

Carbon Sequestration in Terrestrial Ecosystems in the MRCSP Region



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MRSCP Land-Uses Analyzed and Team

- Non-eroded Cropland – The Ohio State University: Rattan Lal
- Eroded Cropland – Purdue University: William McFee and Larry Biehl
- Marginal Land – Pennsylvania State University: Sjoerd Duiker
- Mineland – West Virginia University: Mark Sperow
- Wetland and Marshland – University of Maryland: Brian Needelman
- Modeling all Land Classifications – Michigan State University: Peter Grace

MRCSP Land-use, Area, and Potential C Storage

Land-Use	Area (Mha)	C Storage (MMTC yr ⁻¹)
Non-Eroded Cropland	10.7	3.7
Eroded Cropland	1.6	3.1
Marginal Land	6.5	26.9
Mineland	0.6	1.5
Wetland/Peatland	3.4	3.9
Total	22.8	39.1

MRCSP CO₂ Emissions¹
715 MMT (195 MMTCE²)

MRCSP CO₂ Offset Potential
20% of Emissions

¹ Emissions include only large sources (>100 Kt CO₂).

² MMTCE = Million Metric Tons of Carbon Equivalent

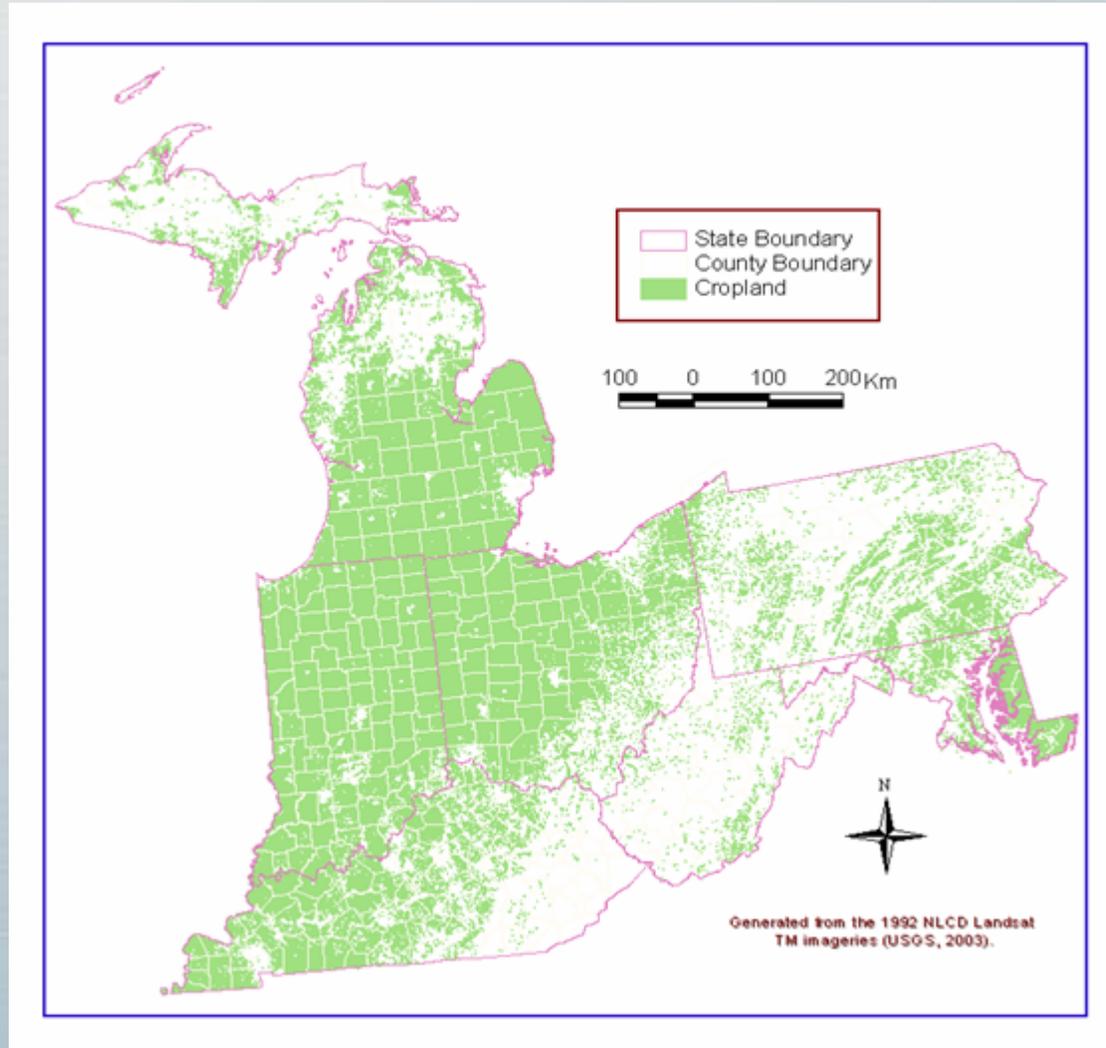
Introduction

- Analysis addresses biophysical potential for C sequestration
- Assess C pools: soils, above-ground biomass, and litter layer
 - 20 year time period analyzed
 - Soil C estimates for the 0 – 30 cm layers
- C accumulation rates derived from literature and modeling
- Common databases for land classifications and soils
 - 1992 National Land Cover Dataset
 - STATSGO
- County boundaries derived from common GIS source
- Specific databases used as required
 - CTIC – tillage intensity by region
 - Unique database for wetland and marshland area
 - GIS and Tabular to define mineland area
- Cropland C estimates based on reduced tillage intensity
- Marginal and mine land C estimates based on afforestation

1992 NLCD Landcover Adjusted to Account for Mineland Area after 1992

		TOTAL	WATER	URBAN	MINE	FOREST	PASTURE	CROP	WETLAND
IN	ORIG	9,376,123	105,912	315,074	22,207	1,763,442	1,770,614	5,141,073	164,136
	ADJ	9,376,123	105,825	315,063	30,201	1,761,721	1,768,645	5,136,906	164,114
KY	ORIG	10,461,312	190,097	191,360	52,262	6,229,925	2,147,310	1,412,998	182,449
	ADJ	10,461,312	189,918	191,337	67,871	6,214,748	2,147,216	1,412,891	182,418
MD		2,738,712	225,942	200,797	29,081	1,058,915	632,247	354,547	221,371
MI		15,069,929	431,339	475,354	68,260	6,169,621	1,371,366	3,602,932	2,558,347
PA		11,733,011	135,322	482,408	125,363	7,643,828	2,644,374	581,759	98,199
OH	ORIG	10,681,297	120,732	562,199	25,898	3,360,629	2,315,073	4,085,227	149,196
	ADJ	10,681,297	120,044	562,014	63,401	3,341,938	2,303,281	4,079,240	149,036
WV	ORIG	6,268,806	51,012	81,981	73,253	5,238,932	688,709	118,158	15,263
	ADJ	6,268,806	50,163	80,654	183,473	5,135,223	685,512	117,174	15,126
TOTAL	ORIG	66,329,190	1,260,356	2,309,173	396,324	31,465,292	11,569,693	15,296,694	3,388,961
TOTAL	ADJ	66,329,190	1,258,553	2,307,627	567,651	31,325,994	11,552,641	15,285,449	3,388,611

Distribution of Non-eroded Cropland

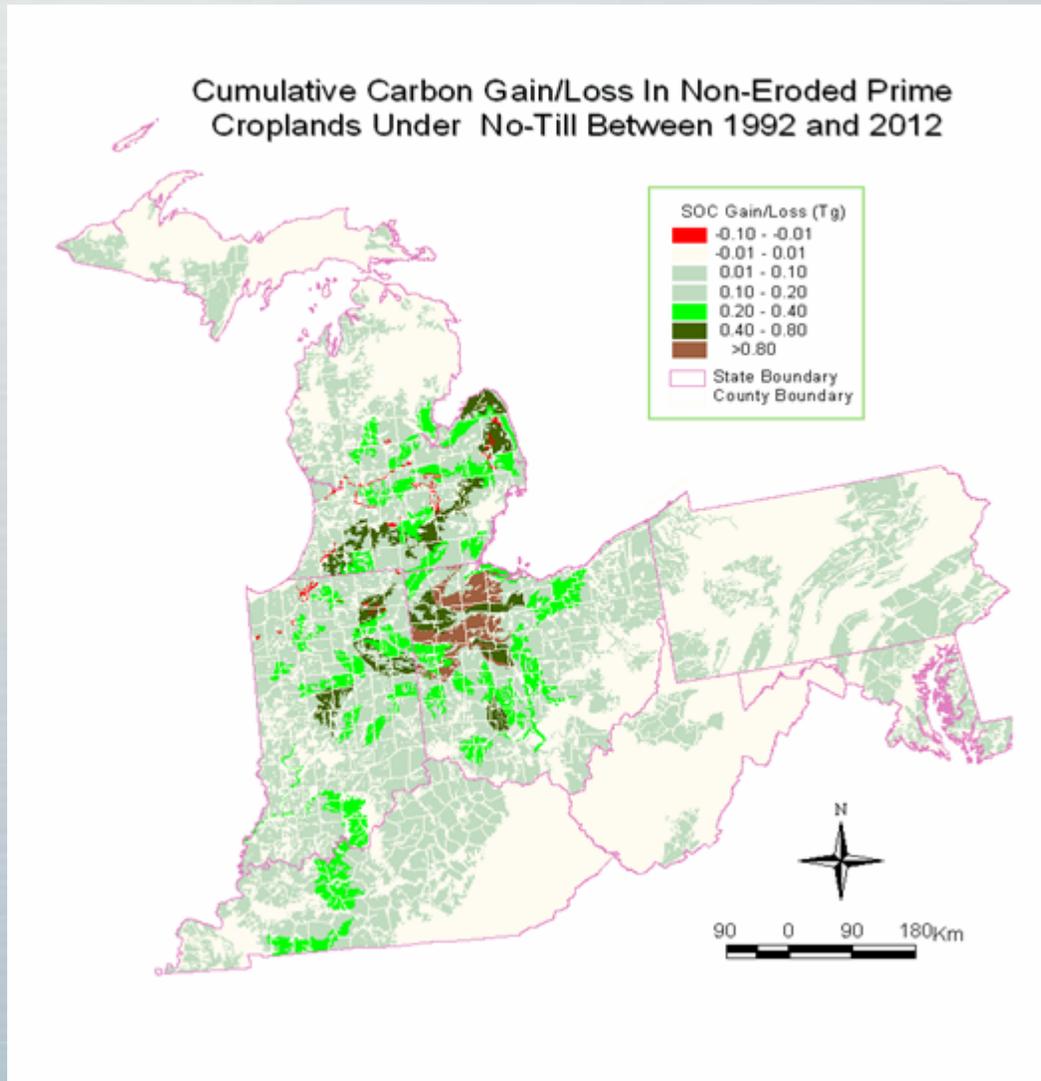


Potential SOC Sequestration Over 20 Years and Annually for Non-eroded Croplands

Scenario	IN	KY	MD	MI	OH	PA	WV	MRCSP	Stdev
Area (Tha)	5,137	1,412	355	3,603	4,085	118	117	15,285	
-----Million Metric Tons -----									
100% NT ¹	23.5	5.2	1.5	19.7	21.4	2.3	0.2	73.9	23.7
75% NT	17.7	3.9	1.1	14.8	16.1	1.7	0.2	55.4	17.7
----- Million Metric Tons yr ⁻¹ -----									
Annual Potential	1.2	0.3	0.08	1.0	1.1	0.1	0.01	3.7	

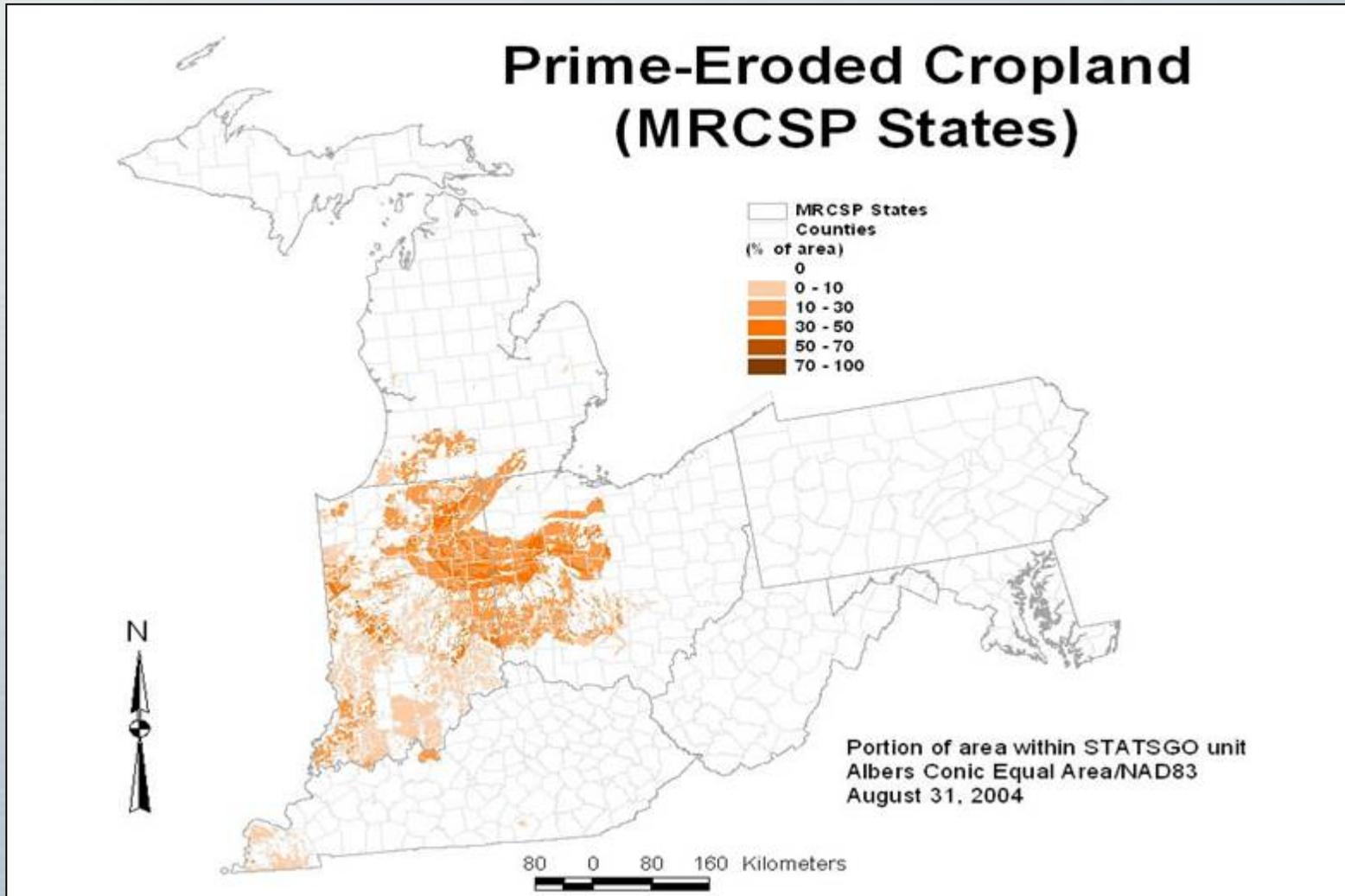
¹ NT = No Till

C Sequestration Potential on non-eroded Cropland in 20 Years



Area	15.3 Mha
Total C	74 MMT

Area of Prime-Eroded Cropland



Potential SOC Sequestration over 20 Years and Annually for Prime Eroded Cropland

State	IN	KY	MD	MI	OH	PA	WV	MRCSP
Area (Tha)	933	39	0	80	513	0	0	1,565

Cumulative C Sequestered (Million Metric Tons)

Scenario 1	7.2	0.2		0.6	4.3			12.3
Scenario 2	36.1	1.1		3.2	21.4			61.8

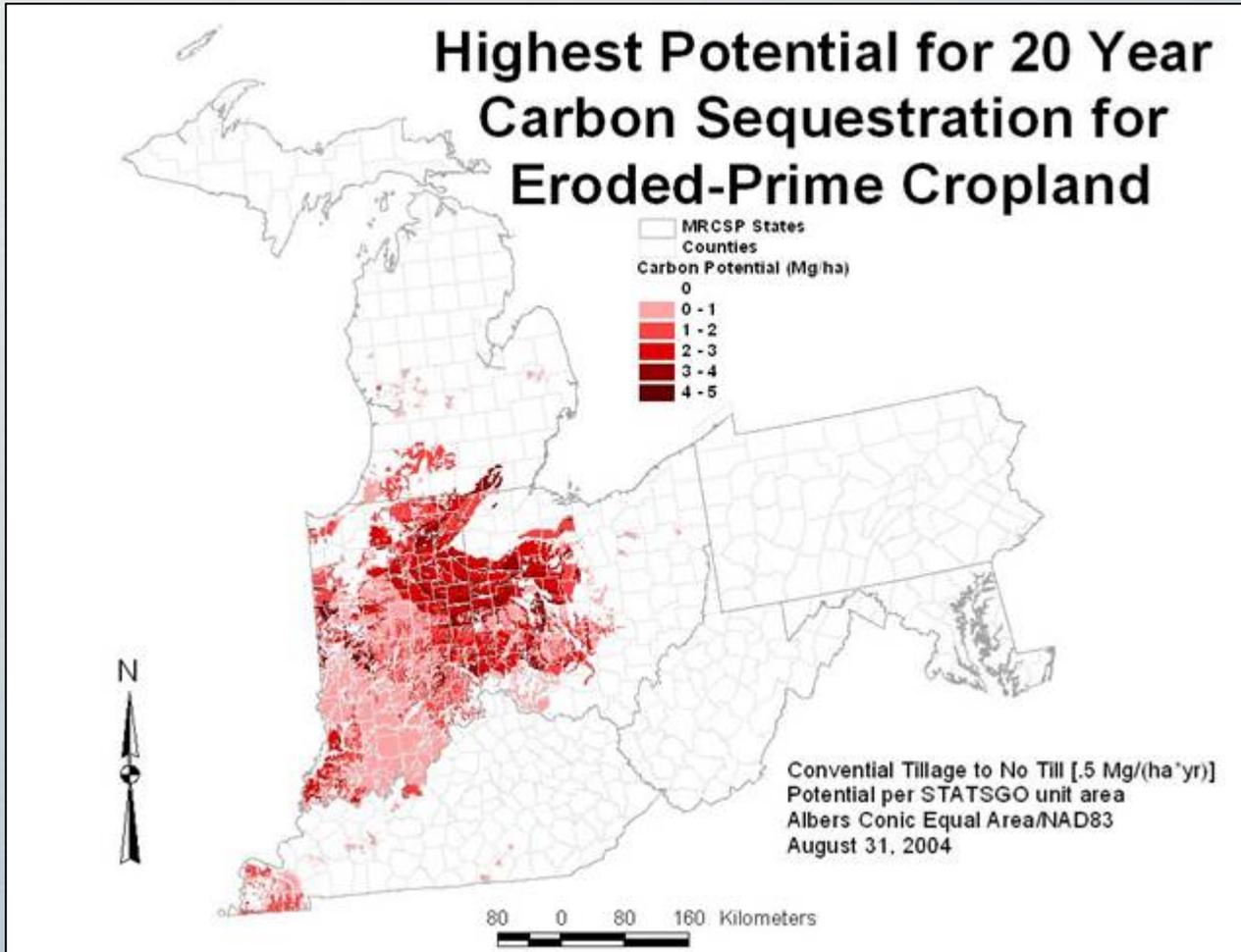
----- Million Metric Tons yr⁻¹ -----

Annual Potential	1.8	0.06		0.2	1.1			3.1
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Scenario 1: SOC may be restored to 60% of native with shift to conservation practices

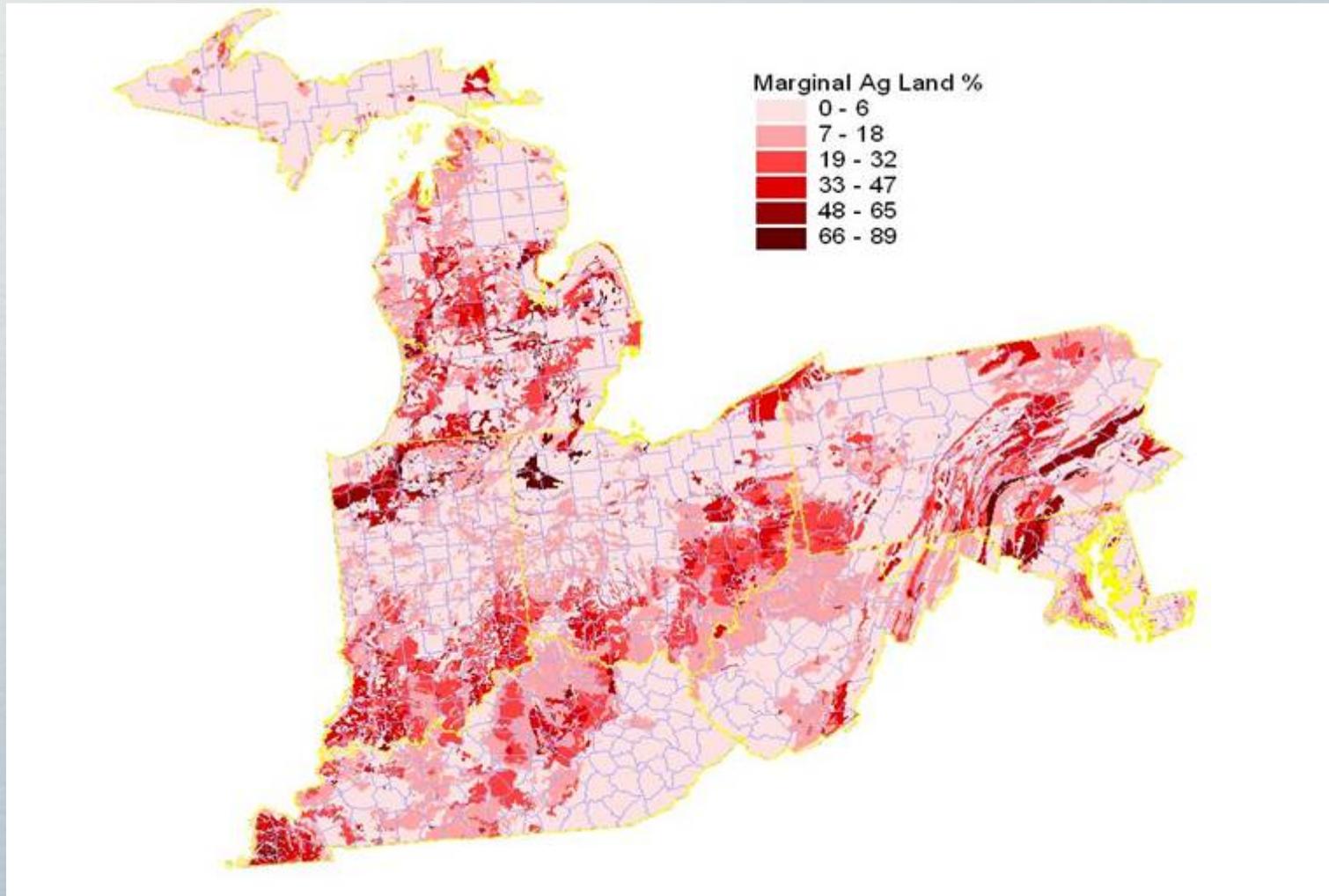
Scenario 2: All SOC may be recovered under good management or set-aside (return to grass/legume)

C Sequestration Potential on Eroded Cropland in 20 Years



Area	1.6 Mha
Total C	62 MMT

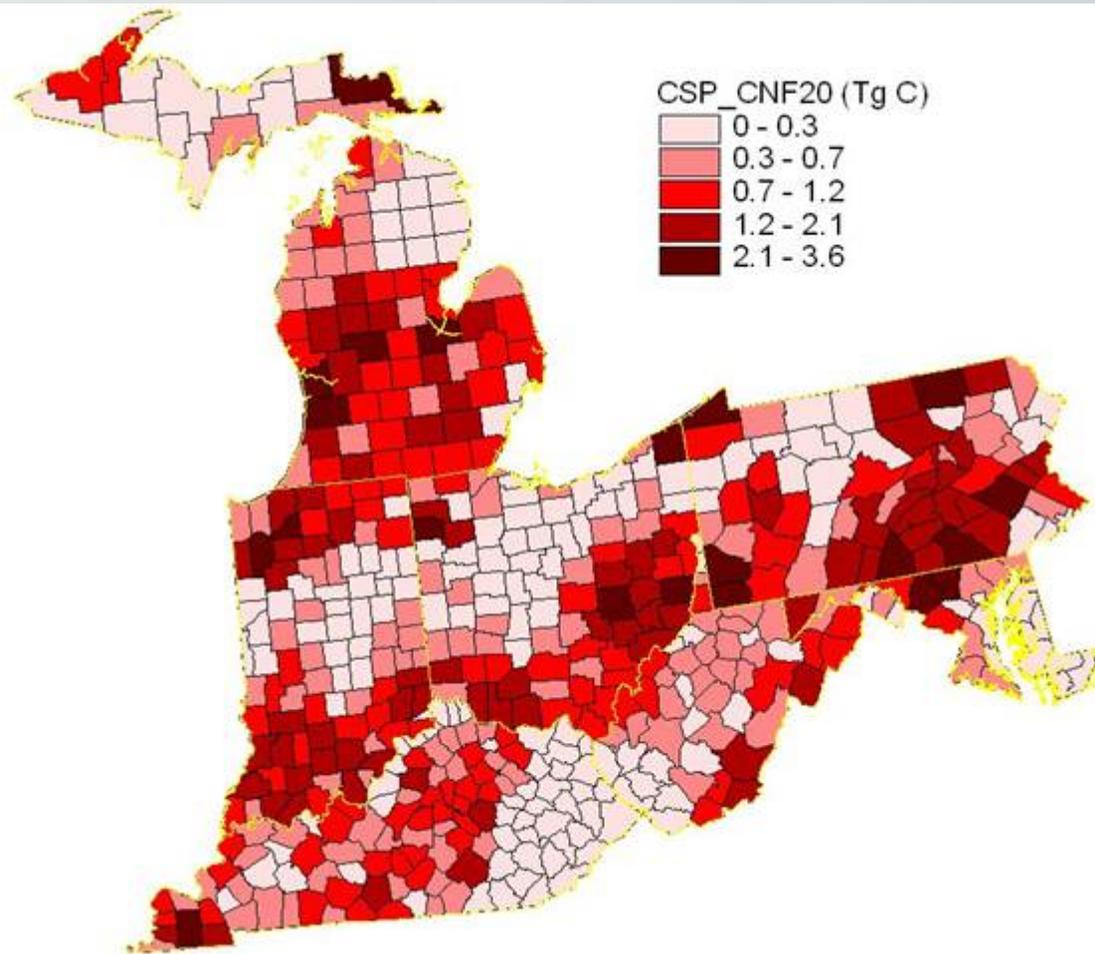
Distribution of Marginal Land



Potential C Accumulation Over 20 Years and Annually on Marginal Land from Afforestation

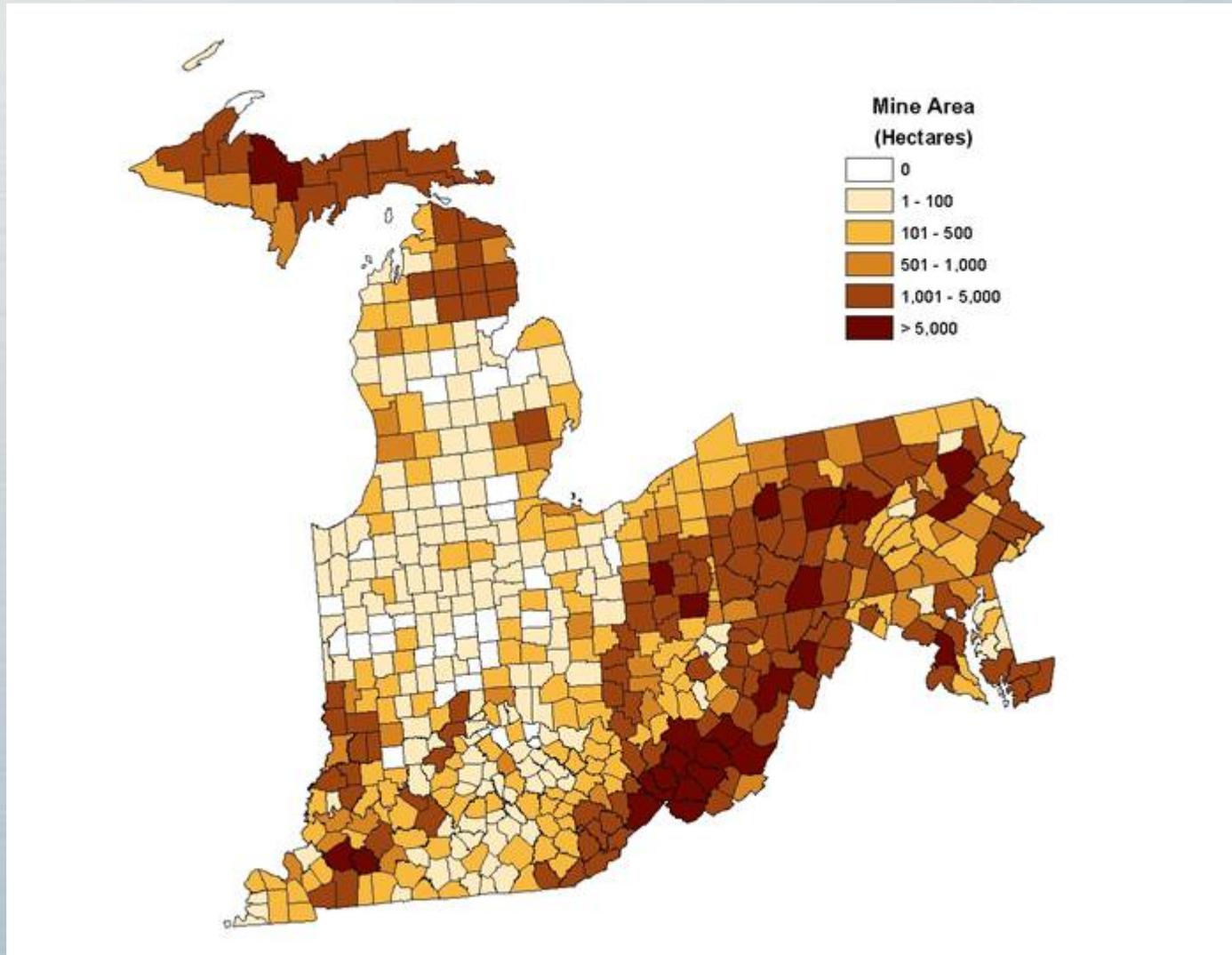
State	IN	KY	MD	MI	OH	PA	WV	MRCSP
Area (Tha)	1,238	1,012	246	1,230	1,156	1,181	481	6,543
----- Million Metric Tons -----								
	105.3	91.6	20.8	87.9	95.3	96.8	41.5	529.2
----- Million Metric Tons yr ⁻¹ -----								
Annual Potential	5.3	4.6	1.0	4.4	4.8	4.8	2.1	26.9

20 Year C Potential on Marginal Lands from Coniferous Forest



Area	6.5 Mha
Total C	529 MMT

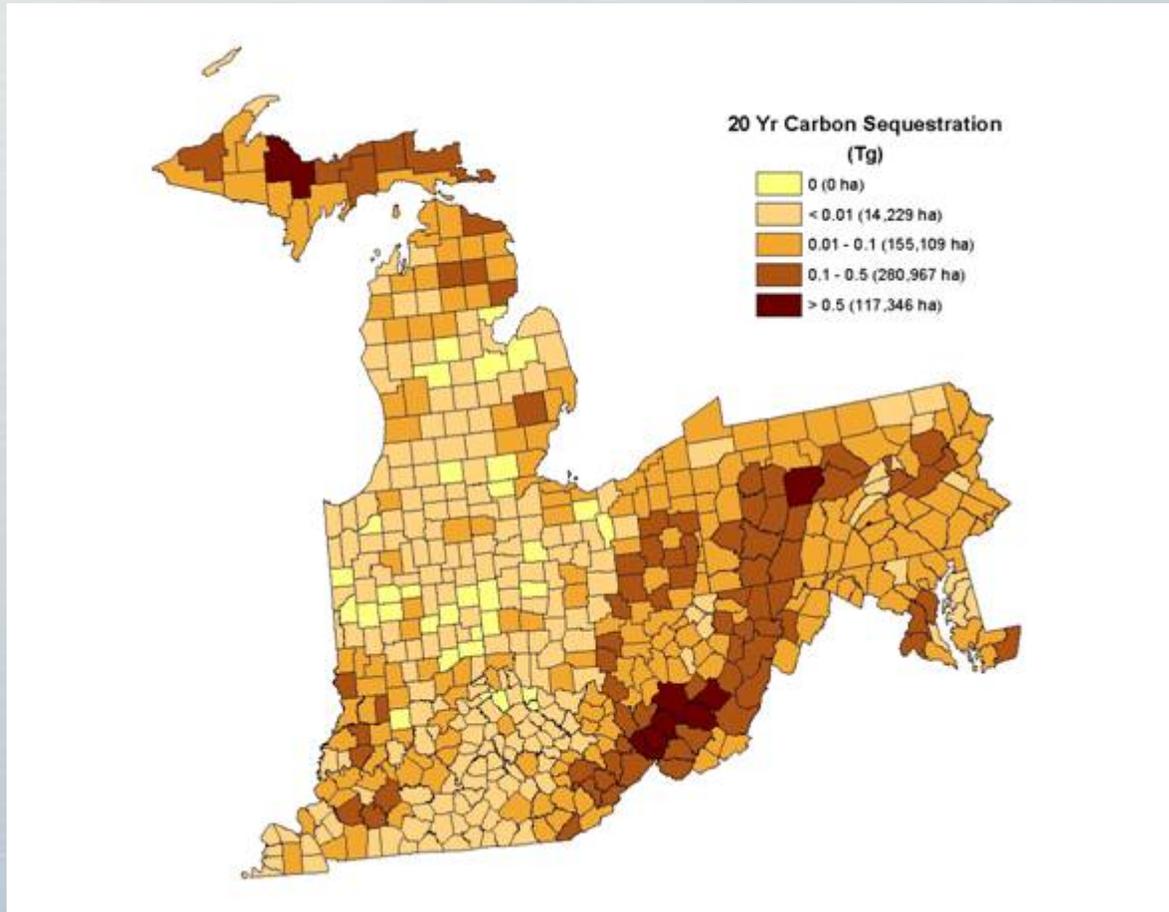
Area of Mineland



Potential C Accumulation over 20 Years and Annually on Reclaimed Minelands

	IN	KY	MD	MI	OH	PA	WV	Total
Area (Tha)	30.2	67.8	29.1	68.3	125.4	63.4	183.5	567.7
----- Million Metric Tons -----								MMT
Total Forest	1.6	3.5	1.4	3.6	3.6	5.1	10.74	29.5
Forest Biomass	0.9	2.1	0.5	1.6	2.0	2.8	6.70	16.6
Forest Litter	0.1	0.2	0.1	0.3	0.2	-0.3	0.36	0.9
Forest Soil	0.6	1.3	0.7	1.7	1.4	2.6	3.69	12.0
Pasture Soil	0.8	1.8	0.8	1.9	1.7	3.4	4.83	15.1
Cropland Soil	0.6	1.8	0.3	1.4	2.3	3.7	1.0	10.9
----- Million Metric Tons yr ⁻¹ -----								
Annual Potential	0.08	0.2	0.1	0.2	0.2	0.3	0.5	1.6

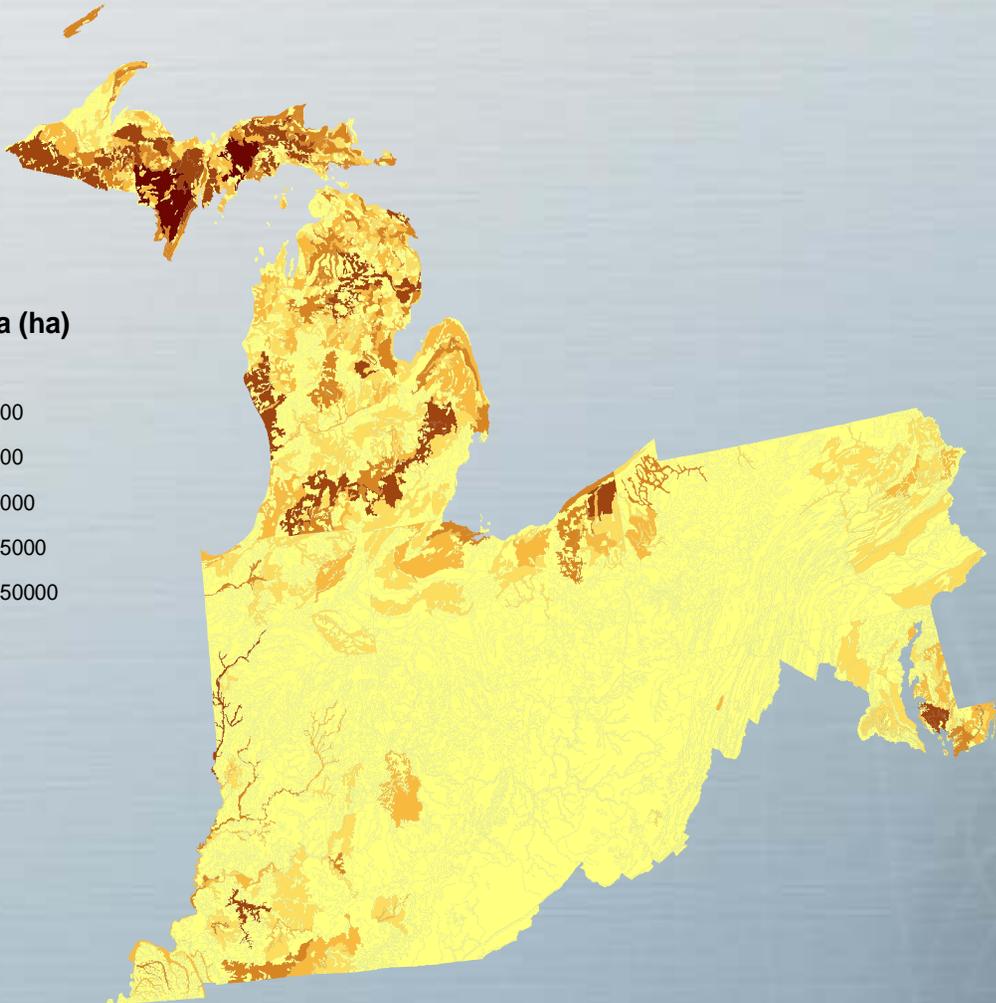
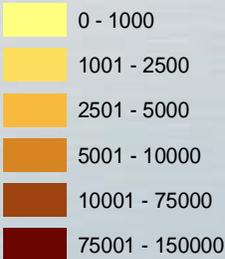
C Accumulation on Minelands over 20 Years



Area	0.6 Mha
Total C	29.5 MMT

Area of Wetlands

Wetland area (ha)



Wetland C Sequestration Potential Over 20 Years and Annually

Land use	Tidal Marshes	Peatlands	Crop to wetland	Total
Area (THa)	82	196	100 to 435	378 to 713
----- Million Metric Tons -----				
Total Potential	4.1 – 9.3	0.9 – 1.4	16 - 68	5 – 10.7 ¹ 21 – 78.7 ²
----- Million Metric Tons yr ⁻¹ -----				
Annual Potential	0.2 - 0.5	0.05 - 0.07	0.8 to 3.4	0.26 to 0.53 ¹ 1.1 to 3.9 ²

1 Without cropland conversion to wetland

2 With cropland conversion to wetland

Note: Current wetland carbon pool is estimated to be **656** MMT on 3.4 Mha.

SOCRATES Modeling Results – Annual Potential C Sequestration

Category	IN	KY	MD	MI	OH	PA	WV	Total
	-----Million Metric Tons yr ⁻¹ -----							
Cropland	2.5	0.8	0.2	1.7	2.3	0.27	0.04	7.8
Eroded Cropland	0.27	0.05	0.00	0.02	0.1	0.00	0.00	0.45
Marginal Cropland	2.98	2.4	0.61	0.94	2.8	2.6	1.1	13.5
Marginal Pasture	3.2	1.8	0.3	3.4	2.1	0.9	0.3	12.0
Mineland	0.15	0.37	0.19	0.27	0.16	0.70	0.42	2.3
Total	9.1	5.4	1.3	6.3	7.5	4.5	1.9	36.0

Economics

- Hierarchy of costs to increase C through activities addressed
 - 1. Non-Eroded Cropland – tillage intensity change
 - 2. Mineland – afforestation (additional costs incurred)
 - 3. Marginal Land – afforestation
 - 4. Eroded Cropland – grass/legumes yield highest C
 - 5. Wetland – restoration of cropland to wetland
- Refined analyses required to define actual costs to compare to benefits

Conclusions for Terrestrial

- Analysis considers only biophysical potential of increased C in soils, biomass and litter
- C accumulations estimated through modeling, so actual C sequestration may be somewhat lower or higher
- MRCSP region represents significant CO₂ offset potential
 - MRCSP Total Annual C Accumulation: **39.1** MMT
 - MRCSP region may offset **20%** of CO₂ emissions
 - MRCSP 20 Year C Accumulation: **773** MMT
- Activities represent options for early deployment at minimum cost
- Economic analyses will be focus of upcoming activities