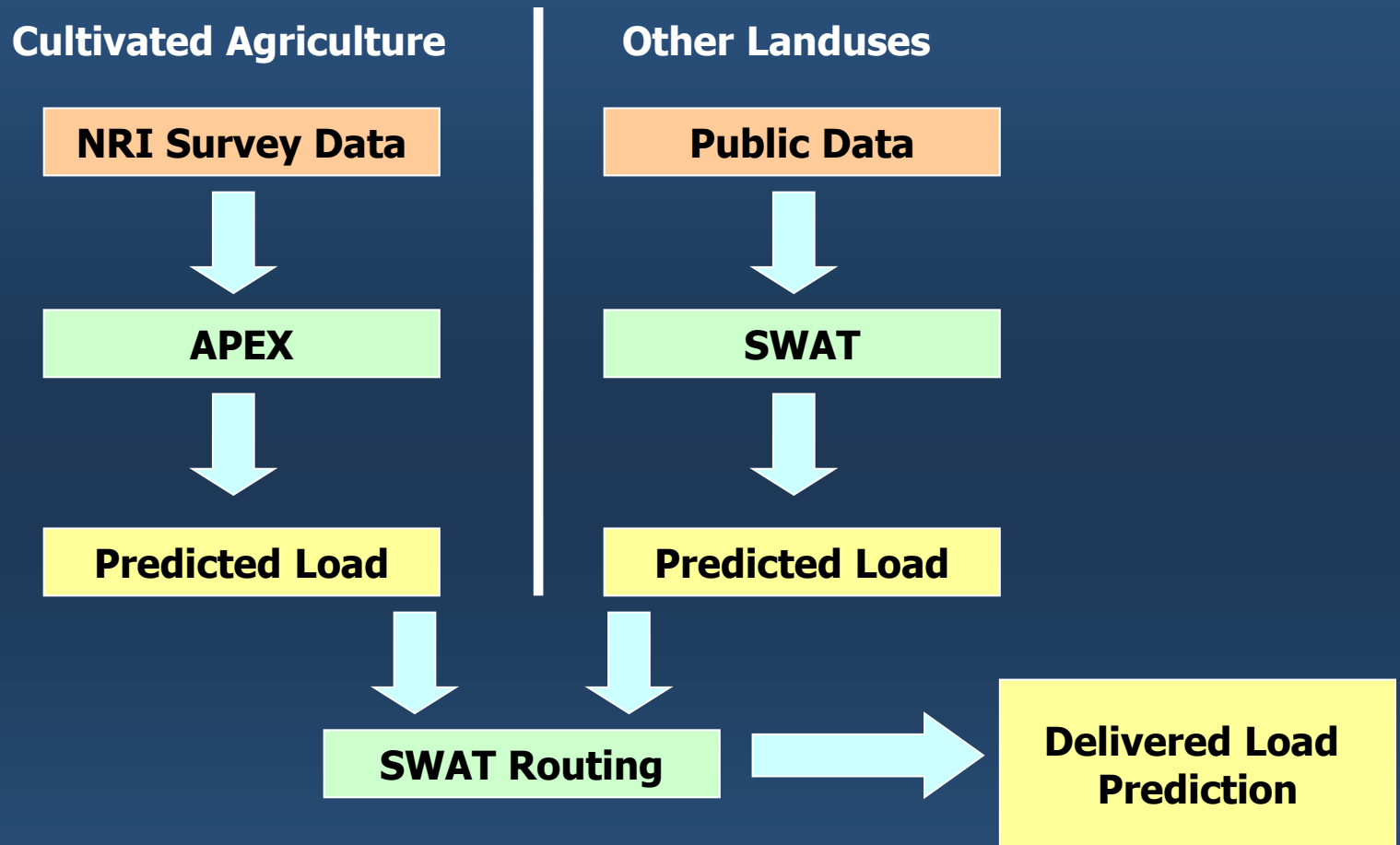
- **Current National Assessments**
- **Future National Assessments**
- **Supporting Data and Tools**

US National Assessments

- **CEAP - Conservation Effects Assessment Project**
- **Justify US conservation expenditures (about 2 billion annually)**
- **Quantitative predictions of water quality improvements**
- **18 river basins simulated using SWAT and APEX**



CEAP Framework



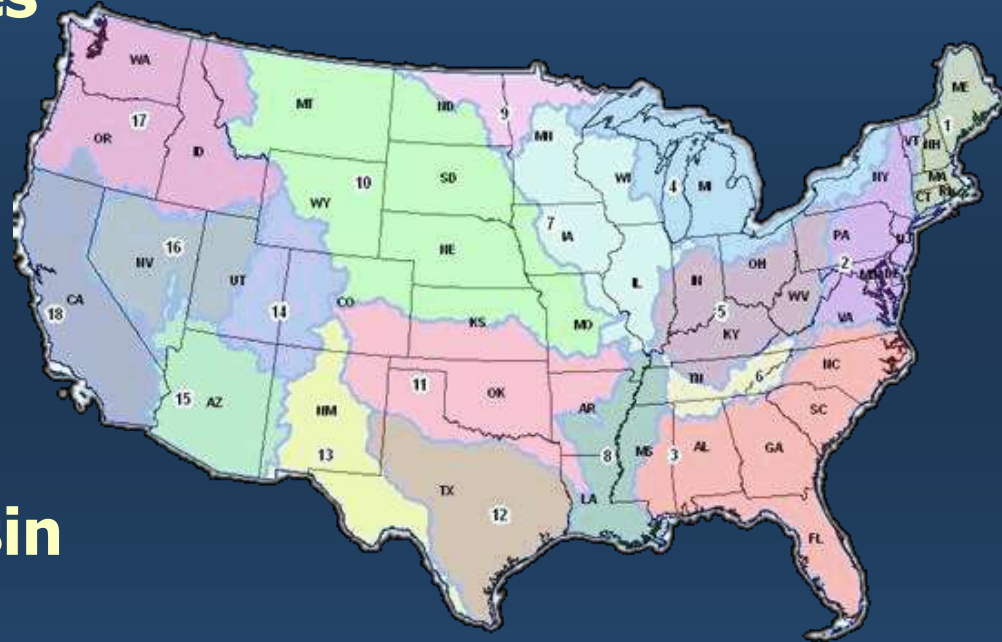
Rapid - CEAP

■ Purpose

- Rapidly respond to congressional inquiries
- Support US Farm Bill development

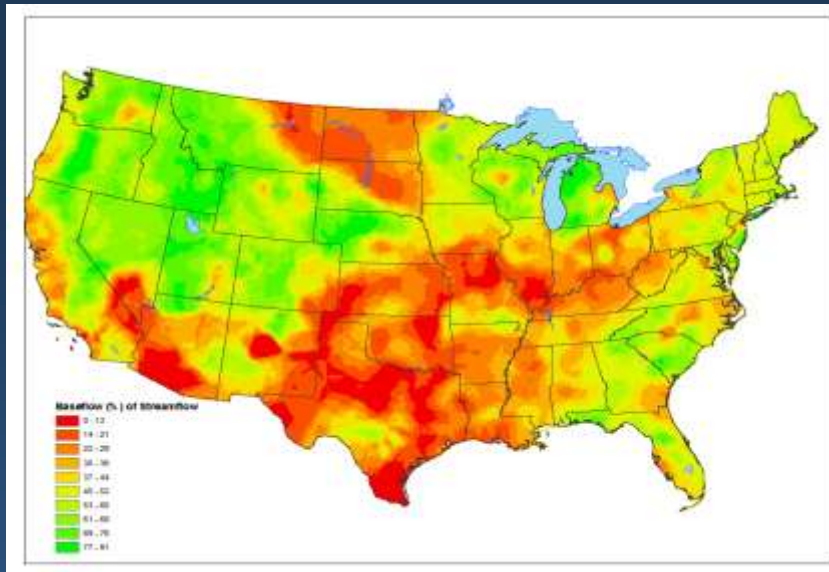
■ Approach

- Identical to CEAP Structure
- Integrate 18 river basin models into a single model
- 2,200 subbasins 45,000 HRUs

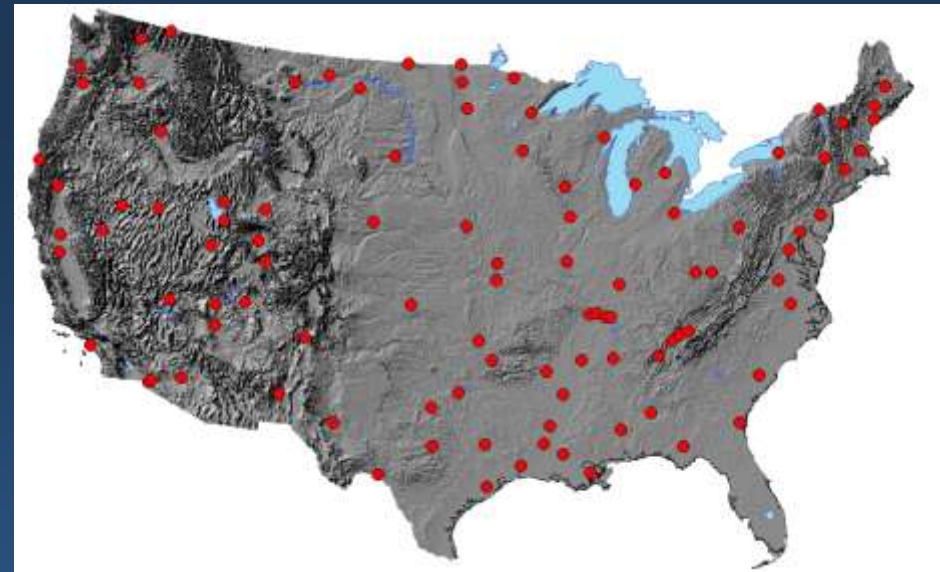


Calibration

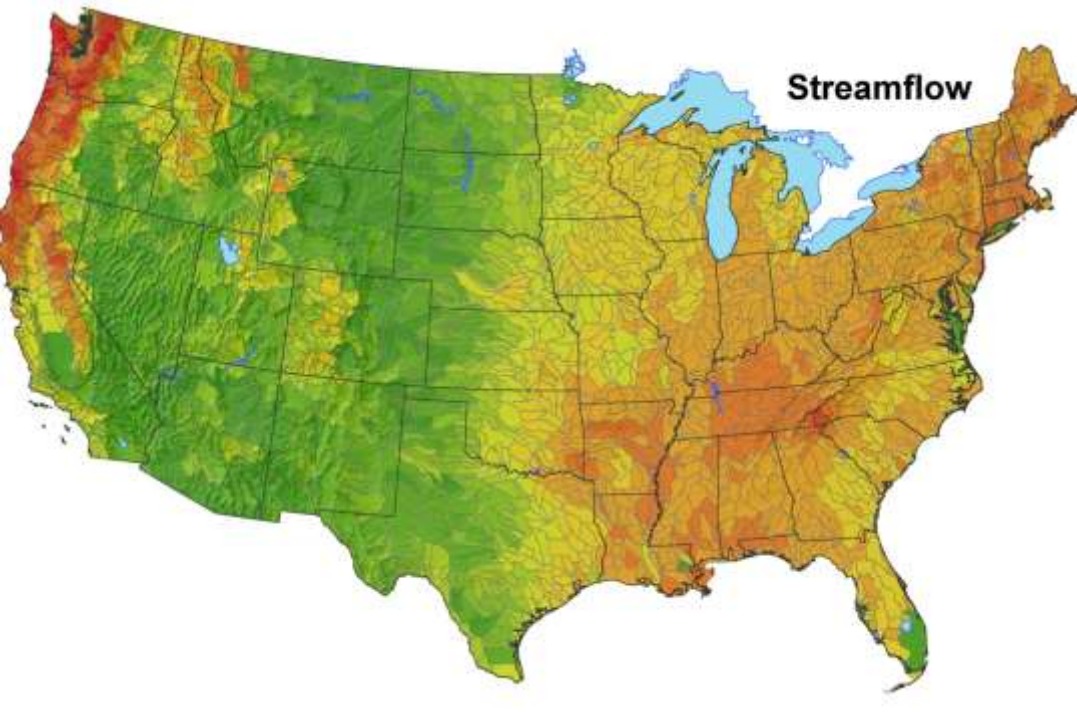
- Streamflow (Surface runoff and Baseflow)
 - calibrated at the 8 digit level to USGS estimated runoff
 - Automated calibration using CEAP software
- Sediment and Nutrients
 - Calibrated to individual estimated loads at ~ 100 sites
 - Automatic calibration using heuristic algorithms



**USGS Interpolated Runoff
and Baseflow**

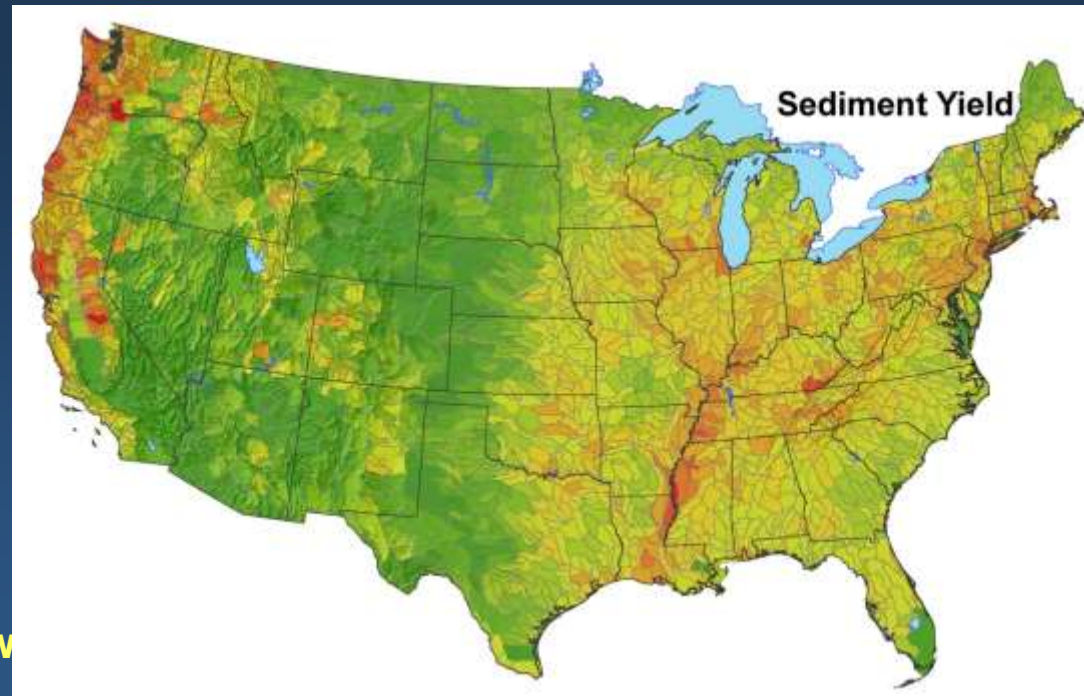


**USGS Gages with Flow,
Sediment and Nutrient Loads**

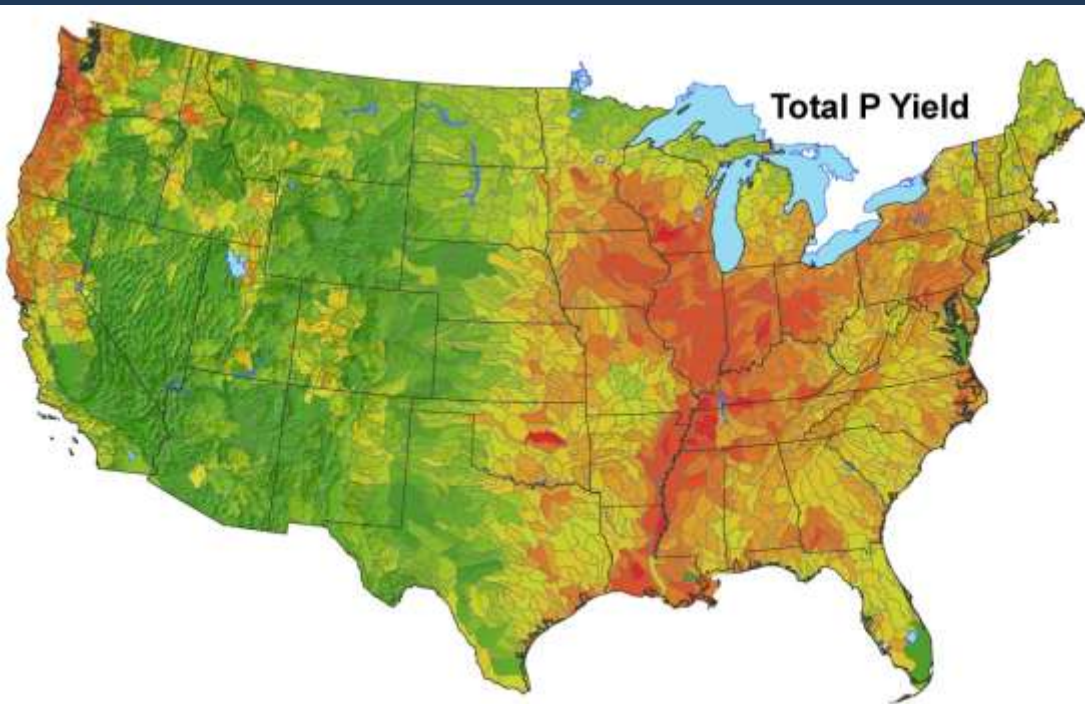
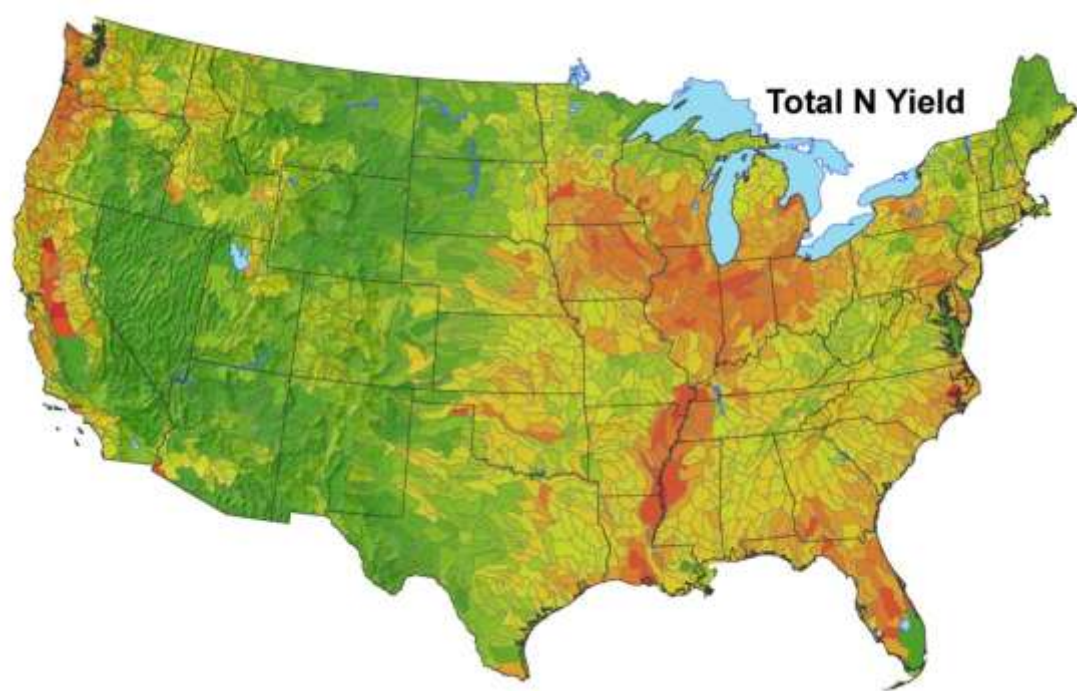


Predicted Streamflow and Sediment Yield

- Green – Low
- Red - High

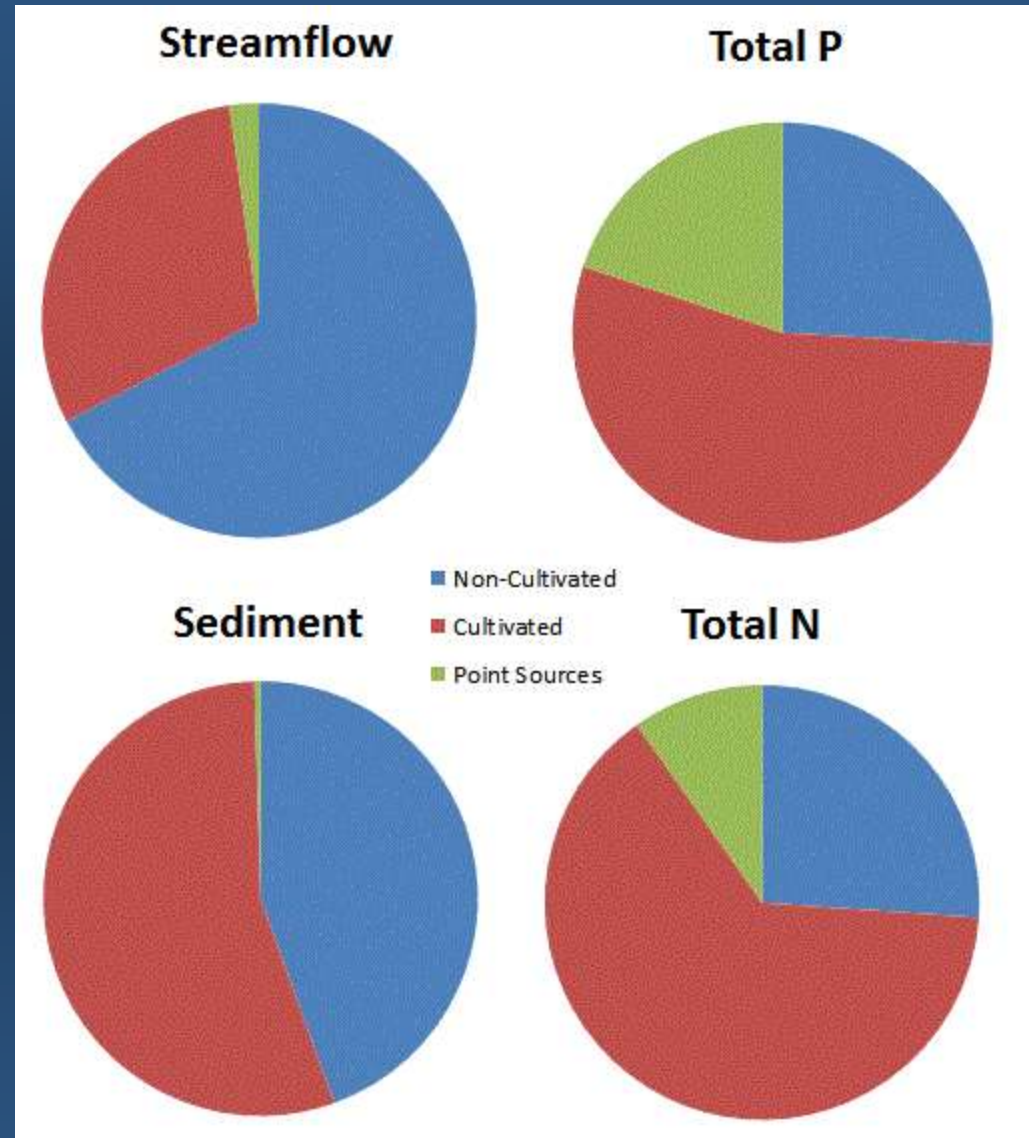


Predicted Nutrient Yields



Load Allocation Results

- Mississippi River total loads to Gulf of Mexico



Beyond CEAP (ECLIPS)

- Environmental and Conservation on Landscapes for Integrated Policy Scenarios
- Remove dependency on proprietary data
- Increase spatial resolution
 - 2,200 Subbasins (HUC 8) to 80,000 (HUC 12)
- Improve calibration data
- Rapidly incorporate new data



ECLIPS Framework

Research Configuration

Public Data



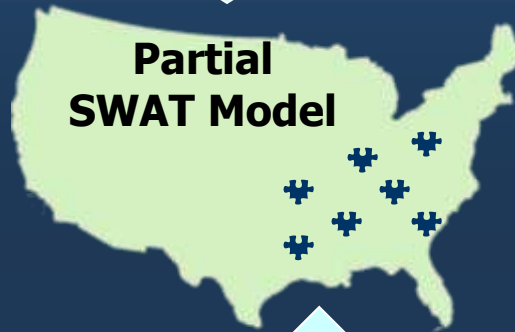
Complete
SWAT Model



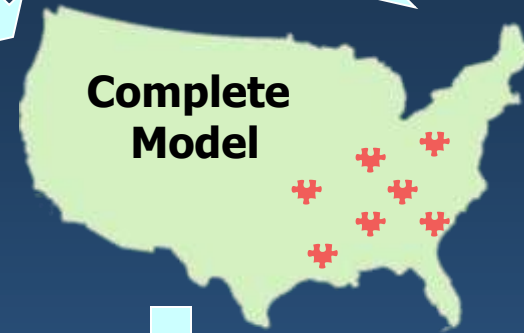
Delivered Load
Prediction

Optional Configuration

Public Data



Partial
SWAT Model



Complete
Model



SWAT Routing



Delivered Load
Prediction

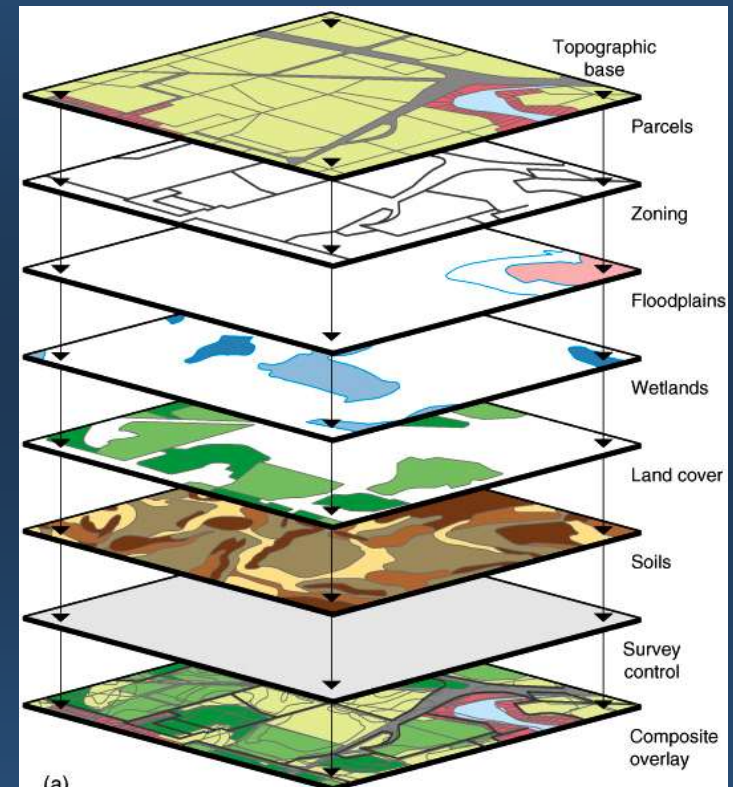
NRI Survey Data



APEX Field
Level

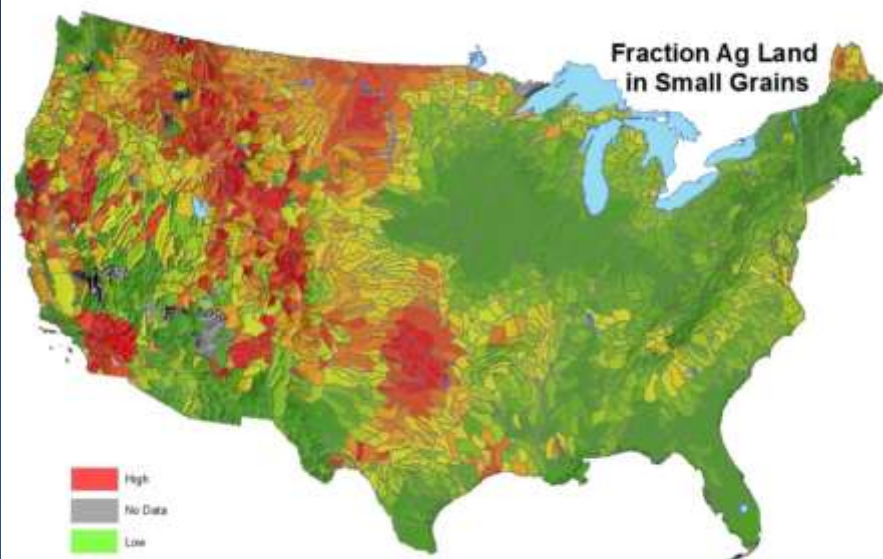
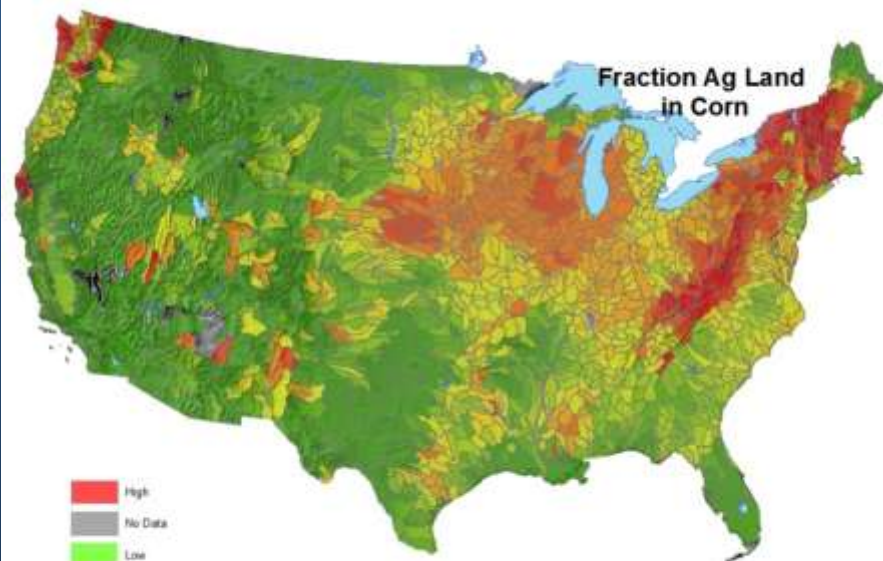
National Model Inputs

- Derived from CEAP (Except Cultivated Ag)
 - Subbasin & Reach Properties
 - Pasture and Range Management
 - Urban and Forest Management
 - Climate
 - Point Sources
- Agricultural Crop Fractions
 - Cropland Data Layer CDL
- Management
 - Fertilizer
 - Tillage
 - Management Operation
 - Planting Harvest Dates
 - Tillage Dates and Implements
 - Irrigation
 - Tile Drains
 - Manure Application
- Reservoirs
 - National Inventory of Dams



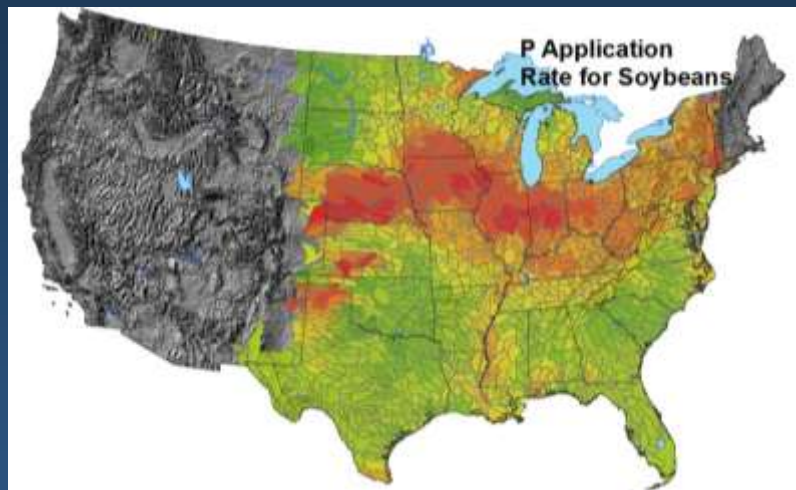
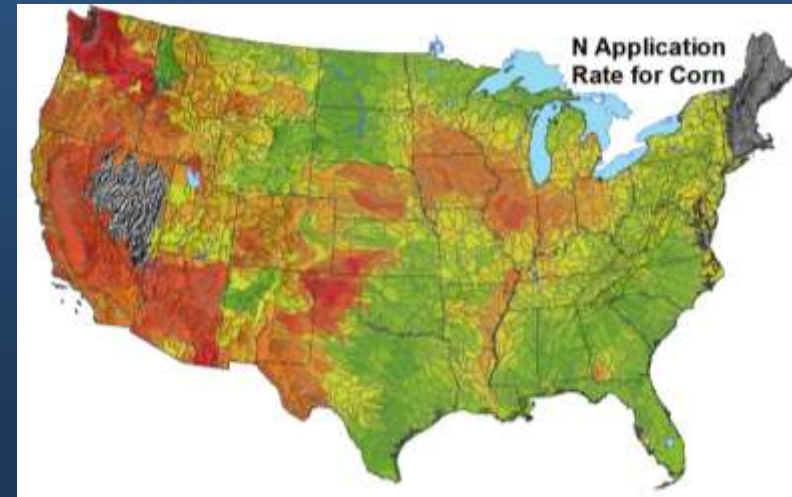
Agricultural Crops

- 2009 CDL Data
- Reclassified from 256 categories
 - Corn
 - Small grains
 - Cotton
 - Vegetables
 - Soybeans
 - Sorghum
 - Fallow



Fertilizer Application Rates

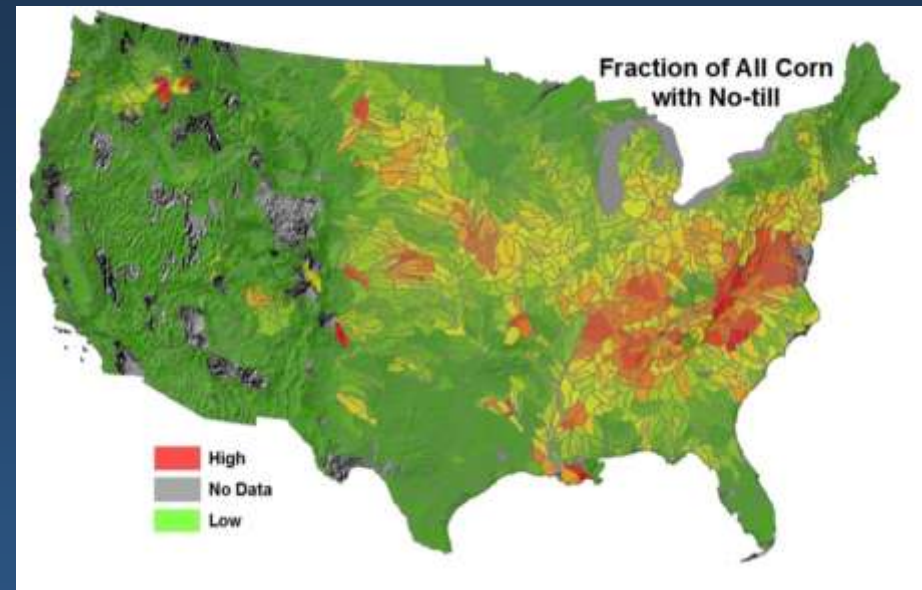
- Derived from Agricultural Census Yield and Fertilizer use data
- 1990-2010



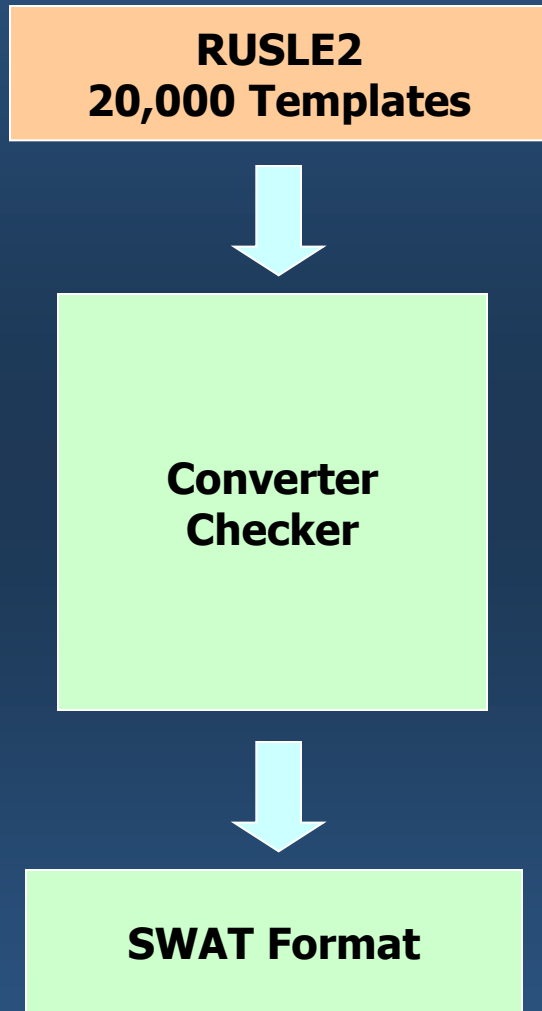
Tillage Practices



- USGS
 - Conservation Technology Information Center (CTIC) Survey Data
- Types
 - Conventional
 - Ridge
 - Reduced
 - Mulch
 - No-Till



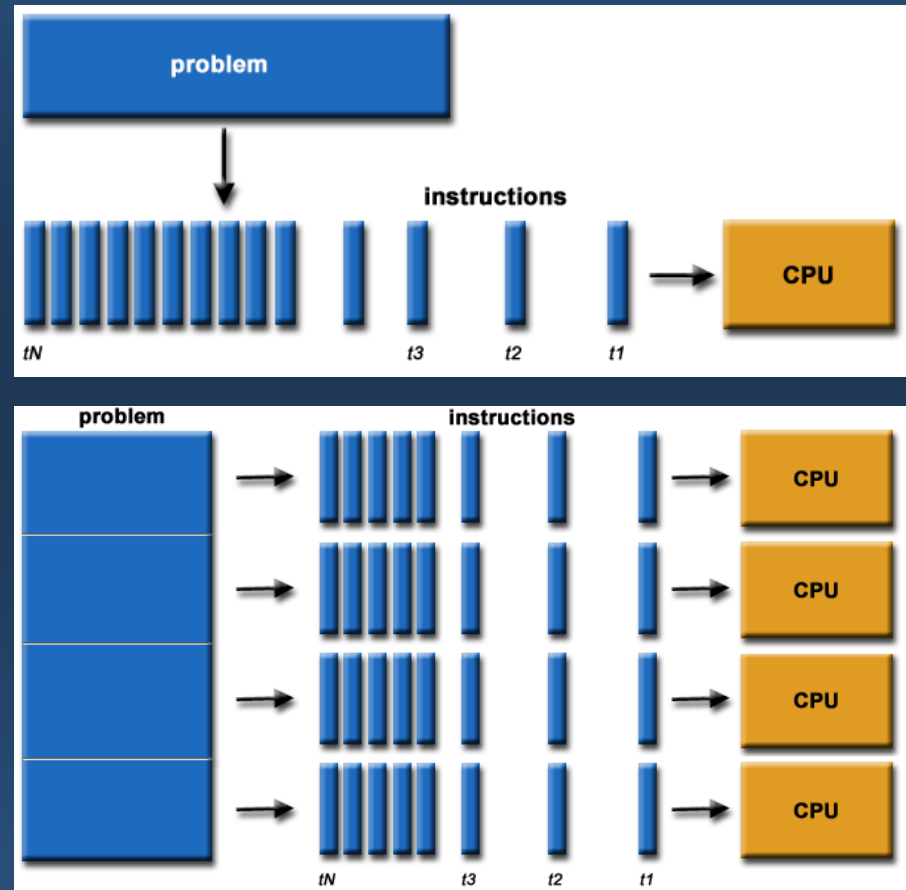
Management



- RUSLE2 Management
- Extensive Conversion
 - Cropping Assumptions
 - Plants
 - Kills
 - Harvests
 - Fertilization
- 6,000 mgt converted

Rapid Execution

- Large Models
 - Currently 2,200 subbasins – 45,000 HRU
 - Future 80,000 subbasins – 2 million HRUs
- Parallel Processing is REQUIRED



Parallelizing SWAT

- 2 Approaches
- Parallelize the model
 - Not Readily Compatible with Existing Architecture
- Parallelize the problem
 - No code changes
- Windows Cluster
 - 45,000 HRU model run for 37 Years takes 15 min



Quality Control - SWAT Checker

- Models are Difficult to Check
- **BAD INPUT DATA OR IMPROPER CALIBRATION CAN CAUSE PROBLEMS**
- Identify Model Outputs out of Normal Ranges.
- Show Visual Representations of Model Outputs



Acknowledgements

The Temple CEAP Team

- A National USDA Effort
 - NRCS
 - ARS
 - NASS
 - Texas A&M & Other Universities



Questions and Comments?