

MODELING CARBON CHANGES IN AGRICULTURAL SOILS

**FORESTRY AND AGRICULTURE MODELING FORUM
14 OCT 2004**

**John Brenner and Joel Brown
USDA NRCS**

CarbOn Management Evaluation Tool (VRGG-COMET)

- **Calculation tool designed for use with DOE 1605b Voluntary Greenhouse Gas Reduction Reporting System**
- **Based on 20 Land Resource Regions with subdivisions**
- **Based on**
 - **Climate, soil and land use data from existing databases**
 - **Management practices from Rural Carbon Sequestration Appraisal technique**
 - **Century SOM Model**
 - **Outputs include uncertainty estimate**



USDA NRCS National Conservation Service



Quantifying the change in greenhouse gas emissions due to natural resource conservation practice application in Iowa

"The Iowa Carbon Storage Project"

Final Report to the Iowa Conservation Partnership
March, 2001
Revised Nov., 2006



A collaboration effort between USDA-NRCS, Iowa State University, and the Iowa Conservation Partnership. Prepared by: John Deere, Ed Schuler, George W. Johnson, and John Williams.

Prepared By:
John Deere
Ed Schuler
George W. Johnson



USDA NRCS National Conservation Service



Quantifying the Change in Greenhouse Gas Emissions due to Natural Resource Conservation Practice Application in Indiana

"The Indiana Carbon Storage Project"

Report to the Indiana Conservation Partnership
February, 2002



Legend:
Yellow: 0-100
Orange: 100-200
Red: 200-300
Green: 300-400
Dark Green: 400-500

A collaboration effort between USDA-NRCS, Indiana State University, and the Indiana State University - Natural Resources Ecology Laboratory, Fort Collins, CO.

Prepared By:
The Staff, John Deere, Ed Schuler, George W. Johnson, John Williams, and John Deere.

Primary Contacts:
Neil Pasolun, Natural Resources Ecology Laboratory, Indiana State University, Fort Collins, CO.
John Deere, USDA-NRCS, Fort Collins, CO.



USDA NRCS National Resources Conservation Service



Quantifying the change in greenhouse gas emissions due to natural resource conservation practice application in NE



"The Nebraska Carbon Storage Project"

Report to the Nebraska Conservation Partnership
March, 2002

A collaboration effort between Colorado State University - Natural Resources Ecology Laboratory, the State of Nebraska, USDA-NRCS, and the US Department of Energy.

Prepared By:
The Staff, Ed Schuler, George W. Johnson, John Deere, John Williams, and John Deere.

Primary Contacts:
Neil Pasolun, Natural Resources Ecology Laboratory, Colorado State University, Fort Collins, CO.
John Deere, USDA-NRCS, Fort Collins, CO.

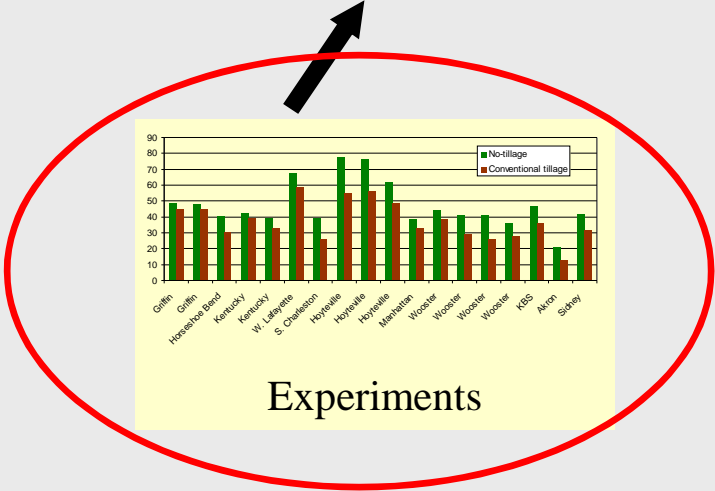
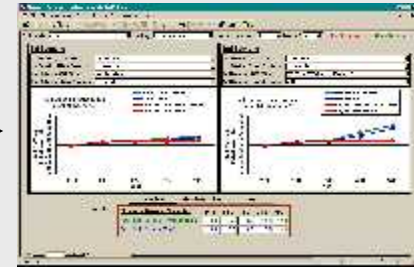
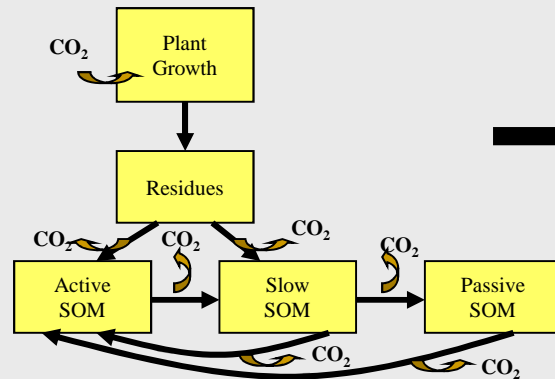
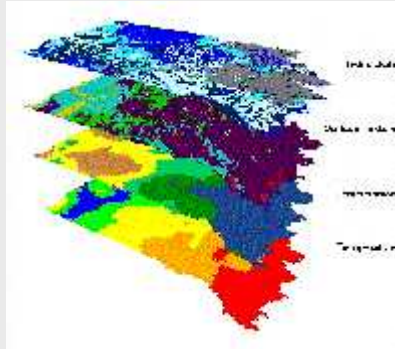
Survey Data: Land Use and Management

Modeling Procedure

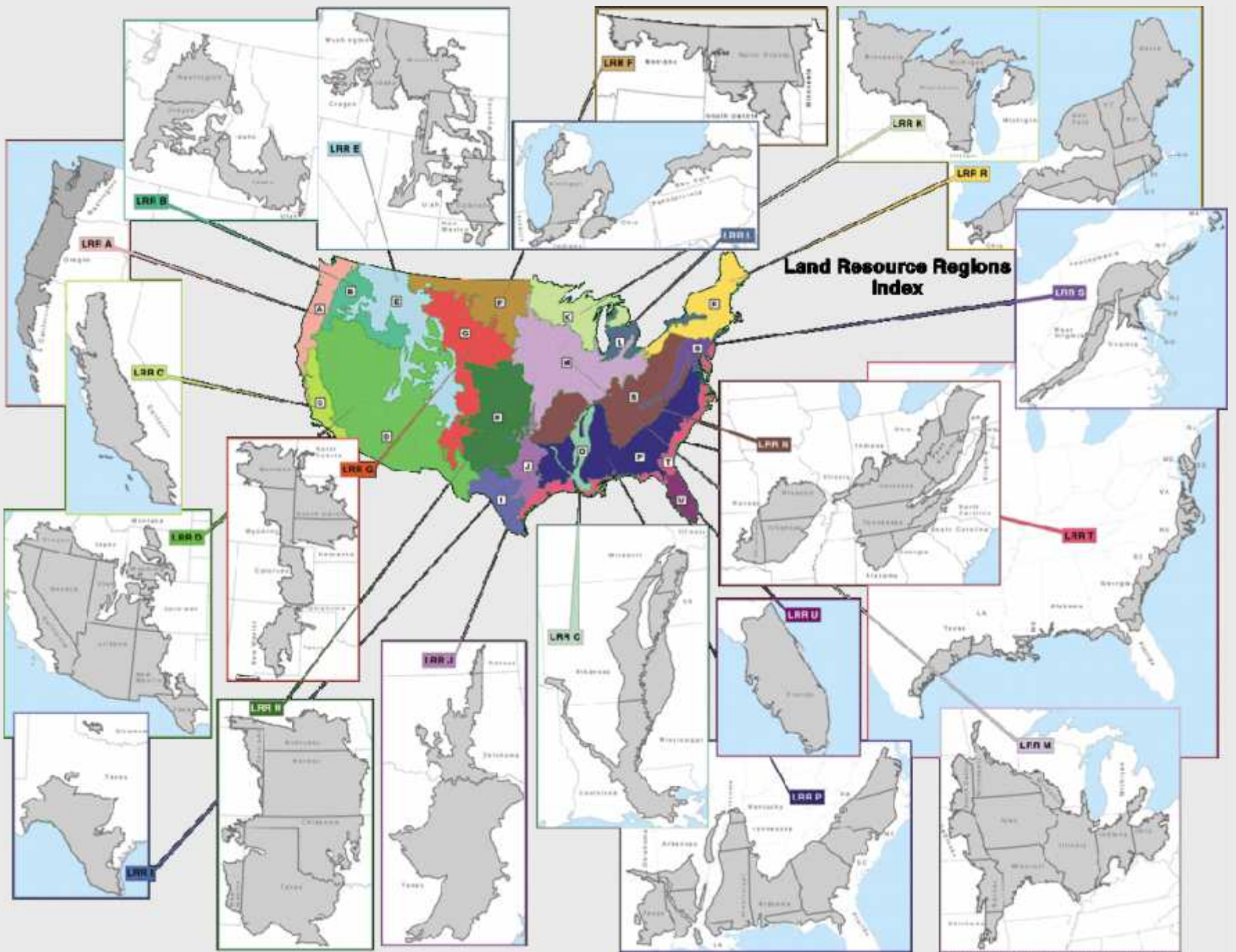
Simulation Model

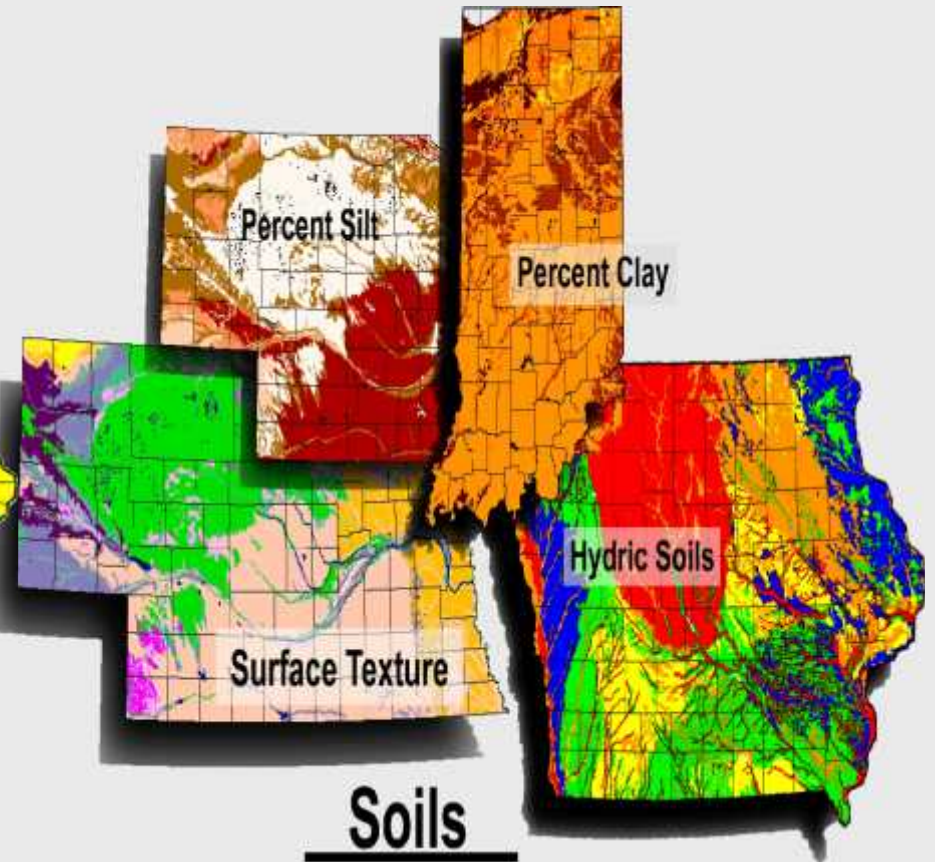
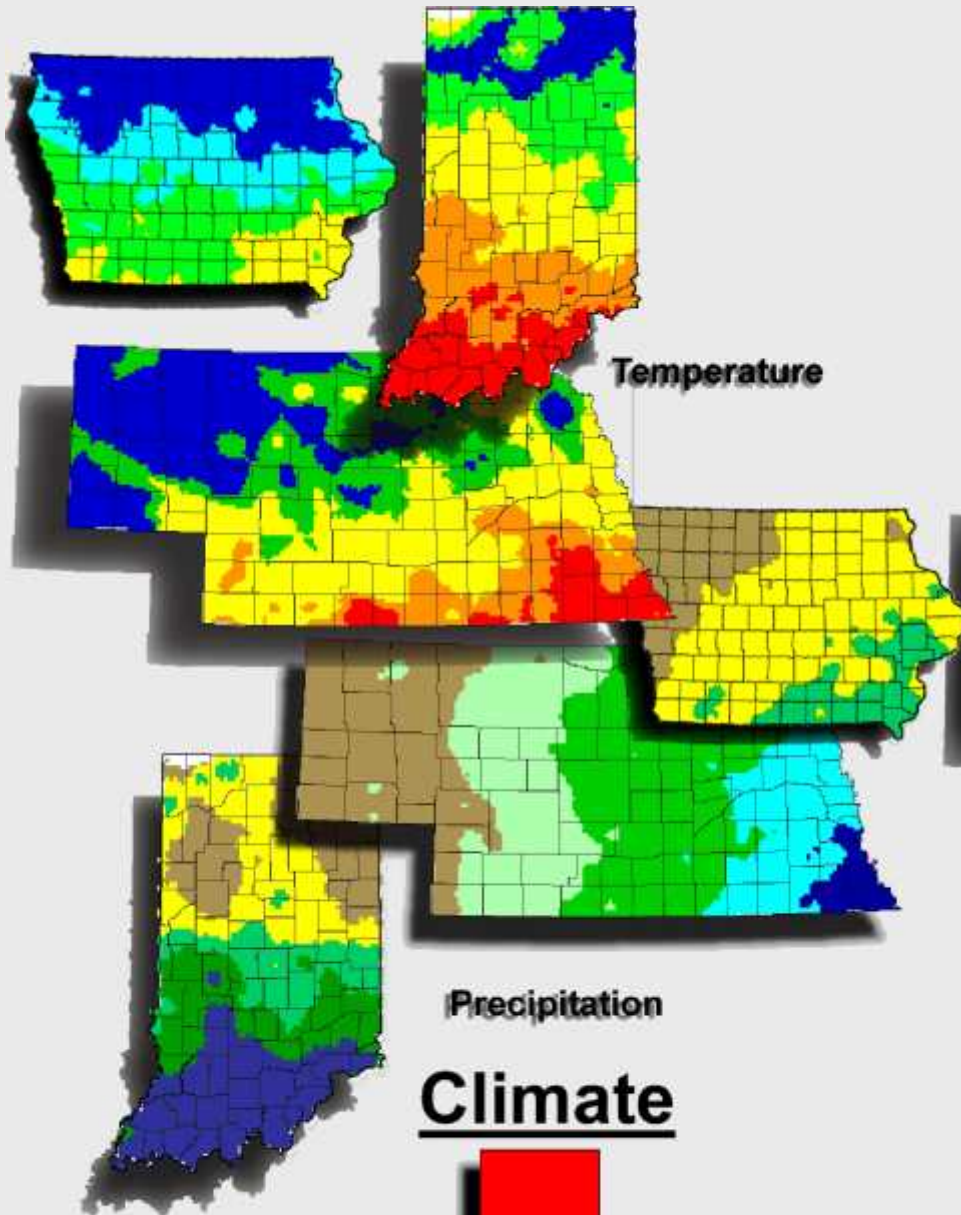
Results

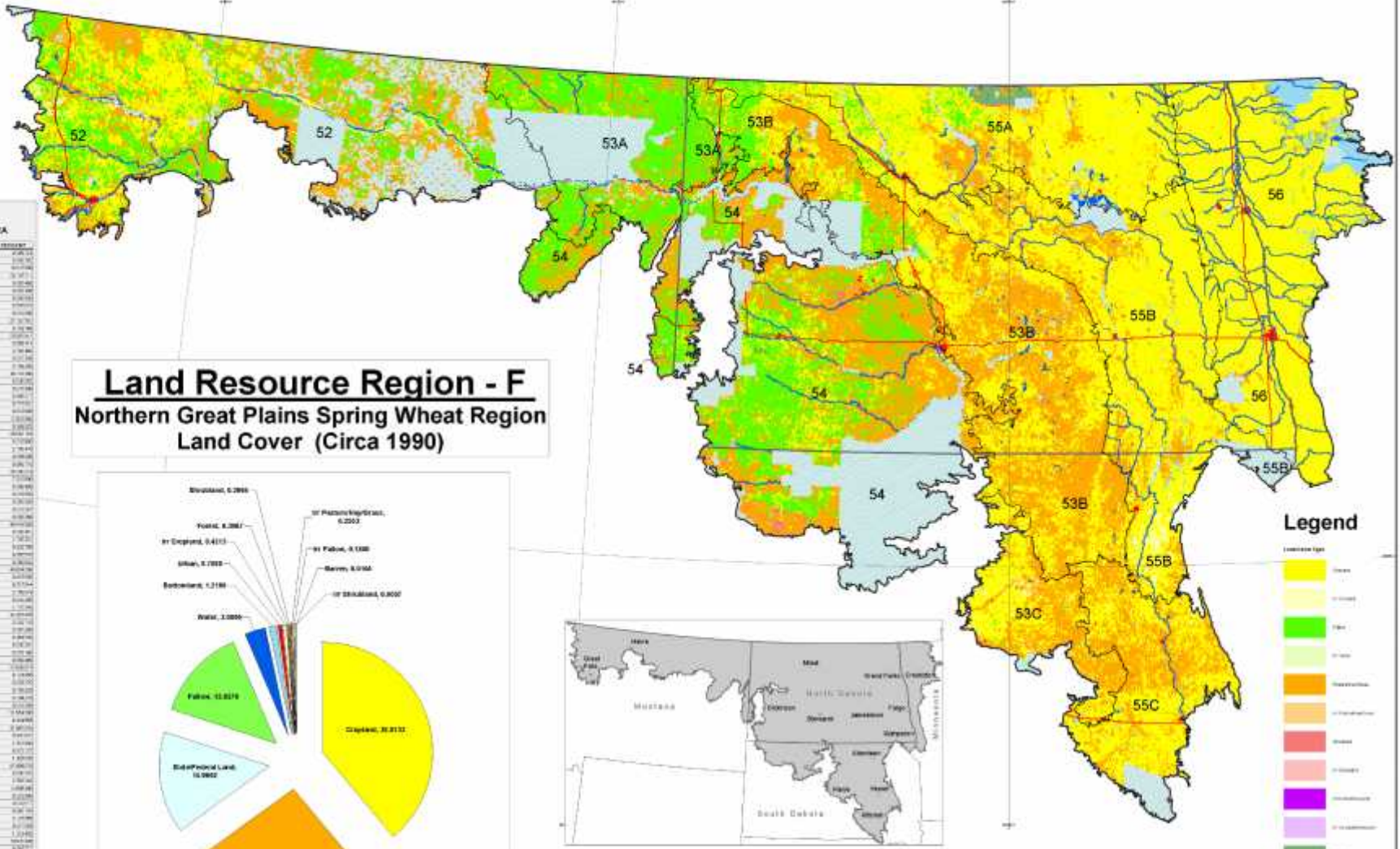
Spatial Data: Soils and Climate



Uncertainty Estimator



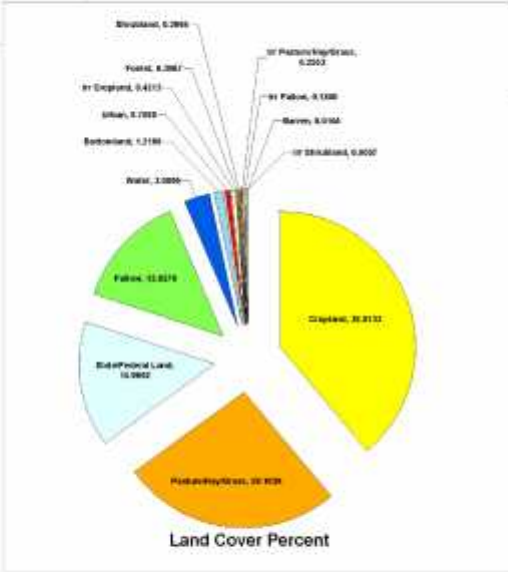




Land Resource Region - F
Northern Great Plains Spring Wheat Region
Land Cover (Circa 1990)

Land Cover in Percent of MLRA

MLRA	LC	PERCENT
52	1	24.00
52	2	1.00
52	3	1.00
52	4	1.00
52	5	1.00
52	6	1.00
52	7	1.00
52	8	1.00
52	9	1.00
52	10	1.00
52	11	1.00
52	12	1.00
52	13	1.00
52	14	1.00
52	15	1.00
52	16	1.00
52	17	1.00
52	18	1.00
52	19	1.00
52	20	1.00
52	21	1.00
52	22	1.00
52	23	1.00
52	24	1.00
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52	26	1.00
52	27	1.00
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52	90	1.00
52	91	1.00
52	92	1.00
52	93	1.00
52	94	1.00
52	95	1.00
52	96	1.00
52	97	1.00
52	98	1.00
52	99	1.00
52	100	1.00



1 inch equals 20 miles
 1:1,243,376



Source:
 National LRR 1995 (b) Carbon Sequestration Analysis,
 USDA Natural Resources Conservation Service (NRCS)
 and Colorado State University Natural Resources Ecology
 Lab (NREL), 06/2003.

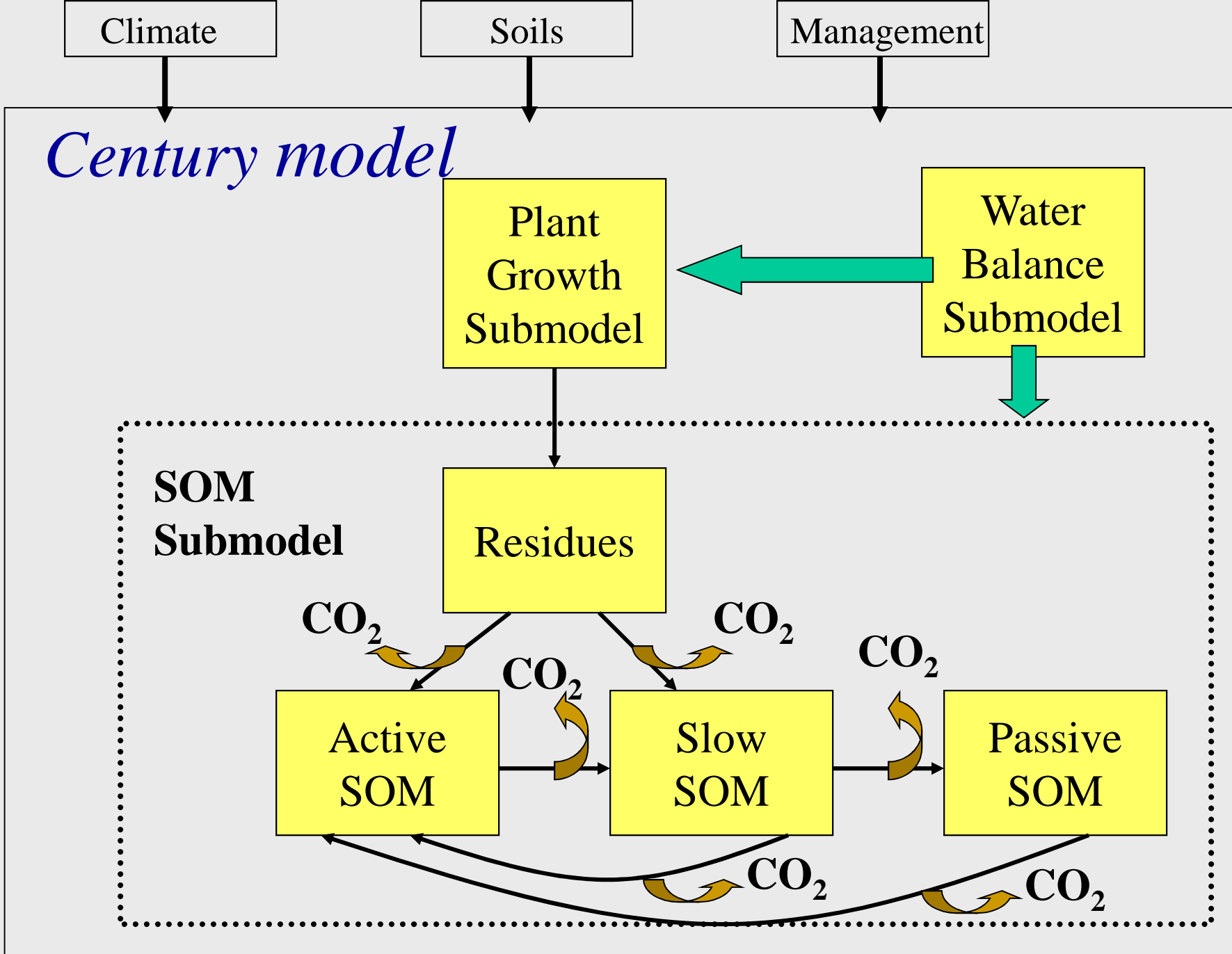
Data Source:
 Land Cover is based on NLCD National Land Cover Data.
 This dataset was produced by the U.S. Geological Survey (USGS)
 and the U.S. Environmental Protection Agency (EPA).
 NLCD was developed using early 1990's Landsat Thematic Mapper
 (TM) imagery. This dataset was enhanced using several source layers
 from 1999 - 2002.

2002 National MLRA for coterminous US, USDA NRCS, National Soil
 Survey Center, Lincoln, NE
 1998 Federal Lands for US, US National Atlas.
 1997 State Lands derived from US Parks.

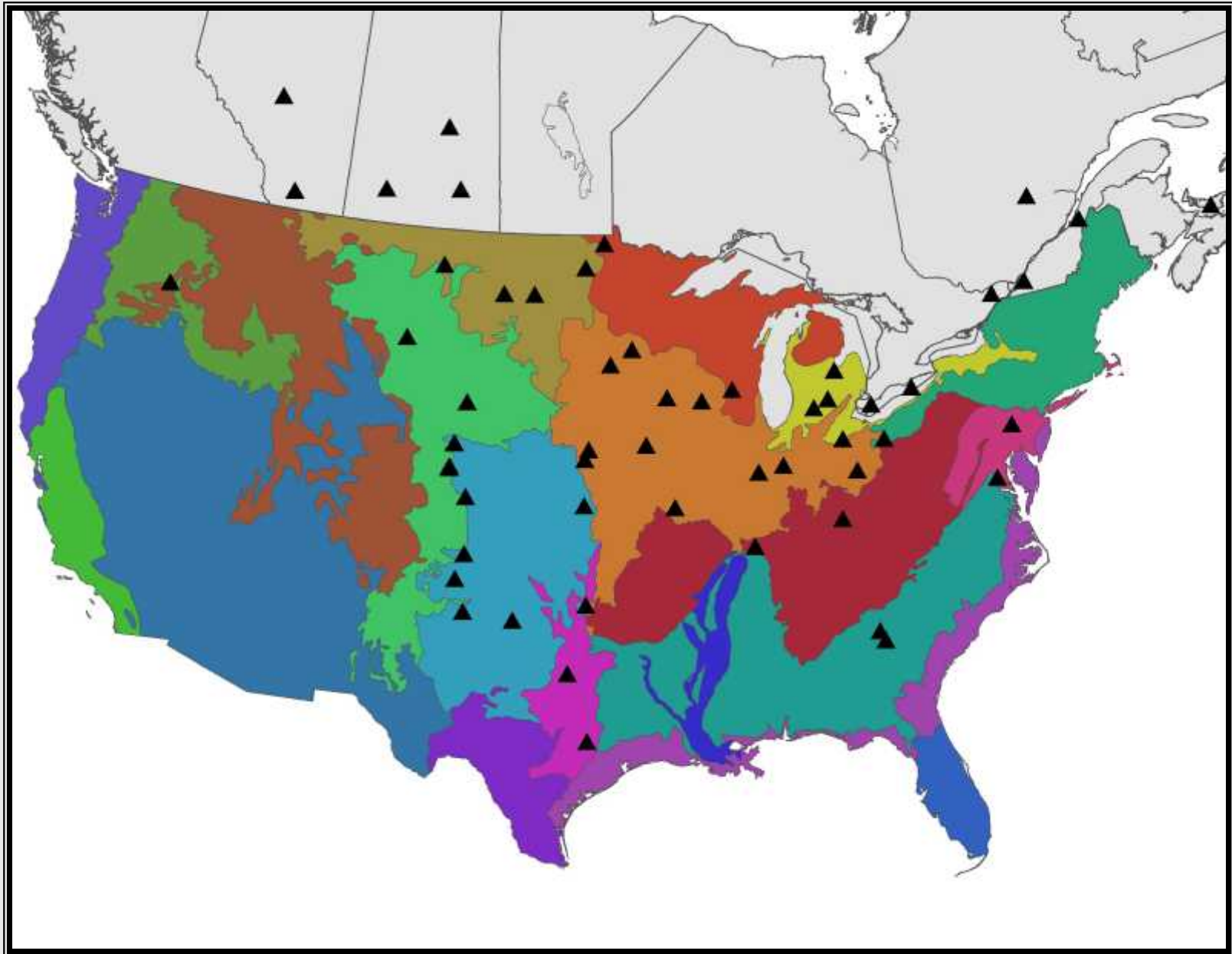
Lambert Azimuthal Equal-Area Projection

COORDINATE SYSTEM DESCRIPTION

Projection	LAMBERT_AZIMUTHAL
Datum	NAD83
Units	METERS
Major Axis	6370827.00000
Minor Axis	6300000.00000
False Easting (meters)	500000.00000
False Northing (meters)	500000.00000
Cell Size	1000 X 1000



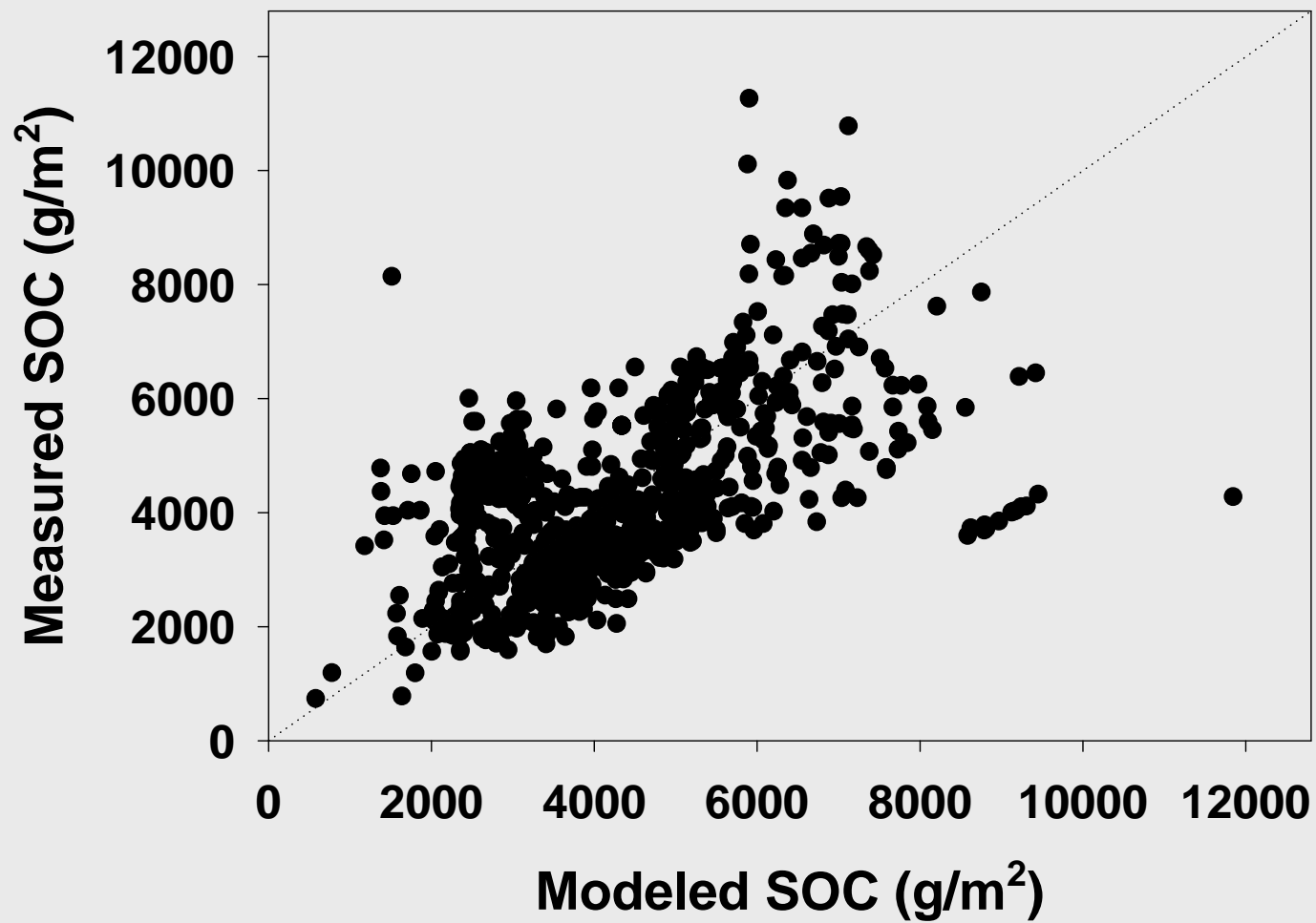
Agricultural Experiments



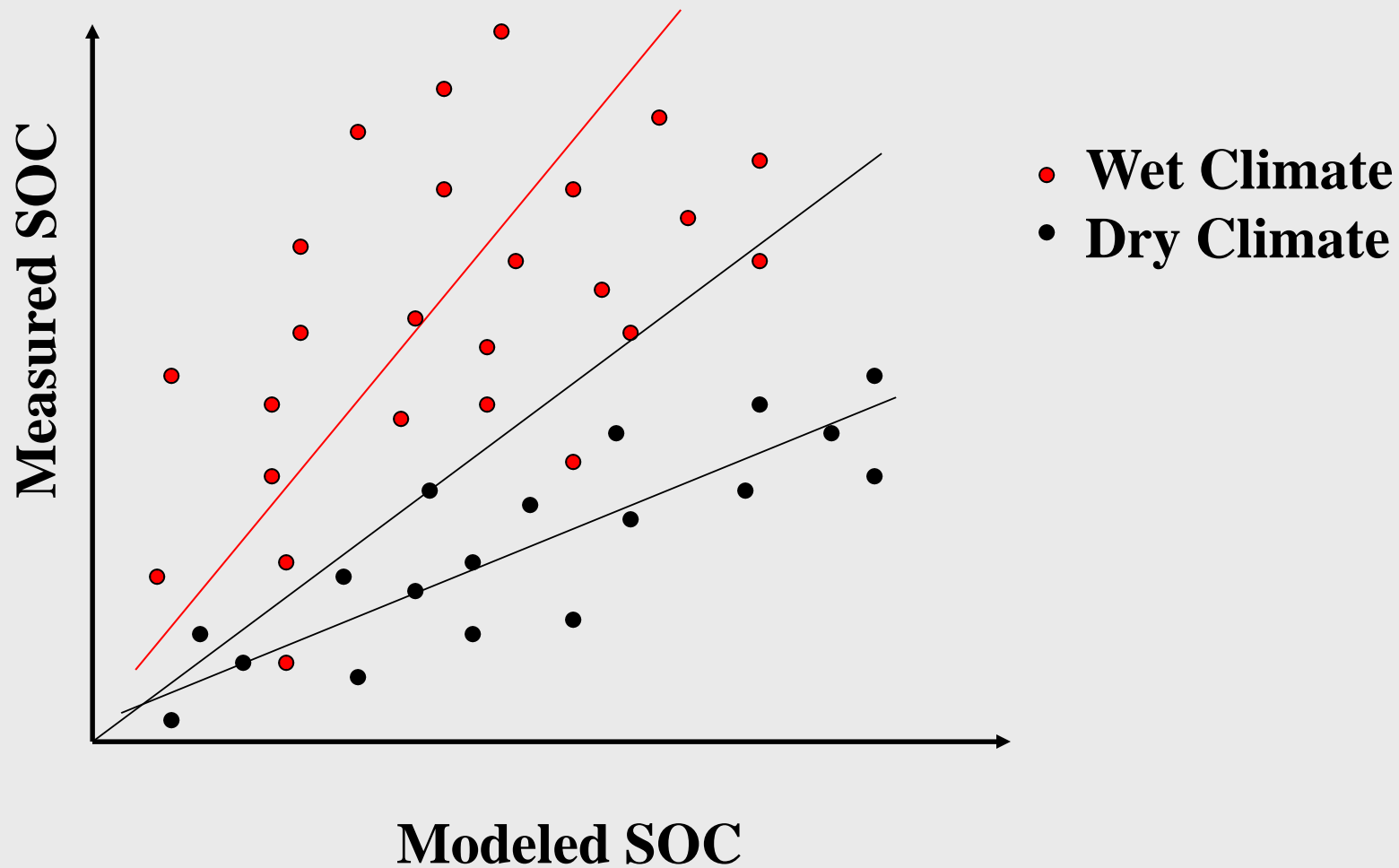
Methods

- **Use Century to model the management impacts on SOC storage based on field experiments**
 - 60 experiments with over 800 treatments
- **Statistically evaluate differences between the model results and field measurements for SOC storage**
 - linear-mixed effect model reflecting uncertainties in model and measurements
 - prediction error for the LRR carbon estimates

Measured vs. Modeled SOC Storage

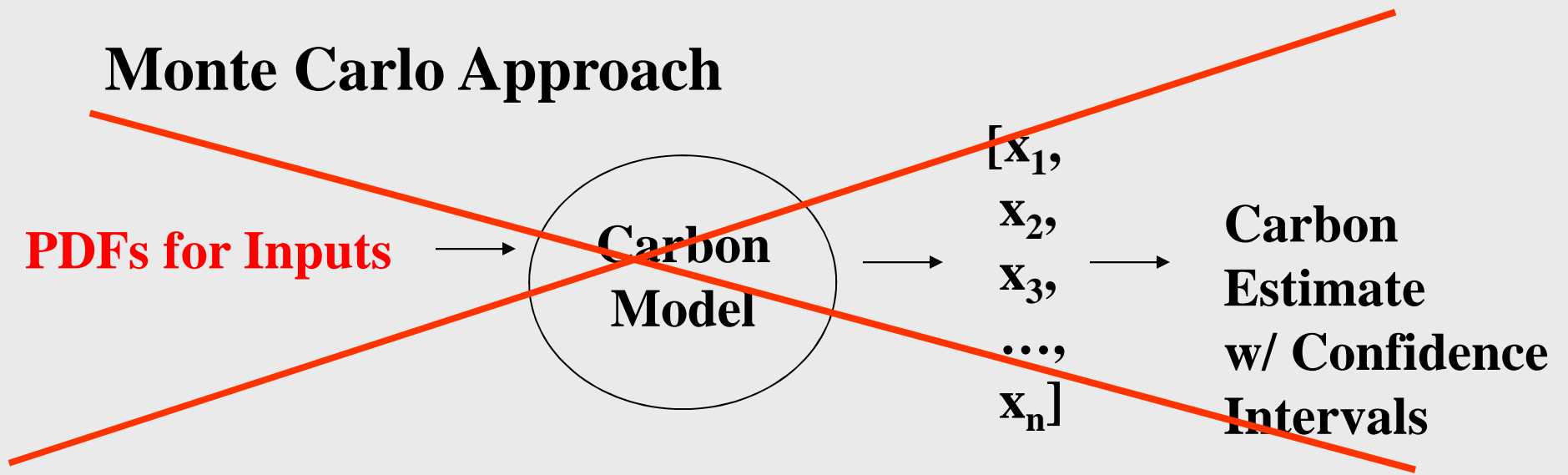


Refine Uncertainty in Management Impacts

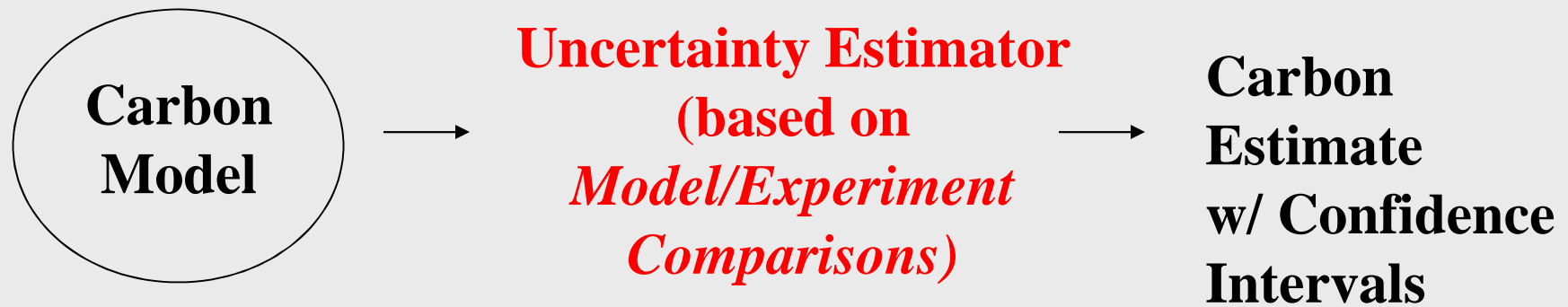


Quantification of Uncertainty

Monte Carlo Approach



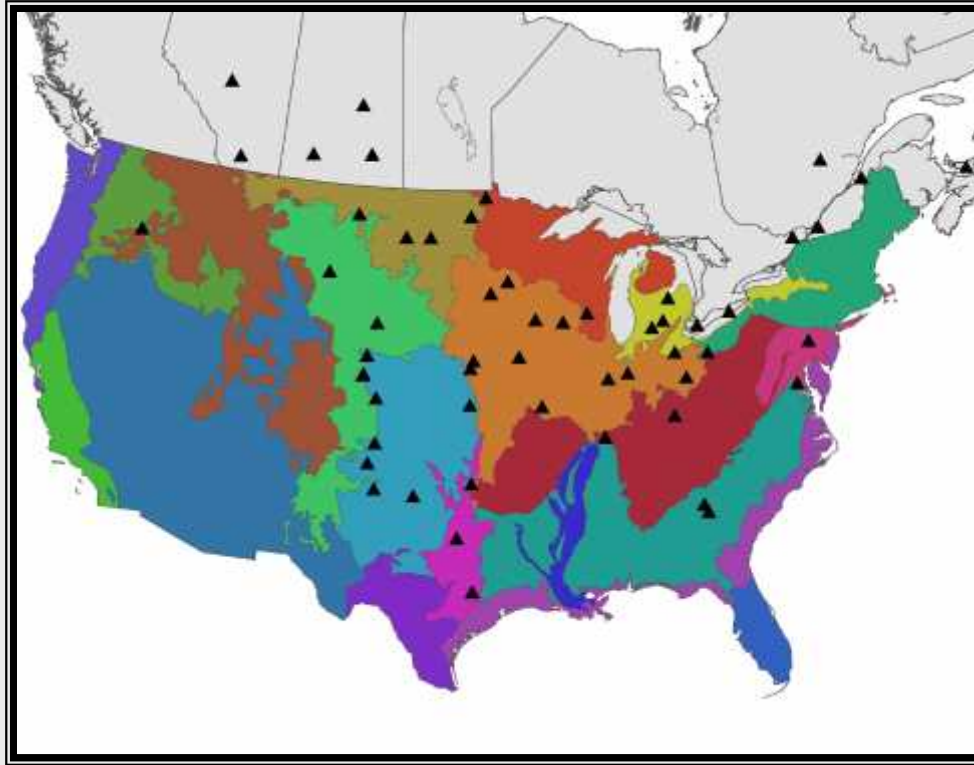
Empirically-Based Approach



Management/Environmental Variables of Interest

- land management systems *
- tillage practices
- residue management
- organic amendments
- fertilizer management *
- climate *
- soil texture *
- potential vegetation *
- length of practice *

Are there limits to this Uncertainty Estimator?



- Only representative for agricultural systems that are modeled.
- Spatial limits



United States Department of Agriculture

Contributors

- ▶ USDA
- ▶ USDA GCPO
- ▶ NRCS
- ▶ ARS
- ▶ CSU NREL

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Welcome to the Voluntary Reporting Carbon Management Online Tool (Beta)

Introduction

The **Voluntary Reporting of Greenhouse Gases-CarboN Management Evaluation Tool (COMET-VR)** tool is a decision support tool for agricultural producers, land managers, soil scientists and other agricultural interests.

COMET-VR provides an interface to a database containing land use data from the Carbon Sequestration Rural Appraisal (CSRA) and calculates in real time the annual carbon flux using a dynamic Century model simulation.

Users of COMET-VR specify a history of agricultural management practices on one or more parcels of land. The results are presented as ten year averages of soil carbon sequestration or emissions with associated statistical uncertainty values. Estimates can be used to construct a soil carbon inventory for the 1605(b) program.

[Click Here!](#) to start the Voluntary Report COMET-VR **or use the navigation link "COMET-VR Tool" at the top of the page.**

About 1605 (b)

On February 14, 2002, the President charged DOE and other agencies with improving the current voluntary emission reduction registration program under section 1605(b) of the 1992 Energy Policy Act because of concerns with the growing threat of global climate change from increasing emissions of greenhouse gases.

DOE is currently leading an interagency process—with stakeholder involvement—to enhance the accuracy, reliability, and verifiability of emissions and emissions reductions data reported to DOE.

About NRCS