Future EPIC to SWAT Linkages

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The goal of this presentation is to stimulate cooperatives efforts

Major Components

Representative Soil Database
NRI Linkage
GIS and Ag. Census Land Use and Topography Data
Statistical Weather Data
Daily Weather Files by Grid
Agricultural Management Generator
EPIC Model
EPIC Spinup Creation of Soil Data Sets with Nutrient Content Estimates
EPIC Spinup Nitrogen Application Estimates by Crop and Grid
Semi-annual Fertilizer Sales Data by State
Fertilizer Allocation by Region by Crop by Application Timing
GIS Linkage for Output Maps
FEST-C Interface to Facilitate Analyses

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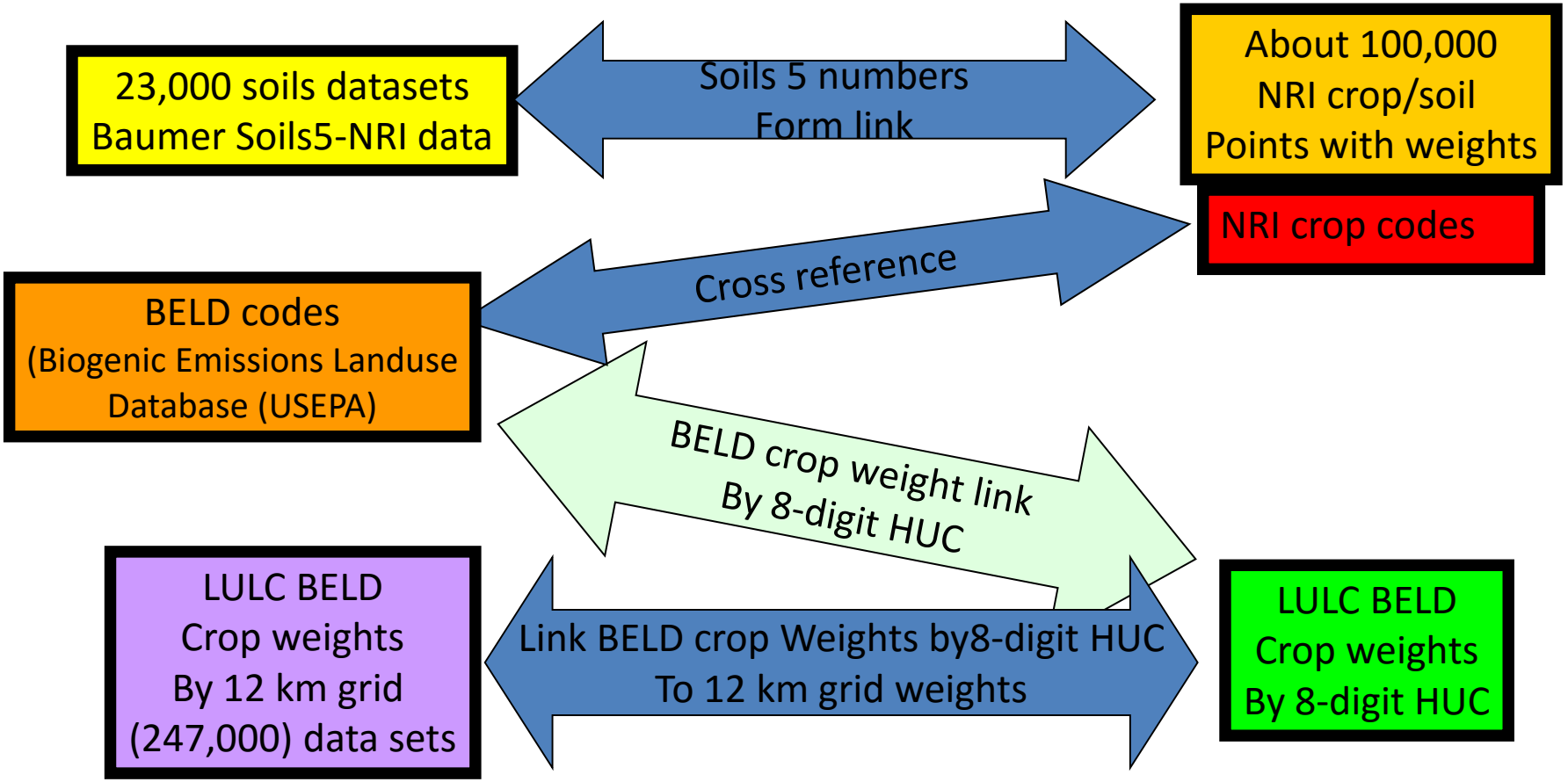
Representative Soil Database
NRI Linkage
GIS and Ag. Census Land Use and Topography Data



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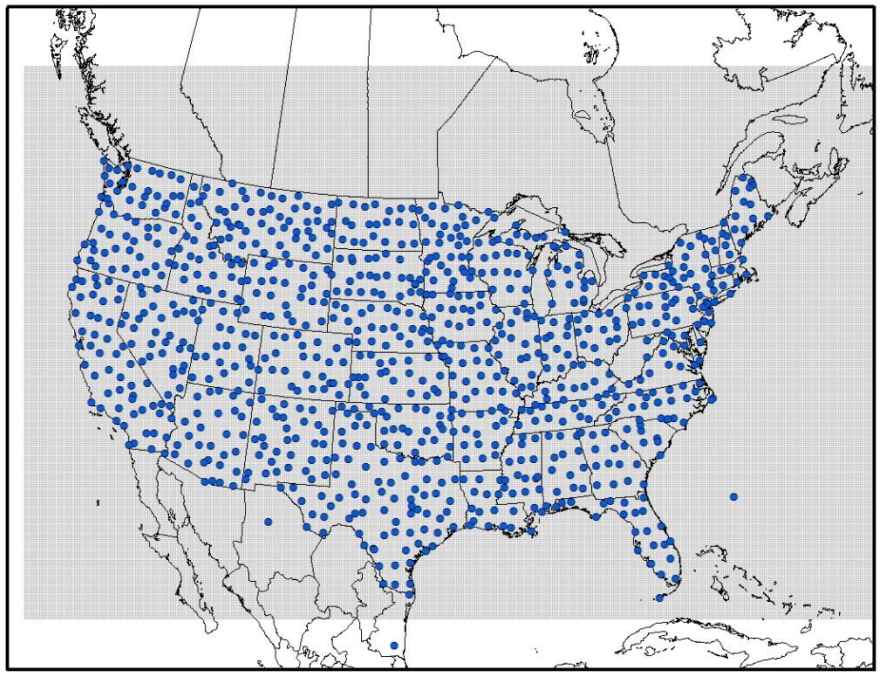
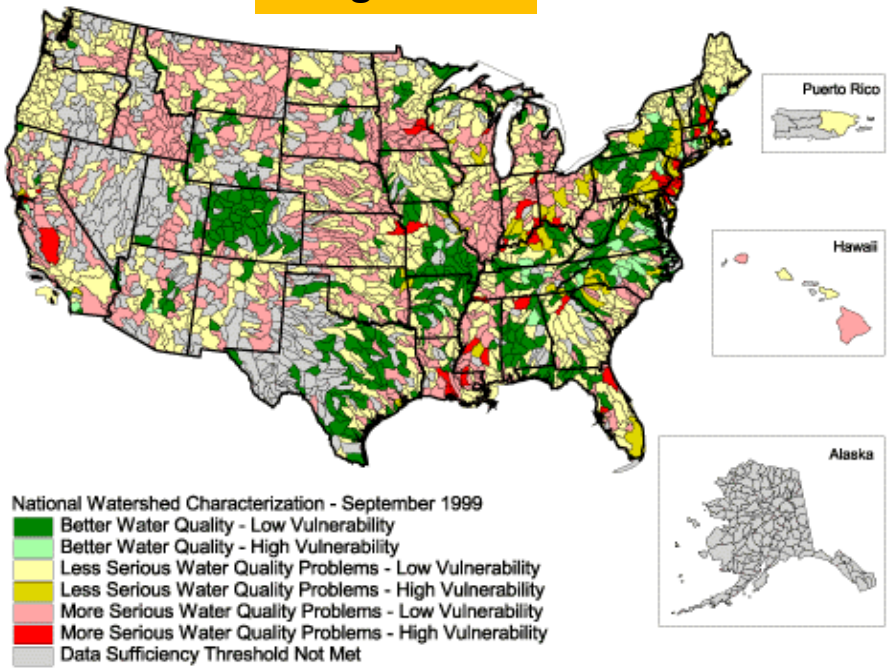
Statistical Weather Stations and 12 KM Grid Cells

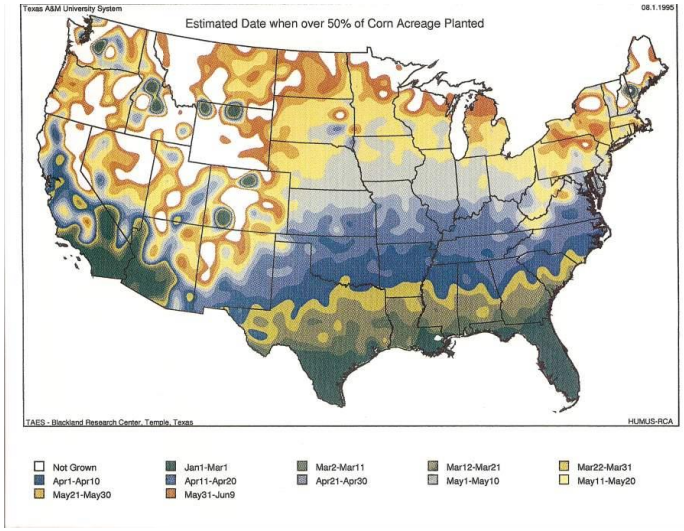


8-digit HUC's



Agricultural Management Generators (Over 500,000 files)

Plant date and germination are based on Crop base temperature Air and soil temperatures



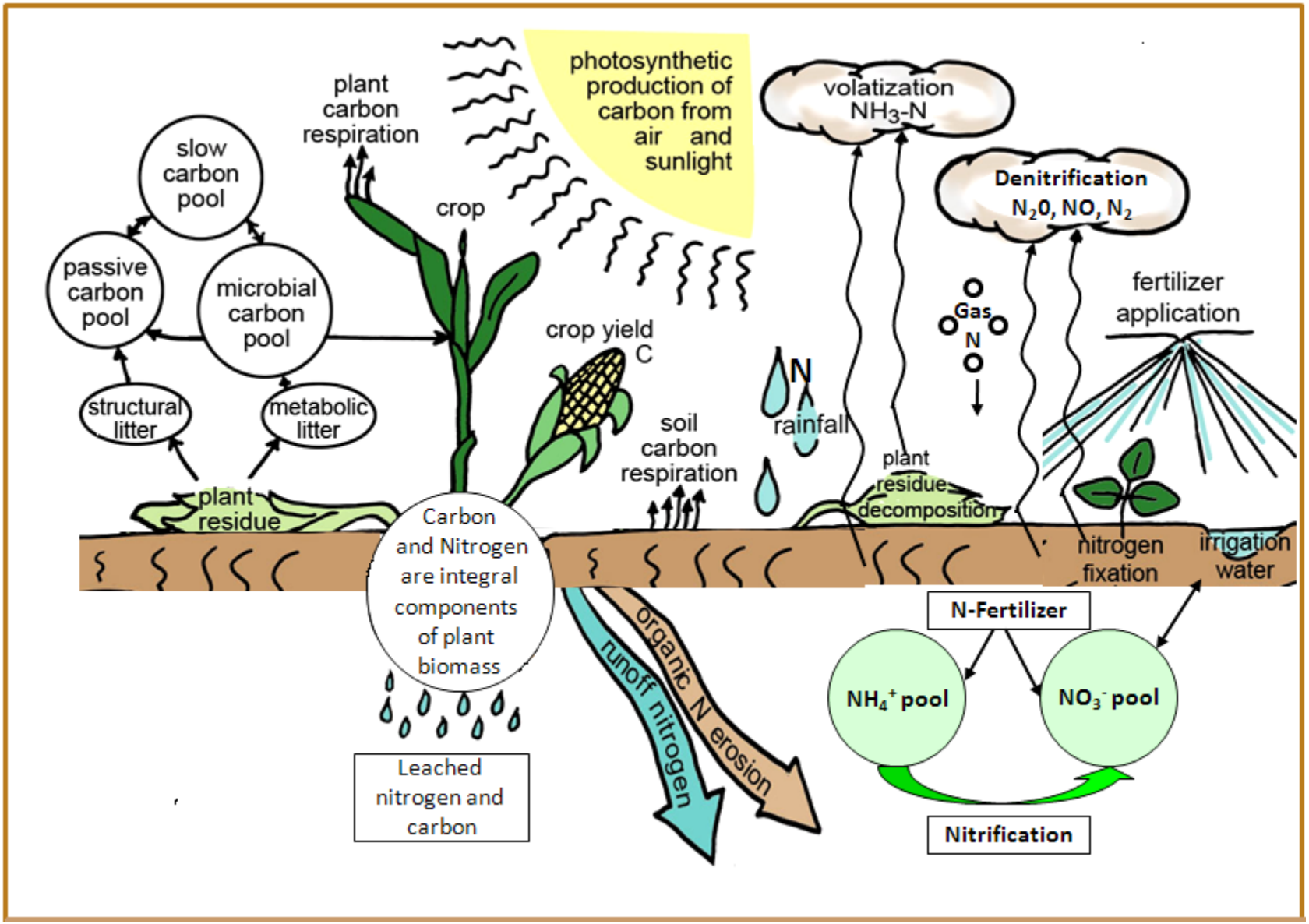
Days to maturity by variety And cumulative average temperature Are used to select the crop variety by grid

USDA Farm Production Regions

Tillage and harvest reflect Conservation tillage and Harvest with some field dry down By region based on 10 regions

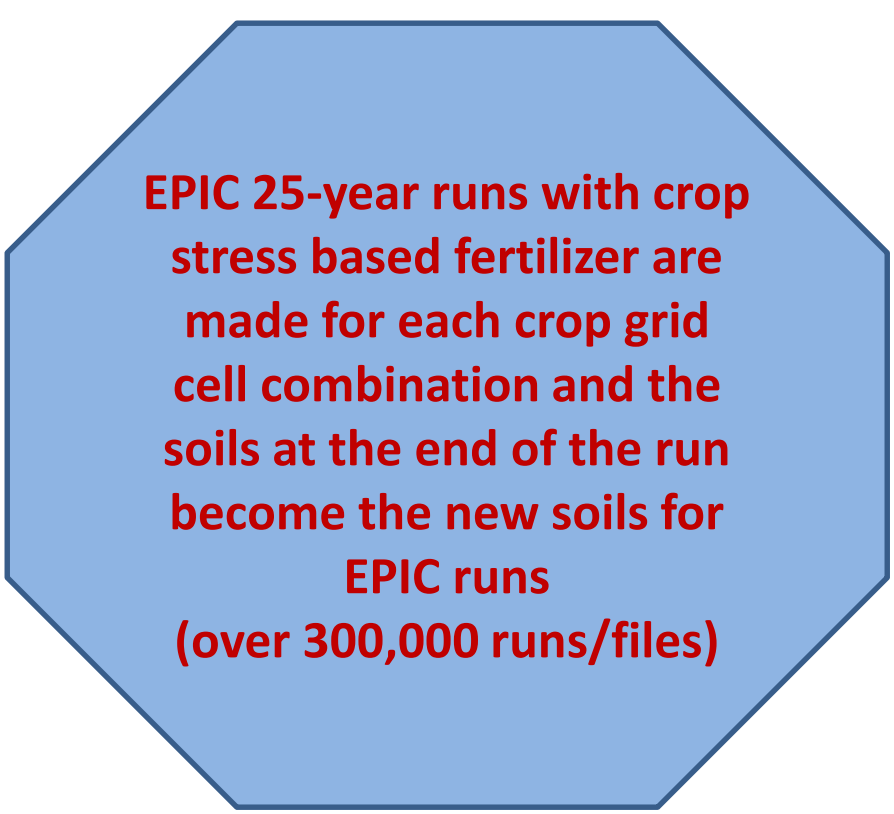
Fertilization amount, type and timing By crop by 10 regions "Based fertilizer sales and surveys"

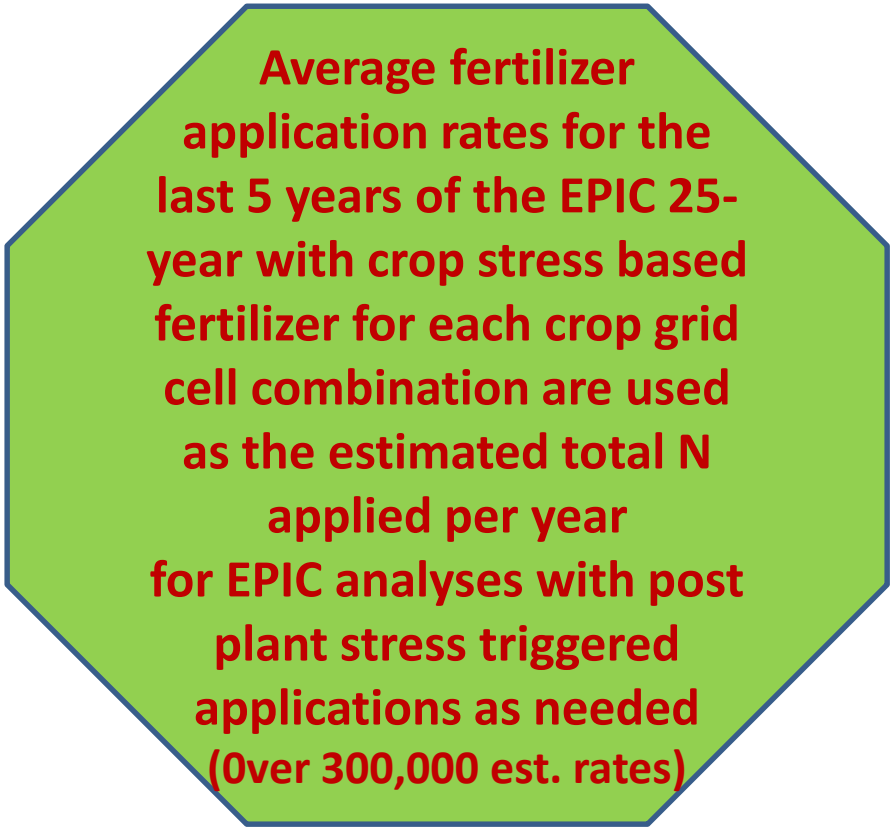
The Environmental Policy Integrated Climate (EPIC) model



EPIC Spinup Creation of Soil Data Sets with Nutrient Content Estimates

EPIC Spinup Nitrogen Application Estimates by Crop and Grid





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Semi-annual Fertilizer Sales Data by State

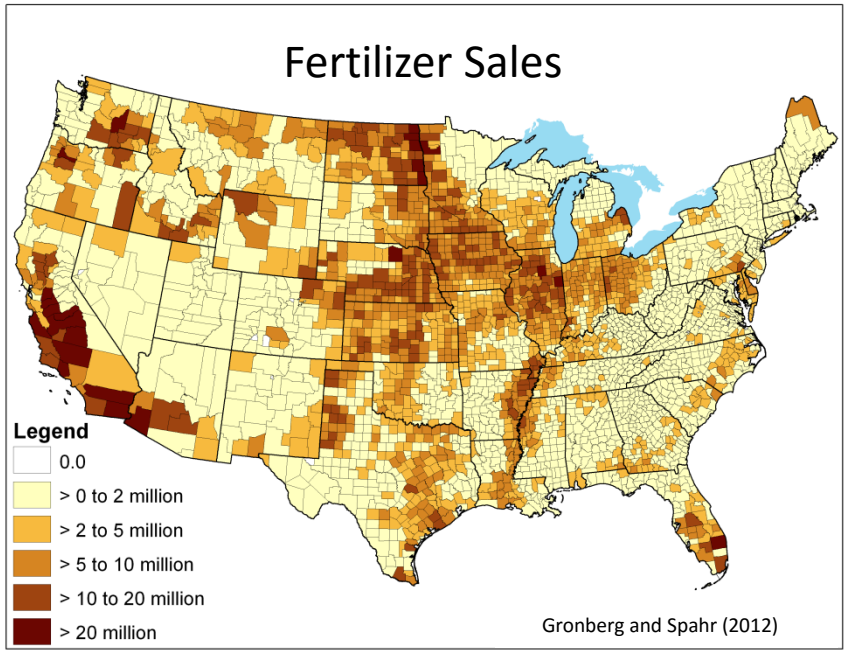
Fertilizer Allocation by Region by Crop by Application Timing

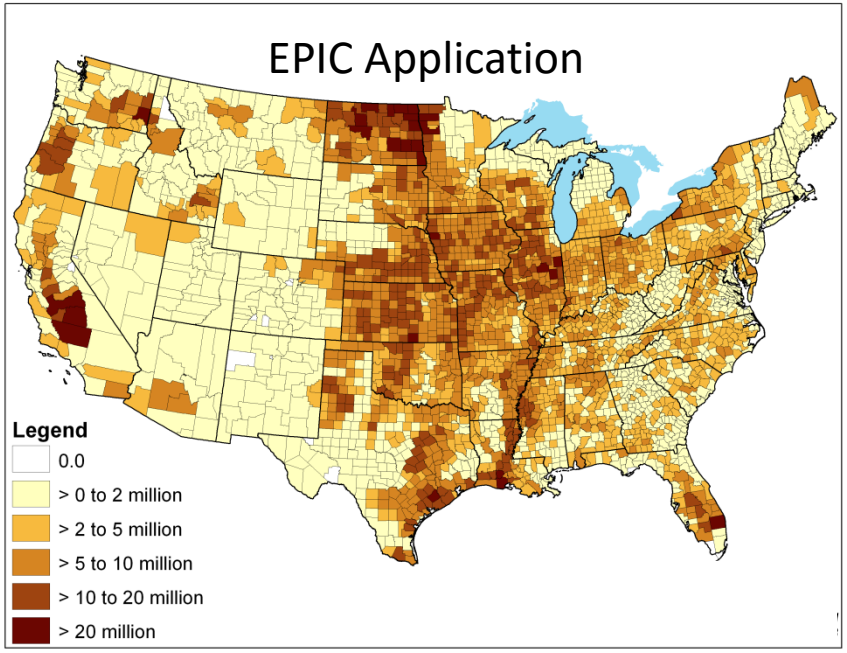
Semi-annual Fertilizer Sales Data by State is summarized by 6-month periods by production regions to estimate the fraction of total fertilizer applied by each form of fertilizer applied (62 fertilizers + manures)

Application timing by percent applied by production regions by crop by grid cell for management files (fall, spring pre-plant, and post-plant + manure in fall)

GIS Linkage for Output Maps
FEST-C Interface to Facilitate Analyses

Nitrogen Application Estimates





The system does a reasonable job reproducing regional patterns of reported agricultural fertilizer purchases and use

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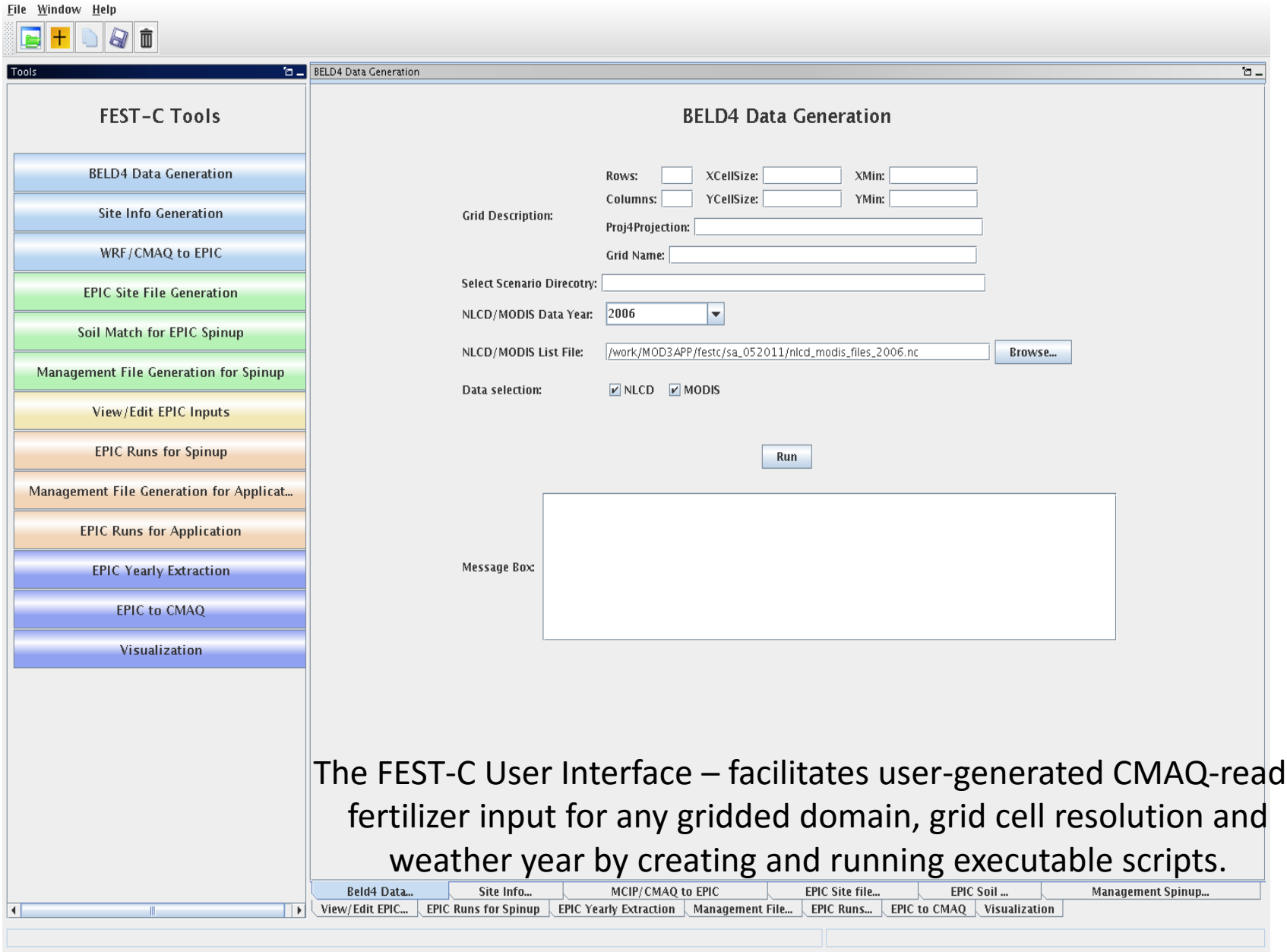

The FEST-C User Interface – facilitates user-generated CMAQ-ready fertilizer input for any gridded domain, grid cell resolution and weather year by creating and running executable scripts.

Crops Modeled (irrigated and rainfed)

- Grass Hay
- Alfalfa Hay
- Other grasses
- Barley
- Canola
- Edible Beans
- Edible Peas
- Grain Corn
- Corn for Silage
- Cotton
- Oats
- Potatoes
- Rice
- Peanuts
- Rye
- Grain Sorghum
- Sorghum for Silage
- Soybeans
- Winter Wheat
- Spring Wheat
- Other Crops

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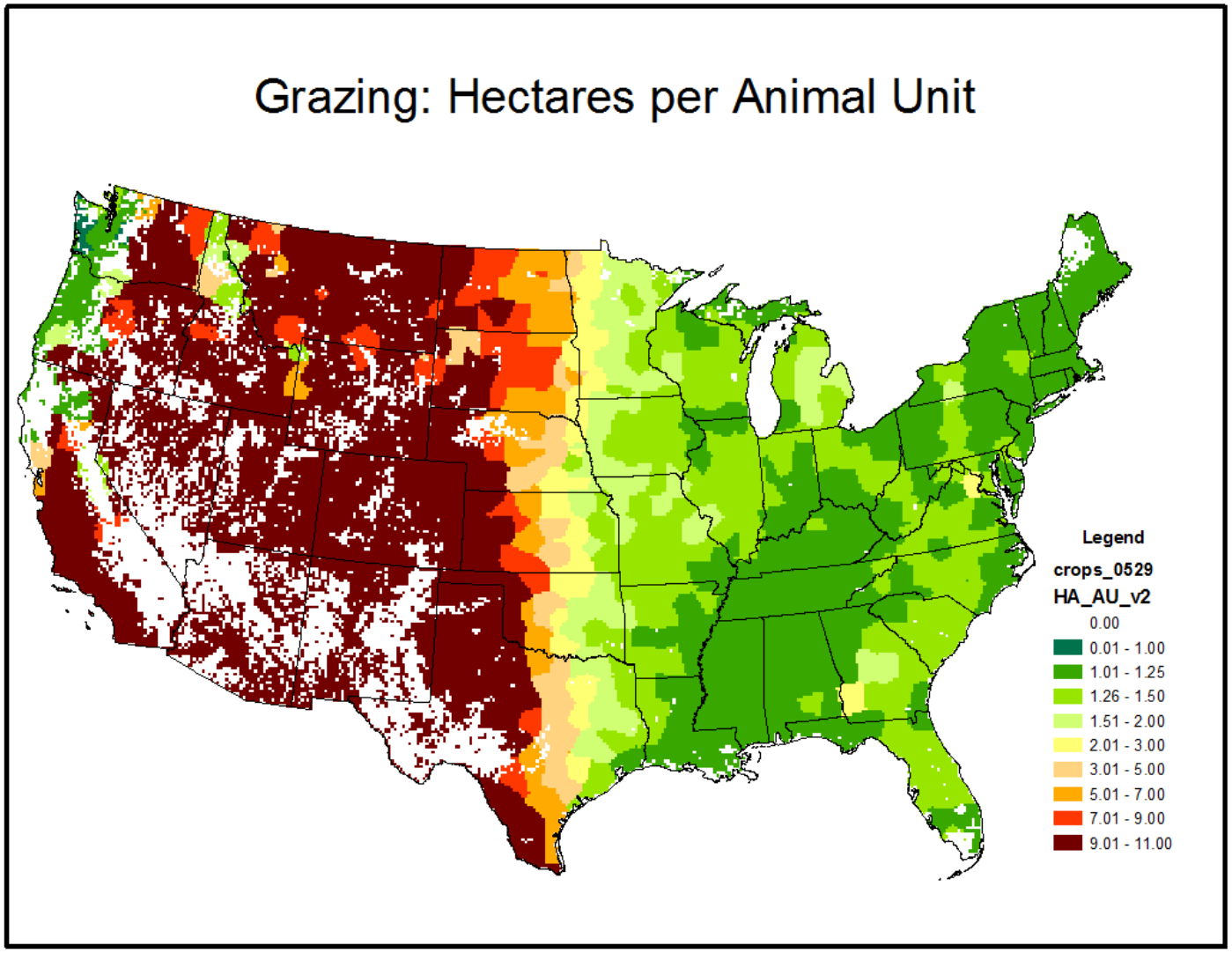

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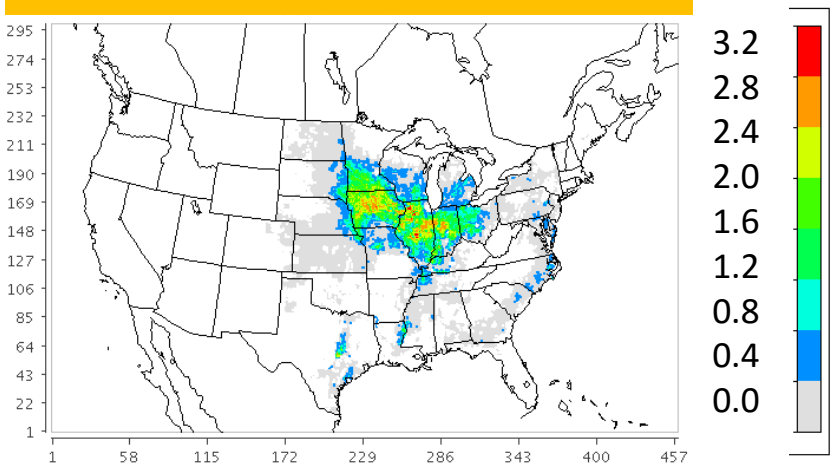
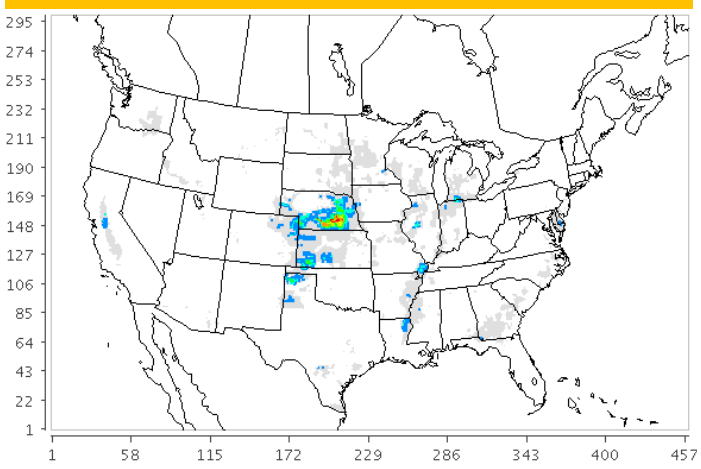
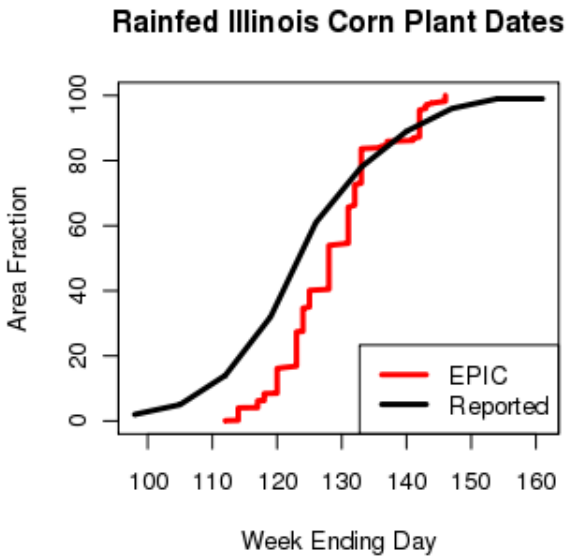
Rainfed Corn Millions Bu/Grid

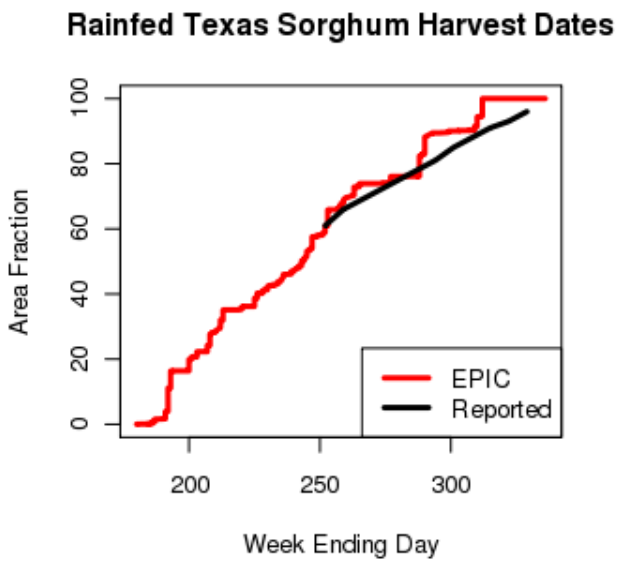


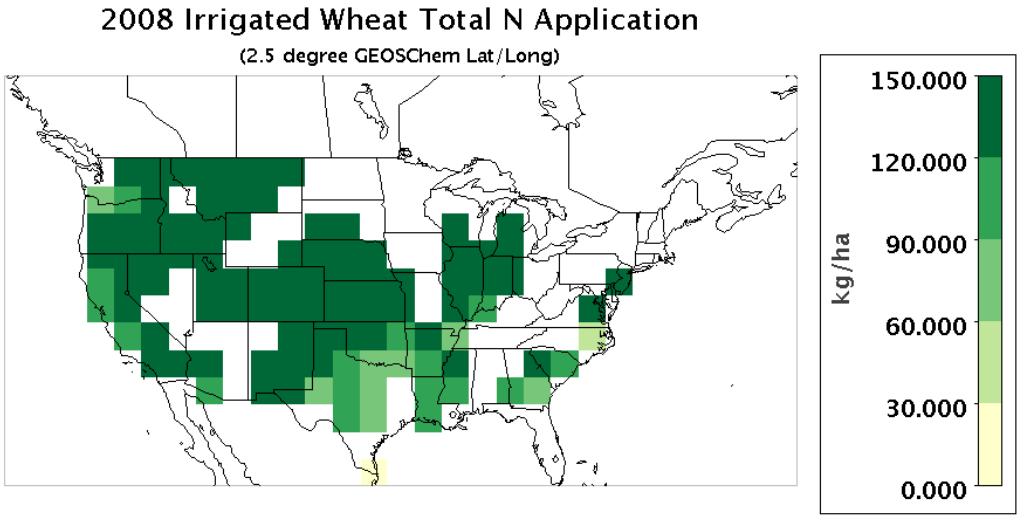
Irrigated Corn Millions Bu/Grid

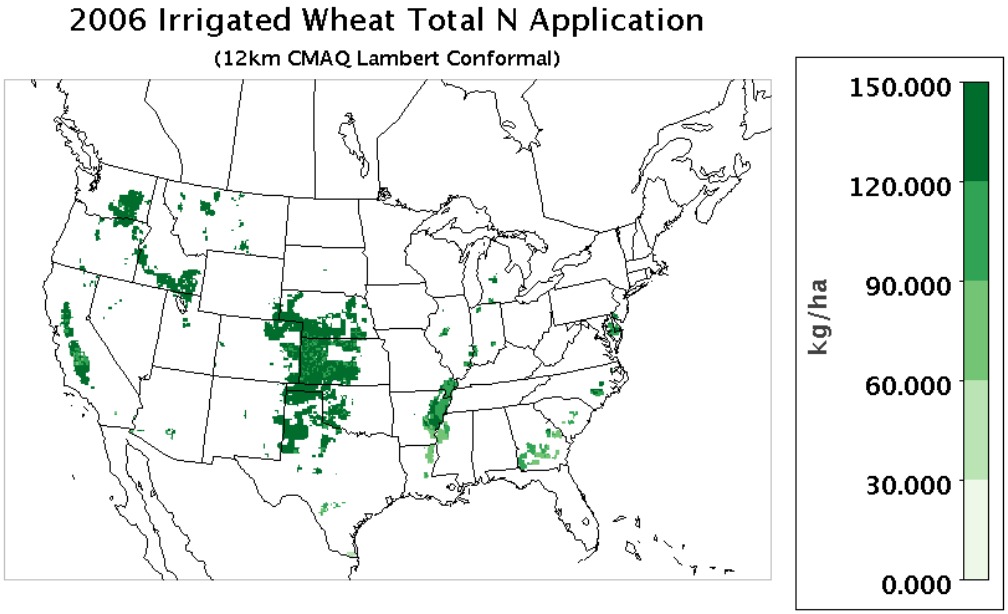


Preliminary Evaluation
Plant and Harvest Dates

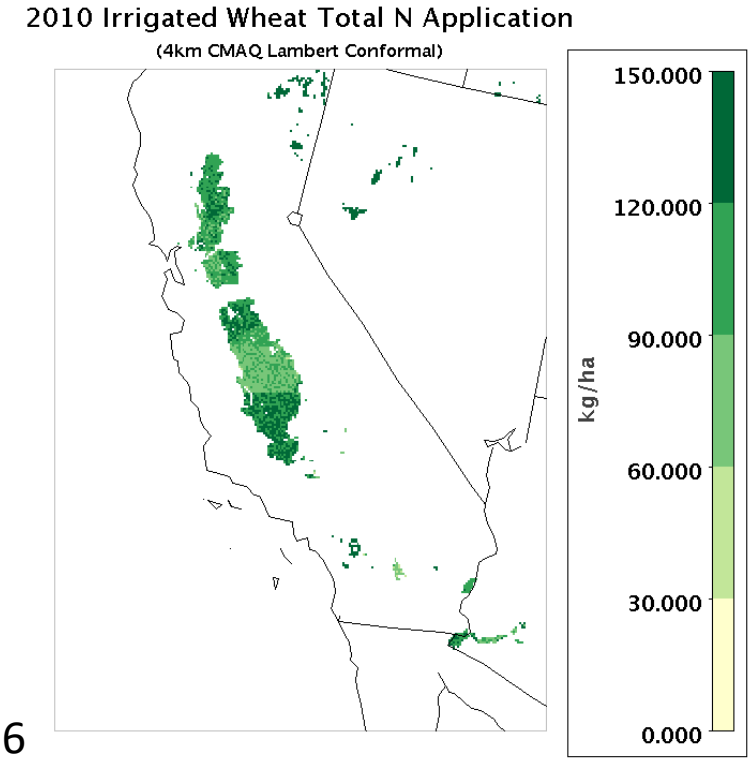








Agricultural management information can be produced for various CMAQ domains to address questions of spatial scale



Technology adaptation to other locations or applications

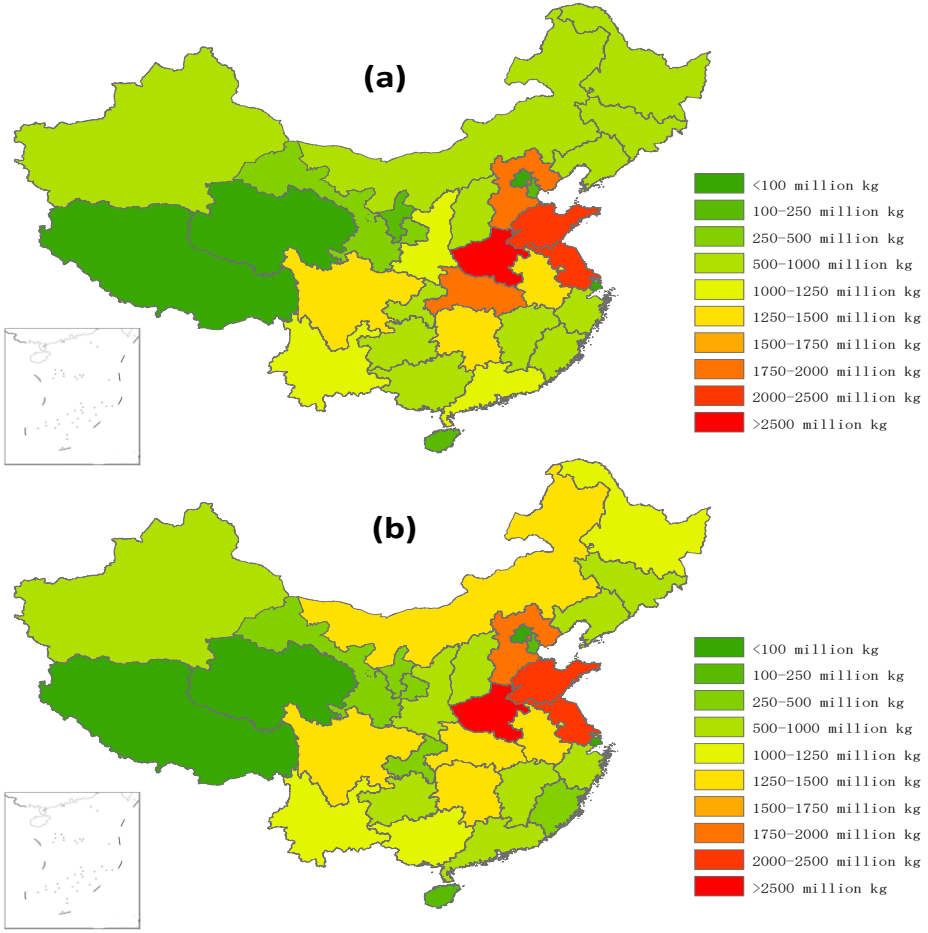


Fig.4 Comparison of annual N fertilizer use at province level between statistical data (a) and EPIC output (b). The small insert represents the south China sea and its islands
Source: Estimating NH_3 emissions from agricultural fertilizer application in China using the bi-directional CMAQ model coupled to an agro-ecosystem model by Xiao Fu et al.

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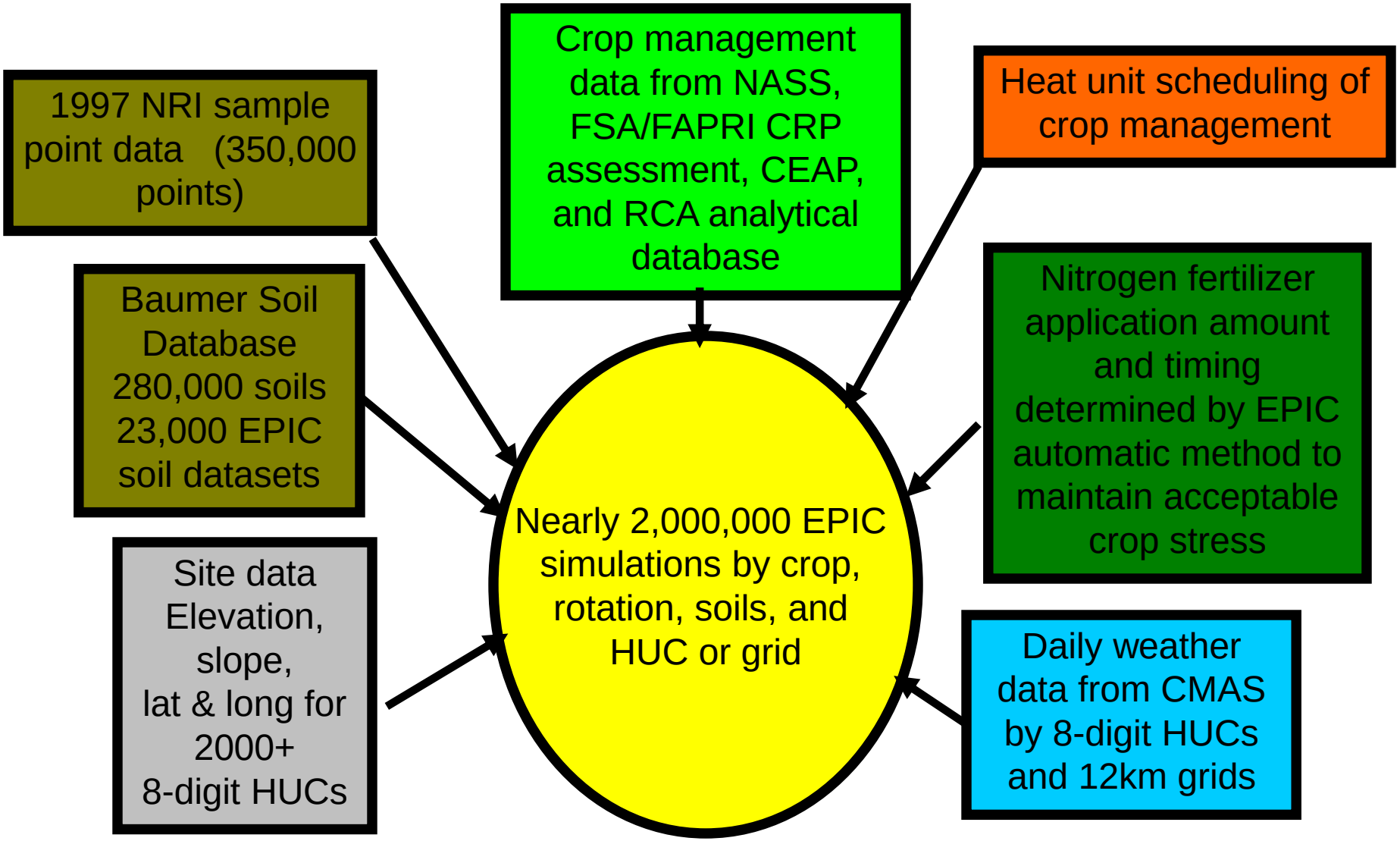

Multiple sets of simulations by alternative weathers, fertilizer practices, and cropping systems,

Future Coupled Air Quality/Agricultural N Applications for Human and Ecosystem Health

•Biofuels (ongoing)

Goal: Assess air quality and ecosystem service responses to land use and land management change associated with biofuel production

•Gulf of Mexico Hypoxia (GOM) (ongoing)

Goal: Reduce the GOM hypoxic zone extent through identification of alternative land use/land management options that could moderate nutrient loadings to the Mississippi watershed (include additional water model linkage).

• Agricultural soil N_2O emissions(ongoing)

Goal: Develop a better understanding of regional N_2O emissions from agricultural soils, improve N_2O emission inventories and identify potential mitigation strategies.

•Linkage to SWAT (ongoing)

Goal: Allow EPIC output from this project to be used directly in SWAT models for sub basins to allow 12 KM grid soil and management information use in SWAT.

•Climate Change (planned)

Goal: Explore joint air quality, water quantity and water quality implications of future climate change.

A CHALLENGE for the Future

Design and Build a Linear Programing Model

Minimizing the Environmental Impacts of Producing Nutrients for Humans and Animals

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Use SWAT, CEAP and FEST-C Analyses to Create Pollutant Indices and Food Production Estimates

Build a Regional Prototype Matrix for the Cornbelt

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Conceptual Matrix

The columns in this matrix are production and conversion activities that represent crops and their conversion tohuman nutrition needs											
Title	Crop 1 Grid 1 per acre	Crop 1 Grid 1 acres	Crop 2 Grid 1 per acre	Crop 2 Grid 1 acres	Crop1 grid 1 production	Crop2 grid 1 production	Crop1 Nutrition per unit yield	Crop2 Nutrition per unit yield	Nutrients Poultry per lb liveweight	Nutrients Human per adult per year	Total needs
Polut Ind	PI11										MinimizeTot
Ad Polut Ind	API11										AltMinimizeTot
N Loss											
Air	Nvol11		Nvol21								
Runoff	NQ 11		NQ 21								
Perk	Nperk11		Nperk21								
P Loss											
Air	Nvol11		Nvol21								
Runoff	NQ 11		NQ 21								
Perk	Nperk11		Nperk21								
Soil Loss											
Air	WindEros11		WindEros21								
Runoff	WaterEros11		WaterEros21								
Yield	Yield 11		Yield21								
Acres crop 1 grid 1	1	-acres crop1 grid 1									
Acres crop 2 grid 1			1	-acres crop2 grid 1	1	1					
Production crop1 grid1					- Yield 11		1				
Production crop2 grid1						- Yield 21		1			
Vegetable											
Calories							-Calories	-Calories	calories	calories	
VegProtien							-VegProtien	-VegProtien	protein	protein	
Meat											
Calories									-calcories	calories	
AnimProtien									-protein	protein	
Human needs										1	population
AccPI11					-PI11						MinimizeTot
AccAPI11					-API11						AltMinimizeTot
AccPI21						-PI21					MinimizeTot
AccAPI21						-API21					AltMinimizeTot

Future EPIC to SWAT Linkages

- The Goal is to Quantify the Relationships Between
- the Production of Nutrients for Humanity
  - and Environmental Pollution Creation
- Then Use those Quantitative estimates to Develop Improved Environmental Policies

Expand Regional Prototype to National and Ultimately World-wide levels

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