Supplementary Methods

Pre- CO_2 treatment soil sampling and C measurement. Soils from the CO_2 gradient were sampled before CO_2 treatment (Jan 9-10, 2006, representing the 2005 growing season) for comparison with post-CO_2 treatment soil samples. Soil was cored to 10 cm depth, separated into 0-5cm and 5-10cm increments, and air dried. For sandy loam, silty clay, and black clay respectively, n = 5, 14, 12. Soil C was determined by combustion gas chromatography at 600°C, the same temperature used to determine organic C content of post-CO_2 treatment soil samples.

Supplementary Tables and Figures

Table S1. Plant species in the CO_2 gradient experiment

Plant type	**Species**	**Common name**
C_4 grass	*Sorghastrum nutans*	Indian grass
C_4 grass	*Bouteloua curtipendula*	side-oats grama
C_4 grass	*Schizachyrium scoparium*	little bluestem
C_4 grass	*Tridens albescens*	white tridens
Forb	*Salvia azurea*	pitcher sage
Forb	*Solidago canadensis*	goldenrod
Legume (N fixer)	*Desmanthus illinoensis*	Illinois bundleflower

Table S2. Experiments referenced in Figure 2, ranked by clay content. The three soils in this paper are bolded and shaded.

Ecosystem	**CO_2 treatment (years)**	**Soil order**	**Clay**	**Reference**
Tallgrass prairie	**4**	**Vertisol**	**55%**	**Fay et al. 2009**
Tallgrass prairie	3	Mollisol	55%	Polley et al. 2003
Tallgrass prairie	**4**	**Mollisol**	**45%**	**Fay et al. 2009**
sweetgum forest	5	Ultisol	40%	Jastrow et al. 2005, Norby et al. 2002
annual grassland	3	Inceptisol	40%	Hungate et al. 1997
annual grassland	3	Mollisol	40%	Hungate et al. 1997
grassland	9	Cambisol	30%	Xie et al. 2005, Hebeisen et al. 1997
aspen forest	6	Spodosol	20%	Karnosky and Pregitzer 2006, King et al. 2005
beech-spruce forest	4	Alisol	18%	Hagedorn et al. 2003
Tallgrass prairie	**4**	**Alfisol**	**15%**	**Fay et al. 2009**
scrub-oak forest	6	Spodosol, Entisol	10%	Carney et al. 2007, Dijkstra et al. 2002
grassland (16, 9 spp average)	8	Entisol	10%	Adair et al. 2009, Tilman 1987
beech-spruce forest	4	Fluvisol	6%	Hagedorn et al. 2003

Table S3. Soil properties in the CO_2 gradient experiment

Property	**Sandy loam (Bastsil series)**	**Silty clay (Austin series)**	**Black clay (Houston series)**
Organic C (%)	0.8	2.2	2.7
Total C (%)	0.9	8.7	5.5
Total N (%)	0.08	0.17	0.22
Organic C/Total N	10.8	13.1	12.2
Sand (%)	60-72	11-12	9-11
Silt (%)	20-26	44-46	36-40
Clay (%)	7-14	42-45	49-55
pH (H_2O)	8.09	8.03*	7.98

Organic C was measured by combustion at 600°C; total C and N by combustion at 1050°C. Soil textures are for the upper 50 cm of soil (Table 2 in Fay et al. 2009). *For sandy loam and black clay, pH was measured in year 2009 soil samples; for silty clay, pH was measured in year 2002 soil samples, prior to gradient operation.

Table S4. Soil sampling scheme for soil incubation experiment

Section	CO_2 ppm	Sandy loam	Silty clay	Black clay
1	514		x	x
2	501			
3	493		x	x
4	480	x		
5	462		x	x
6	448	x		
7	431		x	x
8	422	x		
9	396		x	x
10	380	x		
11	381		x	x
12	372	x		
13	359		x	x
14	347	x		
15	337		x	x
16	321	x		
17	298		x	x
18	290	x		
19	271		x	x
20	262			

"x" indicates a section of the CO_2 gradient where soil cores were taken for a given soil type.

Each CO_2 gradient section contains four monoliths; two of one soil type and two of another.

ANPP was measured in 15 of the 20 CO_2 gradient sections.

Table S5. Sample sizes used in regressions

CO_2 response variable	**Sandy loam (Bastsil series)**	**Silty clay (Austin series)**	**Black clay (Houston series)**
ANPP; Soil CO_2 efflux	n = 16	n = 24	n = 20
Microbial biomass; C_{min} rate; Modeled SOC pools and cumulative C_{min}; Total SOC	n = 8	n = 10	n = 9
SOC physical fractions	n = 15	n = 23	n = 20

In microbial and C_{min} measurements, the black clay has n = 9 rather than n = 10 due to one missing sample. In the SOC physical fractions the sandy loam and silty clay each have one missing sample.

Table S6. Results of incubation kinetics model, averaged across CO_2 gradient by soil type

		Active C		**Slow C**	
Soil	**SOC[a] (g/kg)**	**% of SOC**	**MRT[b], days**	**% of SOC**	**MRT, days**
Sandy loam (15% clay)	8.2	0.67%	10.56	23.04%	267
Silty clay (45% clay)	21.9	0.33%	7.35	20.70%	1128
Black clay (55% clay)	26.7	0.22%	6.26	19.05%	833

[a]SOC was measured by combustion, rather than modeled.

[b]MRT, mean residence time of soil organic carbon

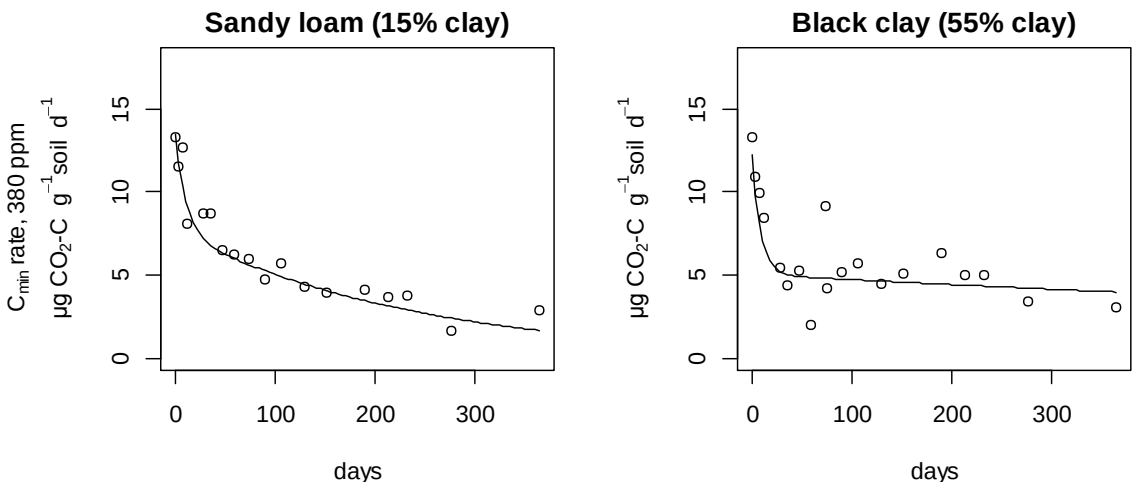

Figure S1. Carbon mineralization rate over one-year laboratory incubation, modeled using a two-pool exponential decay curve. The figure shows a representative curve for one sandy loam sample and one black clay sample from 380 ppm CO_2 treatment.

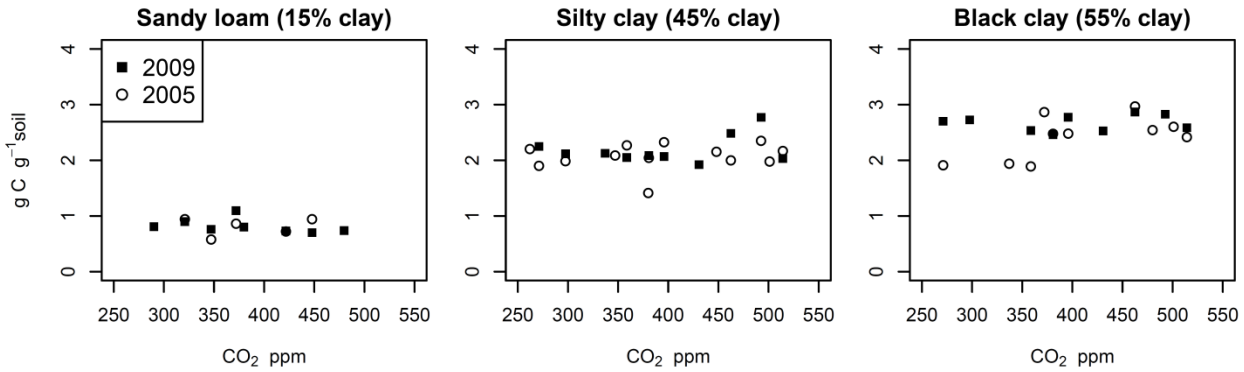

Figure S2. Soil organic carbon after four growing seasons of CO_2 treatment. Linear regressions of SOC vs. CO_2 were non-significant ($p > 0.05$) for each soil type in 2009 samples. SOC concentration did not differ between 2009 and 2005 (pretreatment) samples (paired t-test, $p > 0.05$). Linear regressions of SOC concentration difference (2009-2005) vs. CO_2 were non-significant in each soil ($p > 0.05$). Data points from 2009 represent 0-15cm depth, while data points from 2005 represent the average of 5cm and 10cm depth.