
Modeling net C_{eq} flux from agricultural systems using full GHG accounting

**AmeriFlux Annual Science Team Meeting
Boulder, Colorado
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U.S. DEPARTMENT OF ENERGY**



Presentation outline

- I. Relevance of this project to goals of the NACP
- II. Relevance to NACP Midwest Intensive
- III. Description of project(s)
- IV. Some expected results
- V. Relevance to AmeriFlux (?)

I. Relevance of project to the NACP

The North American Carbon Program:

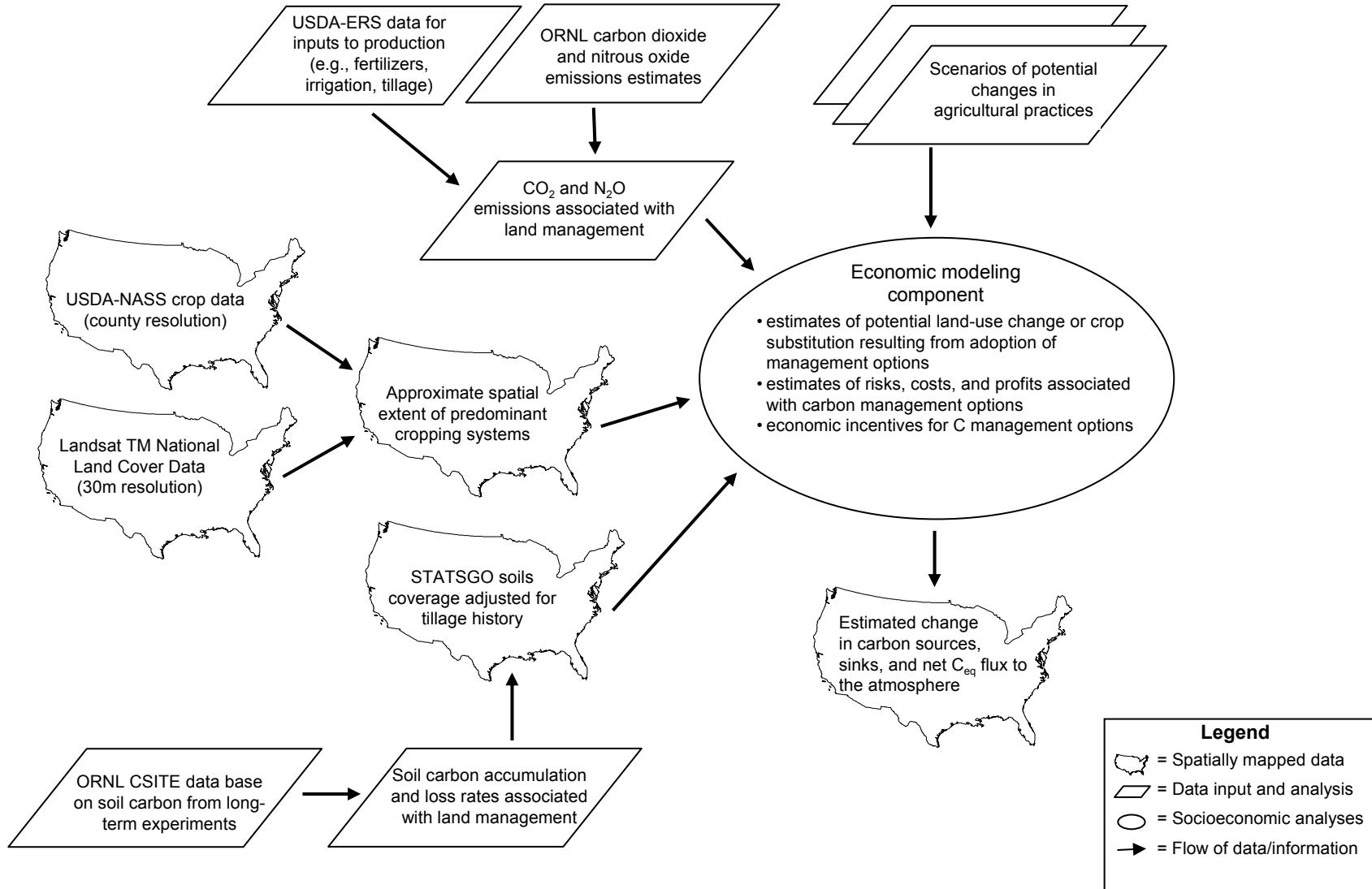
“Develop the scientific basis to implement full carbon accounting on regional and continental scales.”

- **“Quantify C storage and release due to land management practices, including those designed to enhance sequestration in biomass and/or soils.”**
- **“Explore the interaction between C cycle management...and social systems, including economic, institutional, and sociological aspects.”**
- **“Complete carbon accounting, including transportation in or out of an analysis region.”**

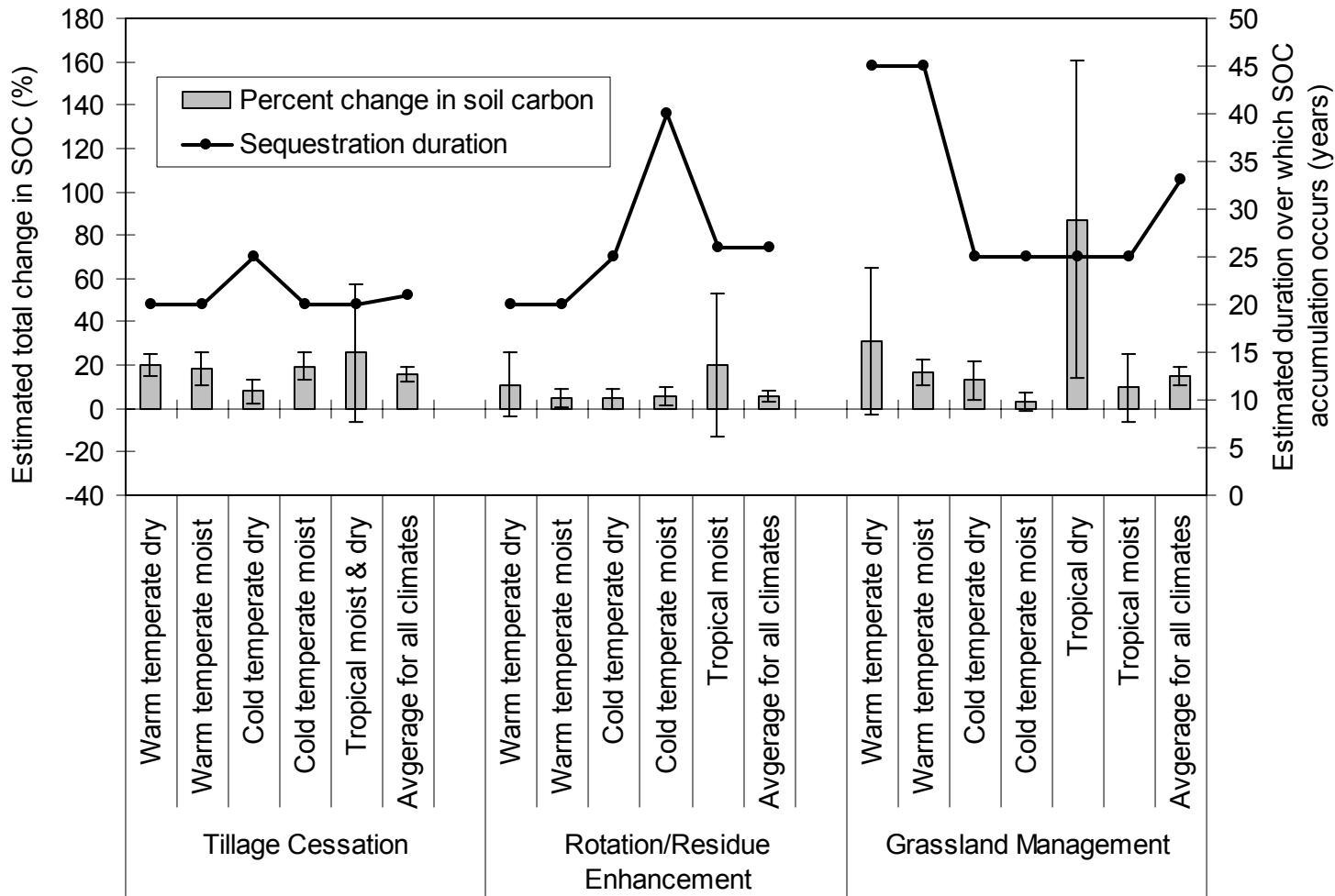
I. Relevance of project to the Midwest Intensive

- Focus on agriculture, particularly croplands
- Data on crop practices and production inputs
- Estimates of soil C stocks and NEP
- Estimates of fossil fuel use and associated CO₂ emissions
- Estimates of CH₄ and N₂O emissions

IIA. Project description – Net C_{eq} Flux

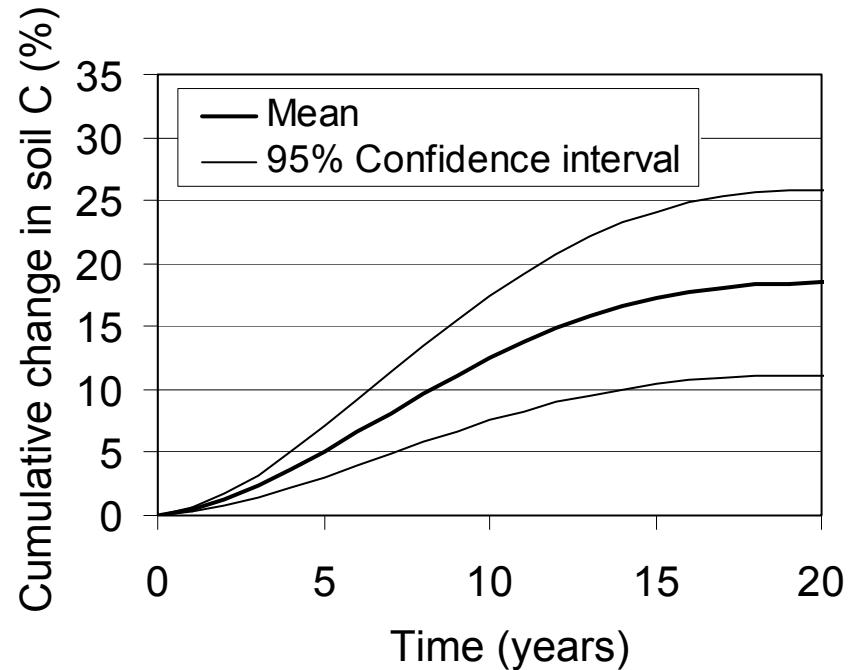
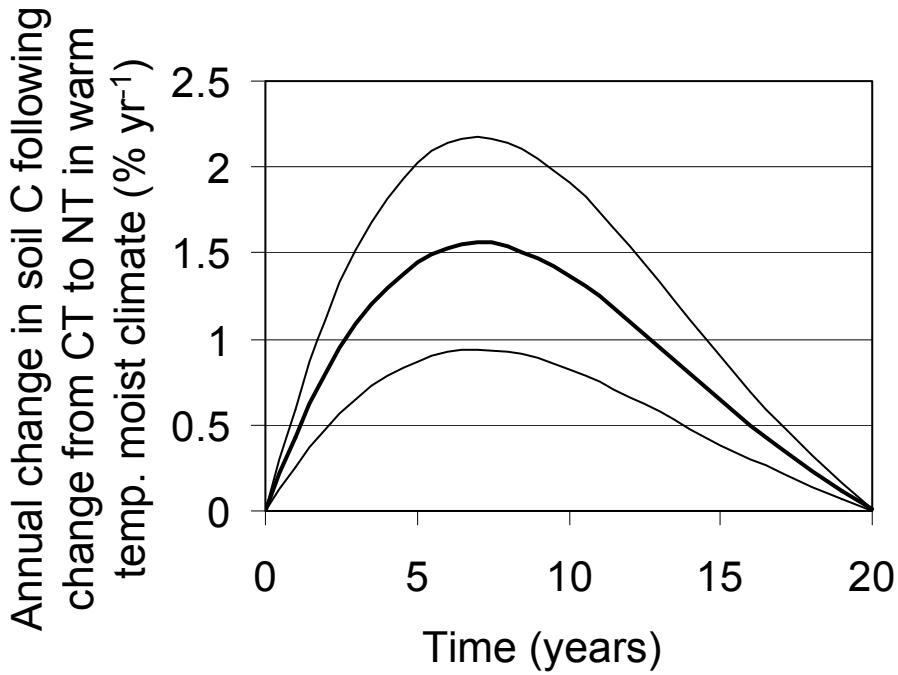


IIA. Project description – Net C_{eq} Flux

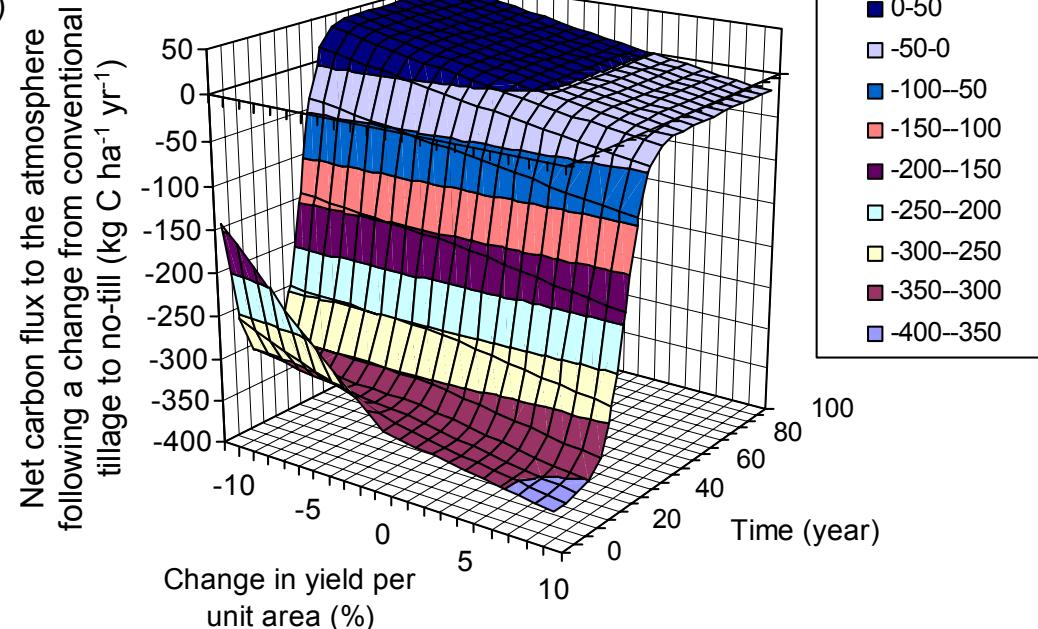
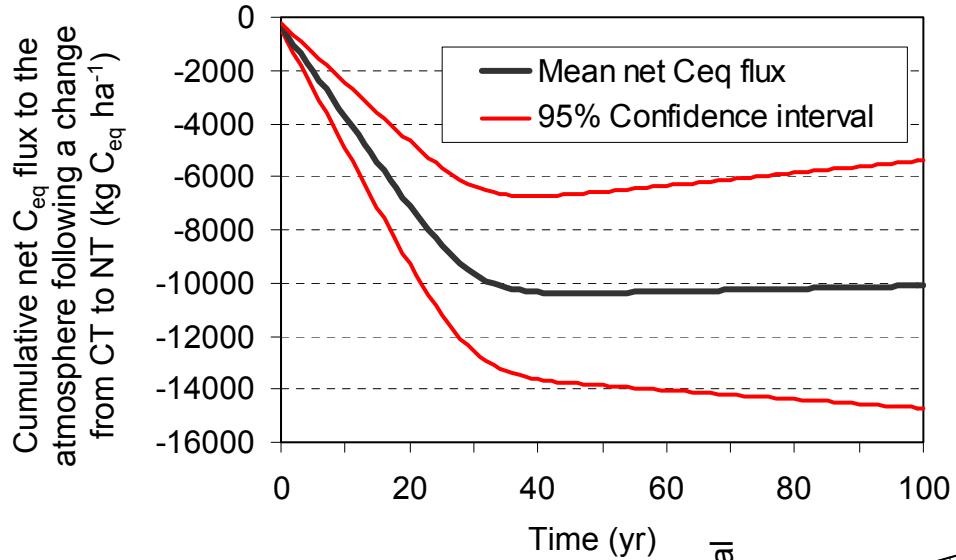


Data from West and Post (2002) and Conant et al. (2001)

IIA. Project description – Net C_{eq} Flux



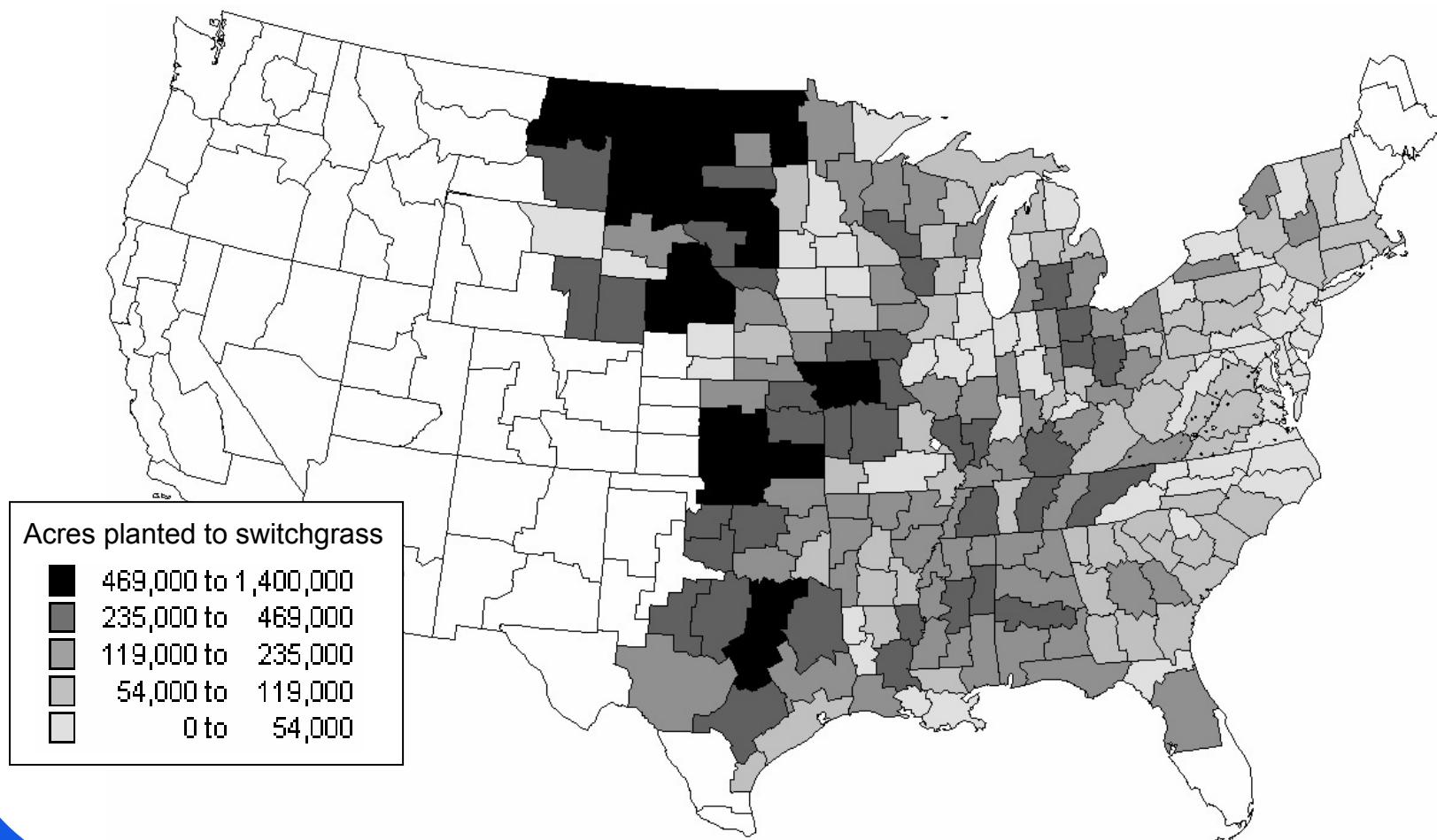
IIA. Project description – Net C_{eq} Flux



Marland et al. 2003.
Tellus B 55: 613-622

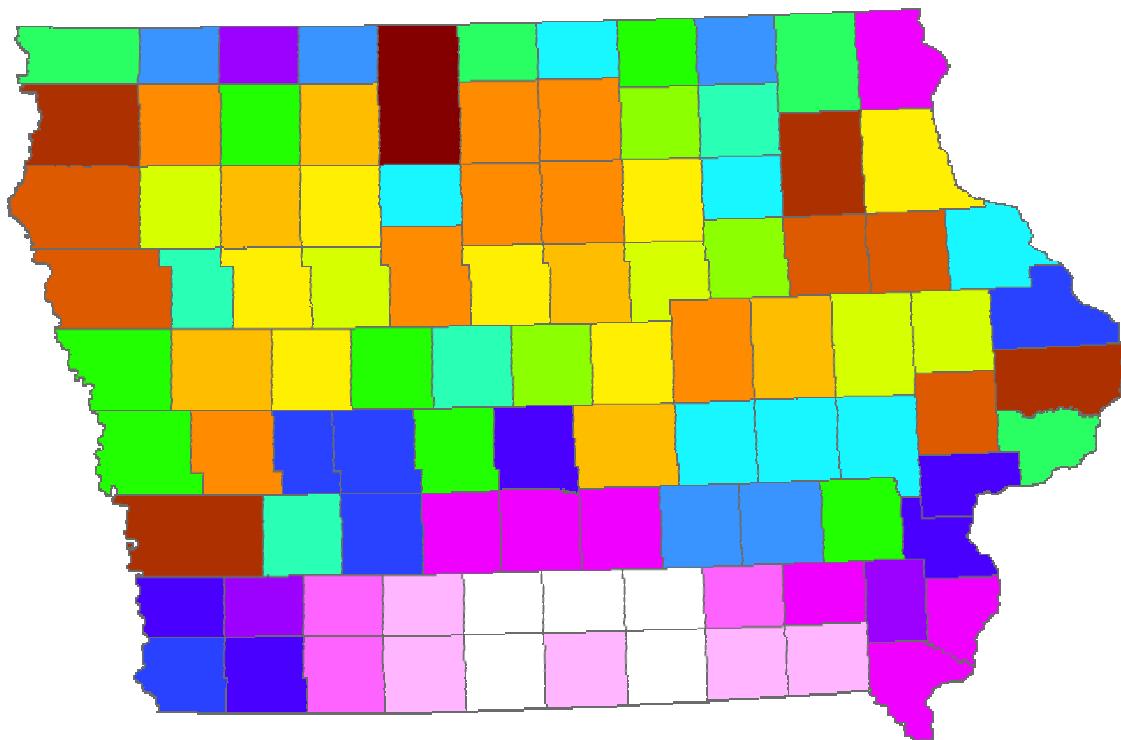
IIA. Project description – Net C_{eq} Flux

Spatially estimated acreage planted to switchgrass,
assuming a farm gate price of \$40 per ton



IIA. Project description – Net C_{eq} Flux

Iowa corn production in 1990 (kg)



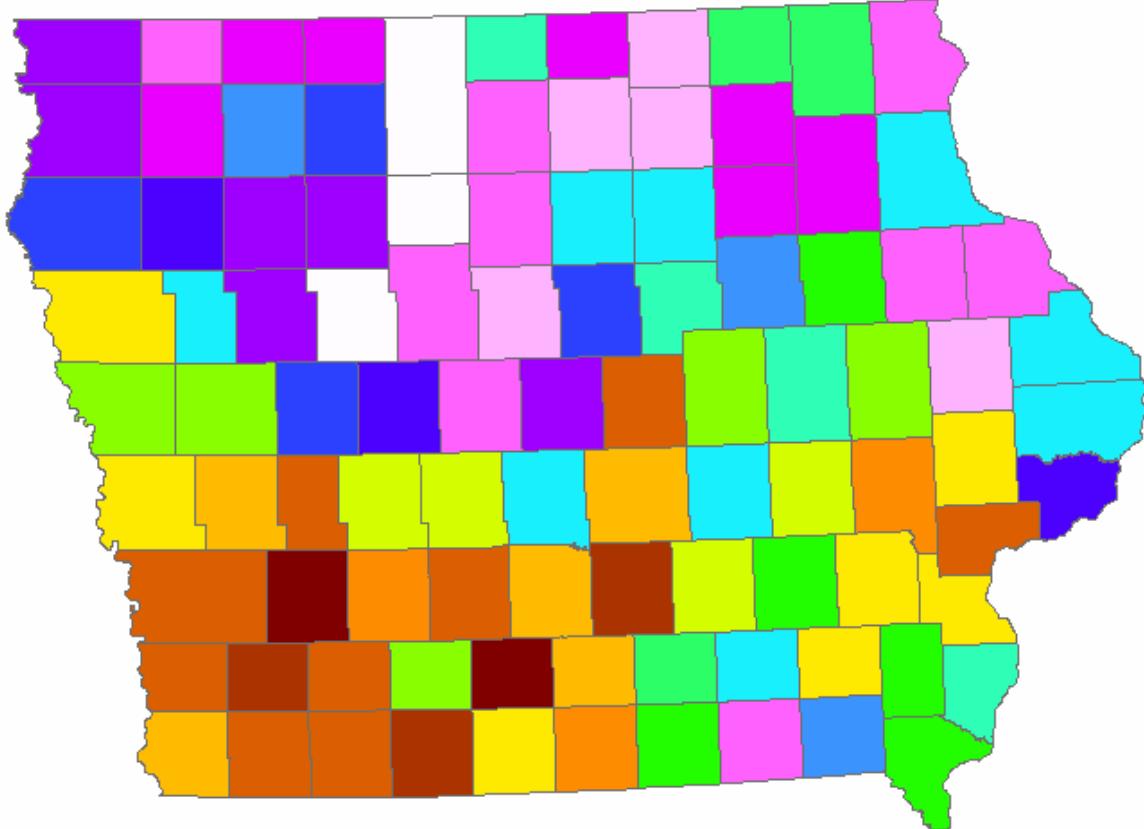
Legend

1990 Corn Production (kg)

[Light Gray Box]	29392880 - 38059360
[Light Pink Box]	38059361 - 57759600
[Medium Pink Box]	57759601 - 75803760
[Dark Pink Box]	75803761 - 95402400
[Purple Box]	95402401 - 111953040
[Dark Blue Box]	111953041 - 122986800
[Medium Blue Box]	122986801 - 135361680
[Light Blue Box]	135361681 - 146933920
[Cyan Box]	146933921 - 156697680
[Light Teal Box]	156697681 - 164917120
[Medium Teal Box]	164917121 - 170860720
[Dark Teal Box]	170860721 - 183621680
[Light Green Box]	183621681 - 190113920
[Medium Green Box]	190113921 - 193161920
[Dark Green Box]	193161921 - 202255120
[Yellow-Green Box]	202255121 - 216377520
[Orange Box]	216377521 - 231231440
[Dark Orange Box]	231231441 - 253715520
[Brown Box]	253715521 - 288879280
[Dark Brown Box]	288879281 - 386191760

IIA. Project description – Net C_{eq} Flux

Fraction of no-till for Iowa corn in 2000



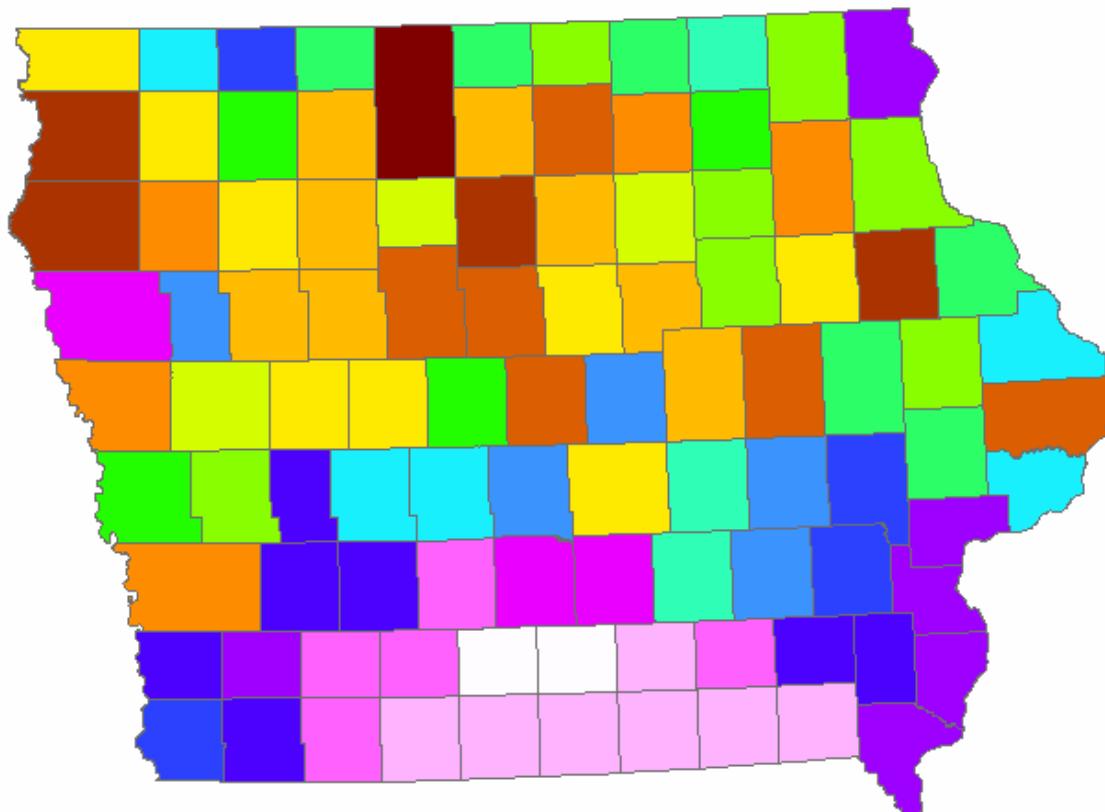
Legend
Fraction in no-till

	0.0080 - 0.0120
	0.0121 - 0.0240
	0.0241 - 0.0400
	0.0401 - 0.0580
	0.0581 - 0.0720
	0.0721 - 0.0810
	0.0811 - 0.0910
	0.0911 - 0.1110
	0.1111 - 0.1330
	0.1331 - 0.1610
	0.1611 - 0.1830
	0.1831 - 0.2160
	0.2161 - 0.2580
	0.2581 - 0.2950
	0.2951 - 0.3330
	0.3331 - 0.4030
	0.4031 - 0.4460
	0.4461 - 0.5170
	0.5171 - 0.5750
	0.5751 - 0.6520

IIA. Project description – Net C_{eq} Flux

C emissions from tillage for Iowa corn in 2000 (kg)

227,201 Mg C from tillage



Legend
C emissions from tillage (kg)

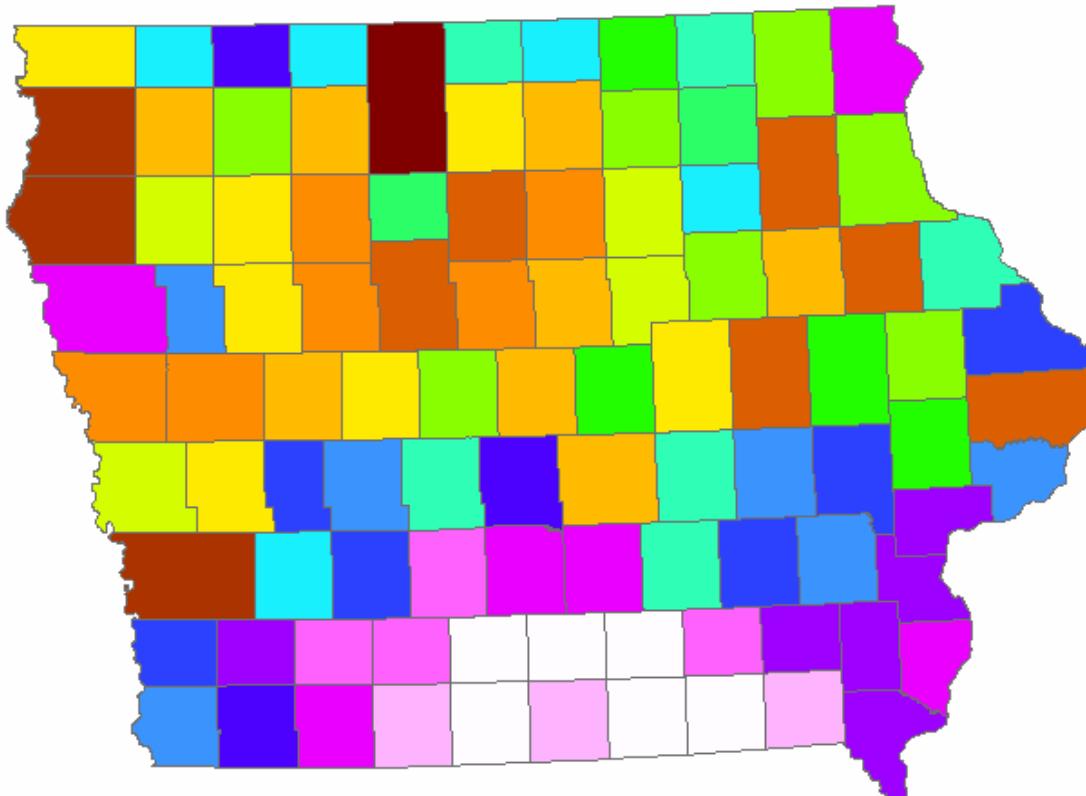
	347614 - 421230
	421231 - 744270
	744271 - 990764
	990765 - 1125498
	1125499 - 1407606
	1407607 - 1600219
	1600220 - 1819229
	1819230 - 1970014
	1970015 - 2093999
	2094000 - 2302211
	2302212 - 2452071
	2452072 - 2592739
	2592740 - 2698467
	2698468 - 2854952
	2854953 - 2995289
	2995290 - 3192403
	3192404 - 3428892
	3428893 - 3630694
	3630695 - 4476309
	4476310 - 6554712

Emissions estimates based on West and Marland. 2002.
Agriculture, Ecosystems & Environment 91:217-232

IIA. Project description – Net C_{eq} Flux

C emissions from production inputs for Iowa corn in 2000 (kg)

1,228,934 Mg C from production inputs

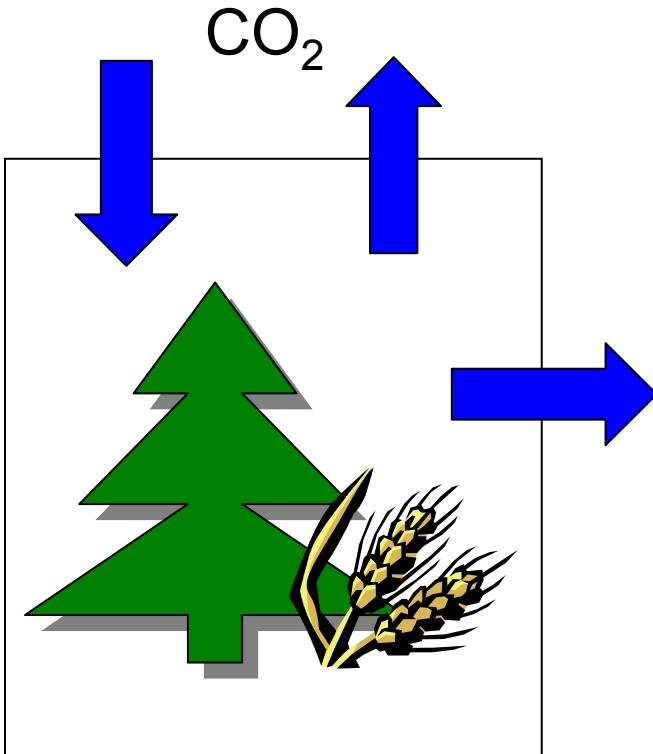


Legend
C emissions production
inputs (kg)

	2189928 - 3145426
	3145427 - 4290361
	4290362 - 6211726
	6211727 - 7343510
	7343511 - 8773624
	8773625 - 9551473
	9551474 - 10623266
	10623267 - 11341670
	11341671 - 11898731
	11898732 - 12634753
	12634754 - 13427938
	13427939 - 14091619
	14091620 - 14634102
	14634103 - 15468510
	15468511 - 15911821
	15911822 - 16416687
	16416688 - 17379741
	17379742 - 19193450
	19193451 - 23690566
	23690567 - 31652729

Emissions estimates based on West and Marland. 2002.
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IIB. Project description – Net “Lateral” C flux



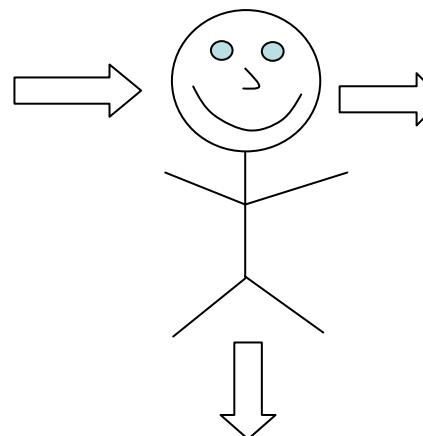
Consumption:

190 lb meat/poultry/fish
239 eggs (34 lb eggs)
580 lb dairy products
66 lb fats & oils
975 lb fruit
416 lb vegetables
2 lb tree nuts
6 lb peanuts
200 lb cereal products

2469 lb food products
@ 50-95% water weight with
remainder at 50% C
= 122 kg C yr^{-2}

(Source: USDA 2004)

$\sim 122 \text{ kg C uptake}$

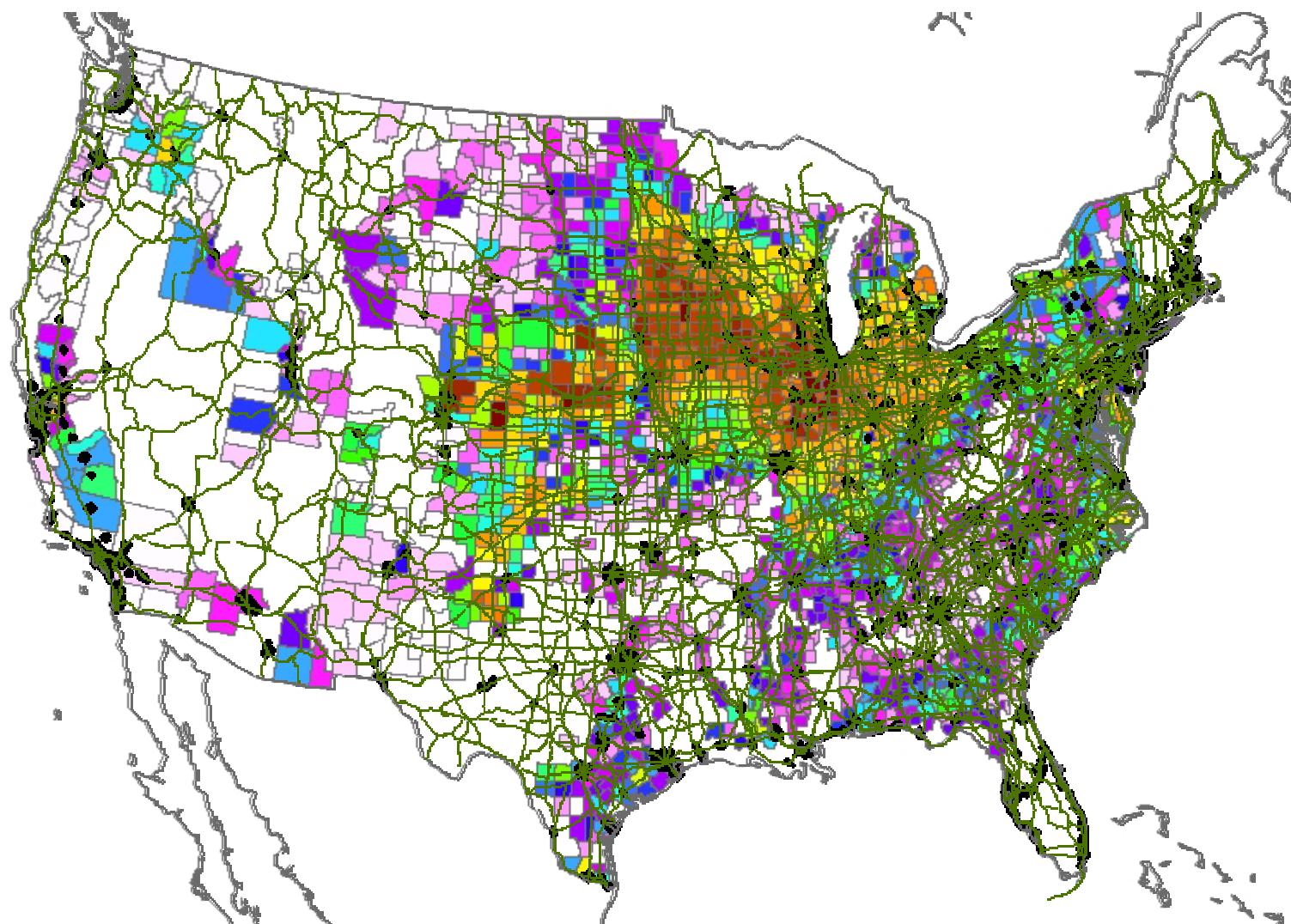


Respire or exhale:
16% O_2 and 6% CO_2
 $= 410 \text{ kg CO}_2/\text{yr}$
 $(112 \text{ kg C yr}^{-2})$

Excrete:
40 kg (dry weight)
 $@ 29\% \text{ C} = 12 \text{ kg C yr}^{-2}$

$\sim 124 \text{ kg C loss}$

IIB. Project description – Net “Lateral” C flux

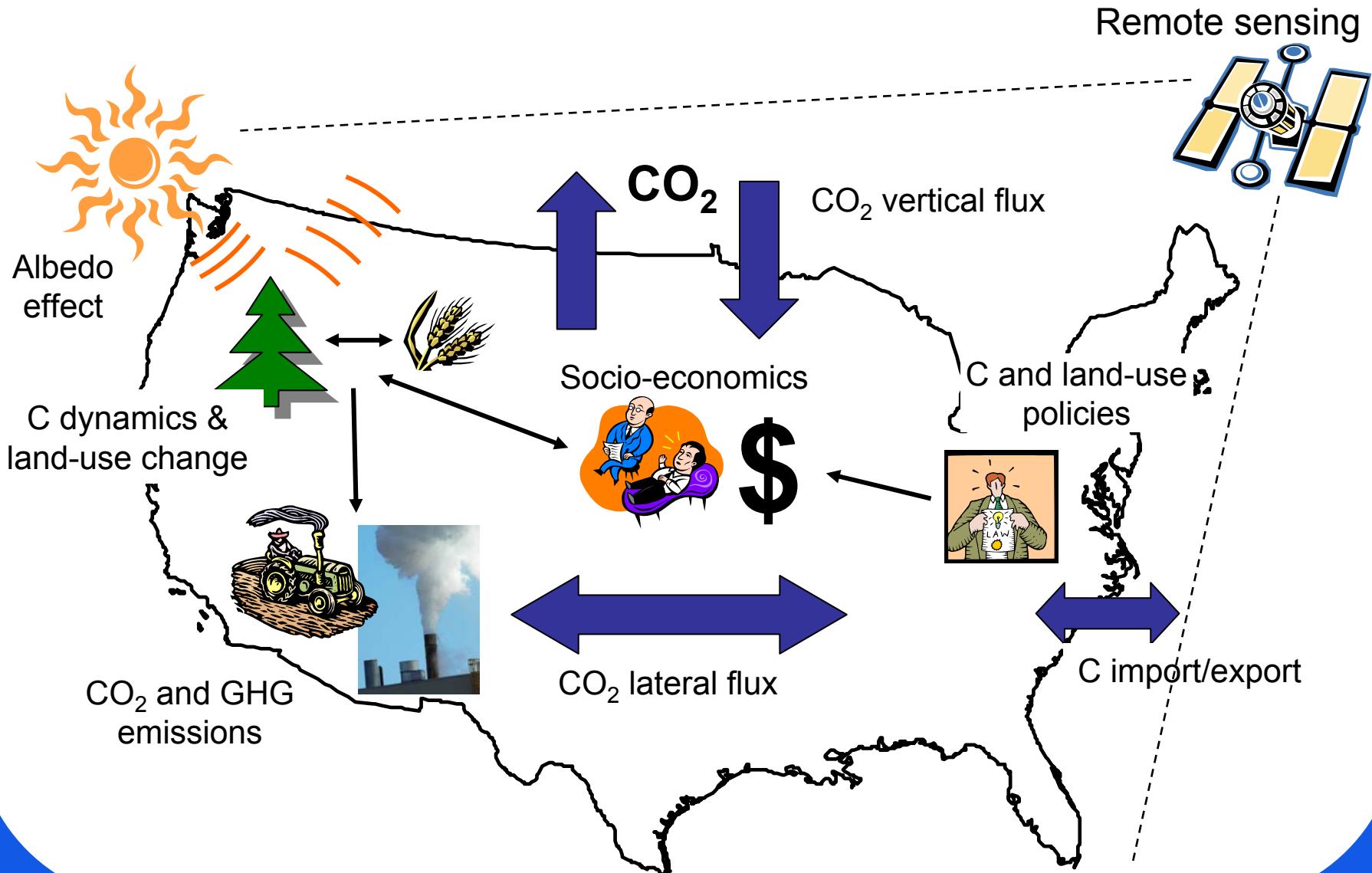


IIB. Project description – Net “Lateral” C flux

Spatial analyses and data sets, at $\leq 1\text{km}$, will include:

- CO_2 uptake based on estimates of NEP
- Grain harvest
- Grain products and waste
- Grain transport and consumption
- CO_2 loss from respiration and decomposition
- Similar analysis for forest growth and products

IIA. Project description – Net C_{eq} Flux



III. Expected results – useful data sets

Data layers to be produced that coincide with LandsatTM cropland areas:

- History of cropping practices
- NEP and yield
- Soils map updated for past cropping practices (SSURGO for Midwest Intensive)
- CO₂, CH₄, and N₂O net emissions
- Lateral flux and release of carbon
- C sequestration strategies ↔ Economics (crop prices, input costs, incentives, risk) ↔ Land-use change
- Estimates of leakage (C benefits/costs outside project boundary) associated with sequestration activities

IV. Potential links to Ameriflux

- Compare estimates of NEP
- Compare baseline soil C values
- Compare modeled changes in soil C following changes in management with measured/estimated changes from AmeriFlux sites
- Provide estimates of CO₂ fossil fuel emissions from farm operations that can be subtracted from AmeriFlux CO₂ flux estimates.
- Provide lateral flux information that may be used to complete C accounting in AmeriFlux estimates.
- Provides future estimates of C seq., GHG emissions, land-use change, and interactions between socio-economics and policy.