

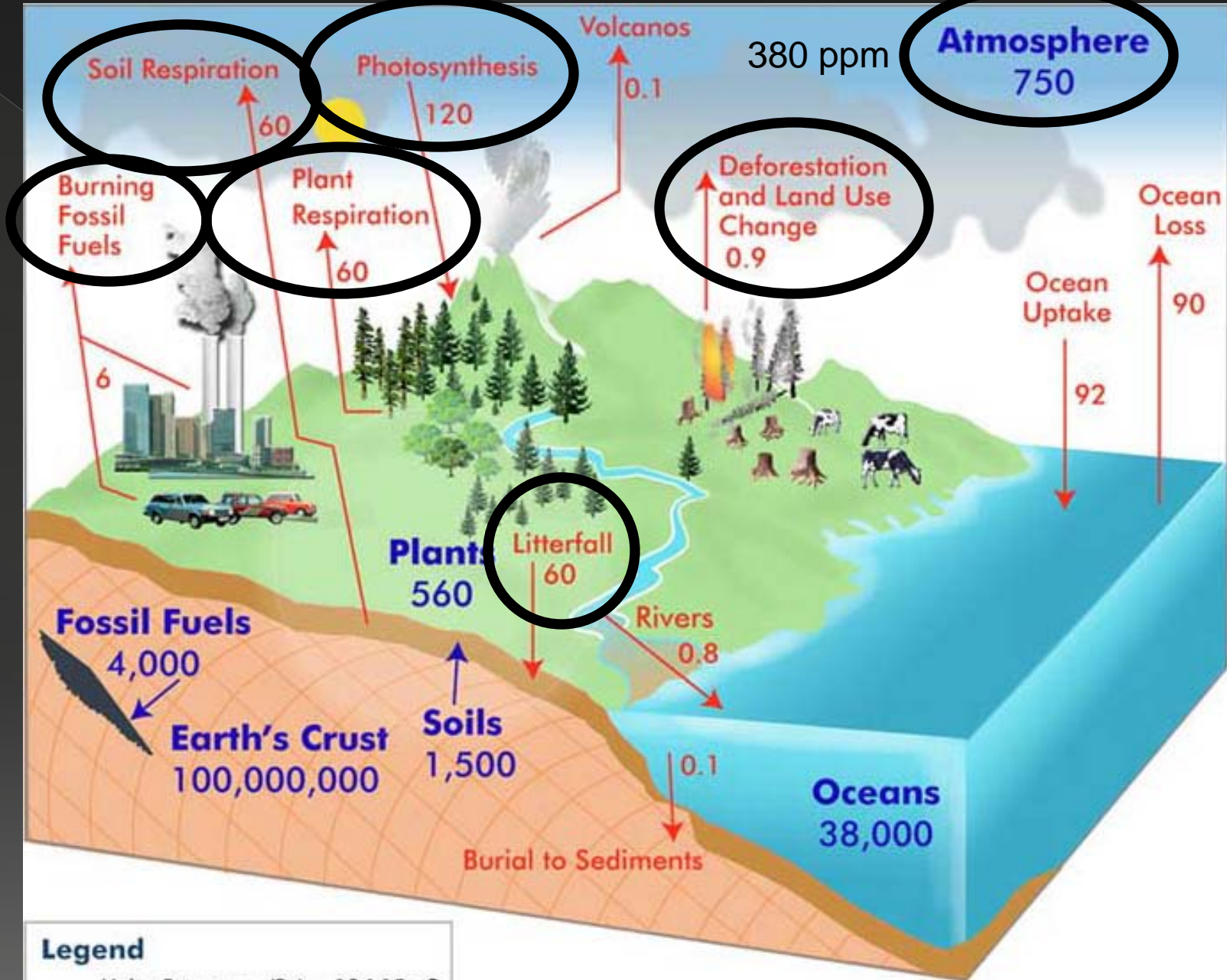
Soil Carbon Sequestration and Carbon Credits

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What is Soil Carbon Sequestration

- ◉ Transfer of atmospheric CO₂ to the soil through land management practices.
- ◉ Goal:
 - › Offset CO₂ emissions to atmosphere from fossil fuel combustion.
 - › This offset can be sold as a carbon credit.



Legend

Units: Petagrams (Pg) = 10¹⁵ gC

- Pools: Pg
- Fluxes: Pg/year

What's the Potential for Soil Sequestration of CO₂

- ◉ The USDA estimates that U.S. Farms and Rangeland could sequester 12-14% of current U.S. CO₂ emission
- ◉ Much of this CO₂ will be sequestered through the reversal of soil carbon losses from:
 - > Cultivation
 - > Overgrazing

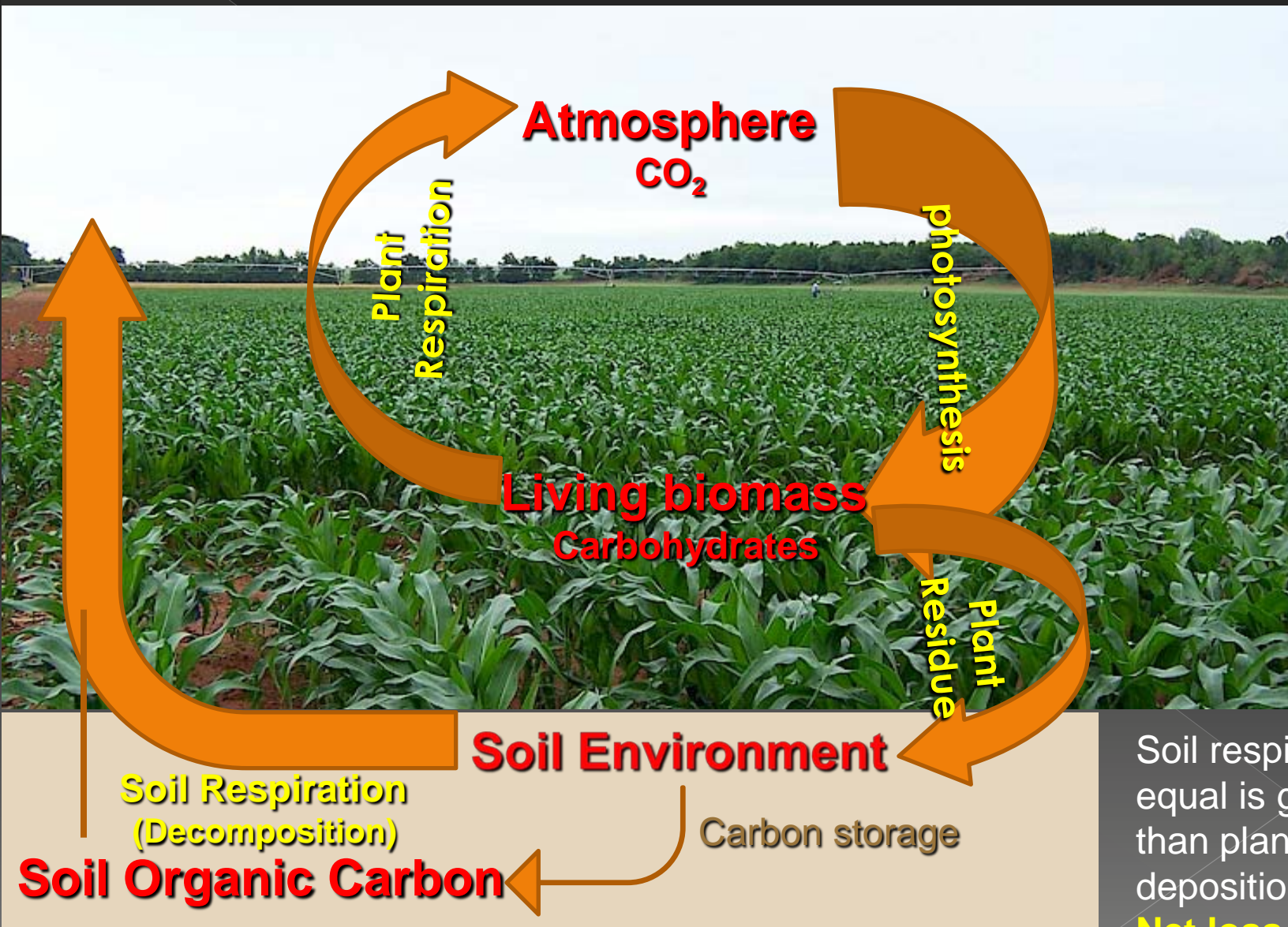
Soil Organic Carbon in Oklahoma

- Presettlement there were approximately 2.3 billion tons of carbon in Oklahoma Soils
- We have lost ~114 million tons of Carbon through cultivation:
 - > (38% of C in top 6 in)

Why do we lose Carbon after cultivation.

- Cultivation aerates the soil and breaks up soil aggregates.
 - > Aeration increases microbial respiration
 - Organic Carbon is utilized for energy

Impact of Tillage on Soil Carbon cycle



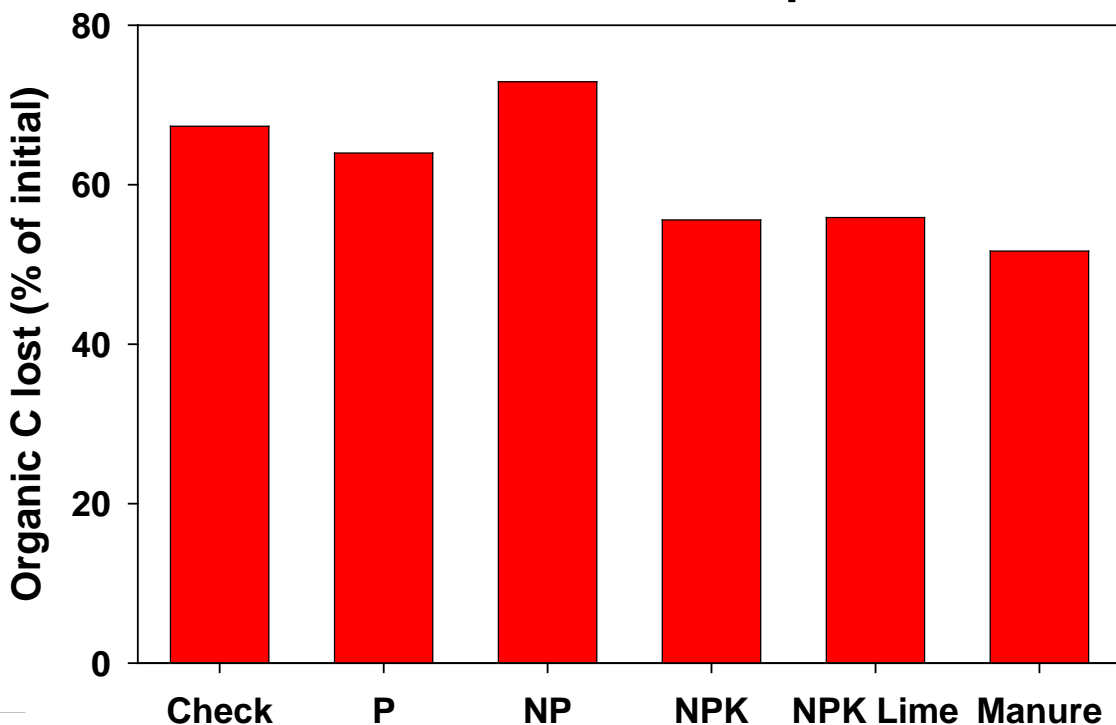
Soil respiration is equal is greater than plant residue deposition.

Net loss of Carbon

Magruder Plots, Stillwater: Soil Carbon loss after 110 years of Continuous Wheat

- Initial C was 1.8%
- Lost 46 to 70% of the initial C.
- ~28-42 Mt CO₂/acre
- 2300 to 3400 gal of gasoline/acre!

Soil Carbon Loss in Top 6 inches

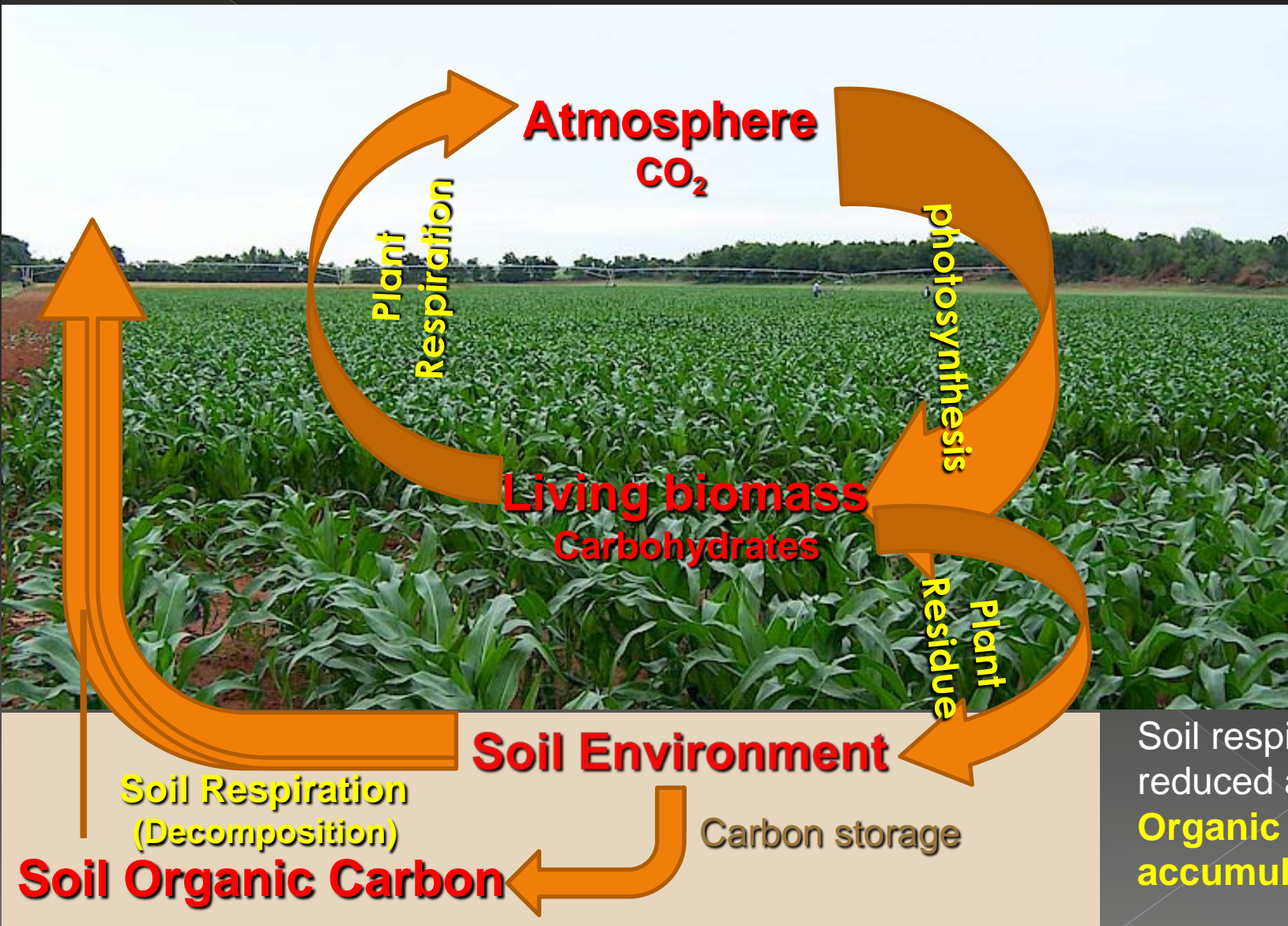


Reversing Soil Carbon Losses

- Eliminate whole field tillage from our croplands
 - > No-till management
 - > Grass plantings



Change in Soil Carbon Cycle when Tillage is Removed

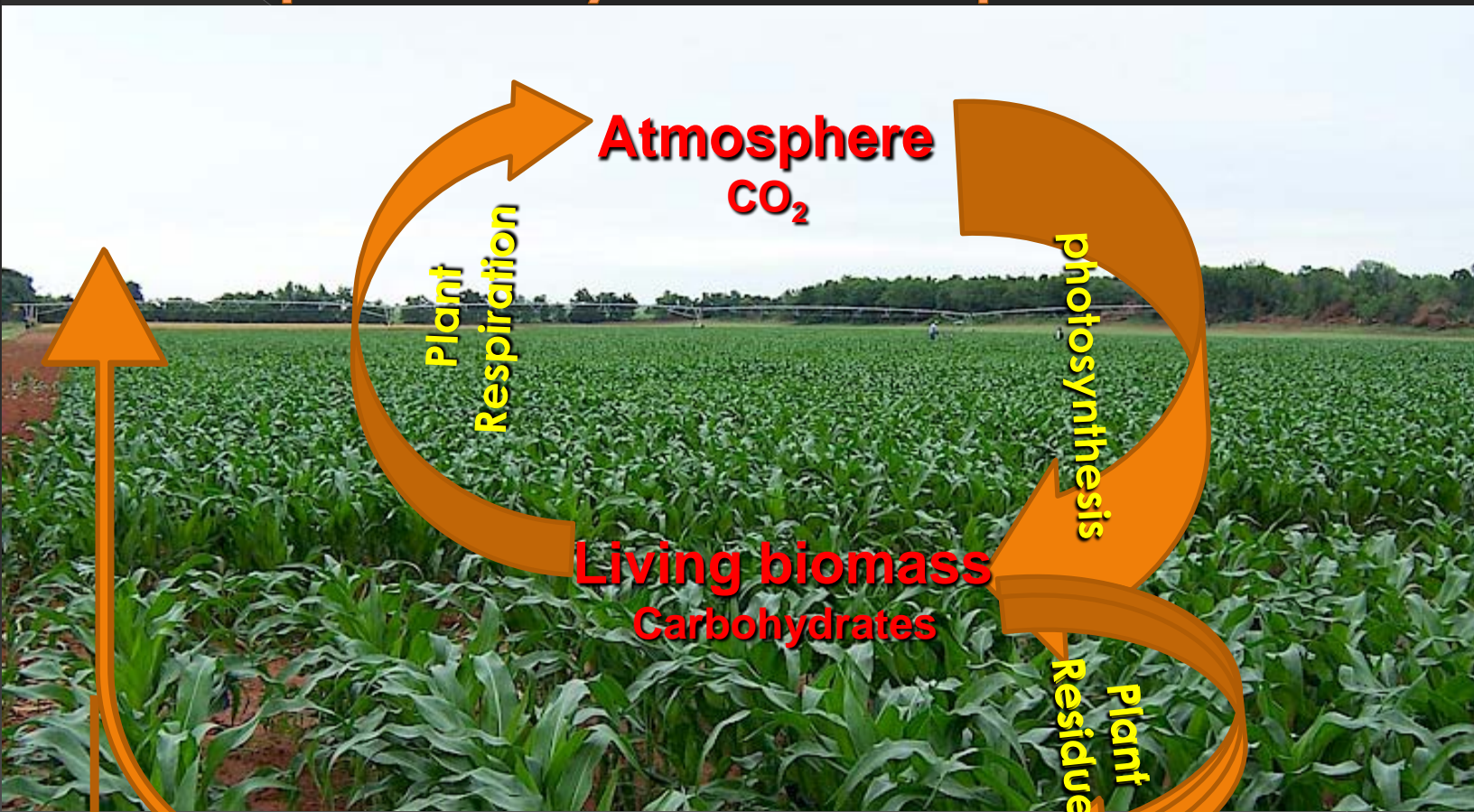


Soil respiration is reduced and **Organic carbon accumulates.**

Other Factors influencing soil Carbon Sequestration

- Crop Residue input into soil system
- Crop Residue Quality

The rate of Carbon Sequestration is also Impacted by Residue Input



**Atmosphere
CO₂**

Plant
Respiration

photosynthesis

**Living biomass
Carbohydrates**

Plant
Residue

Soil Environment

Soil Respiration
(Decomposition)

Carbon storage

Soil Organic Carbon

Plant residue
deposition is
reduced

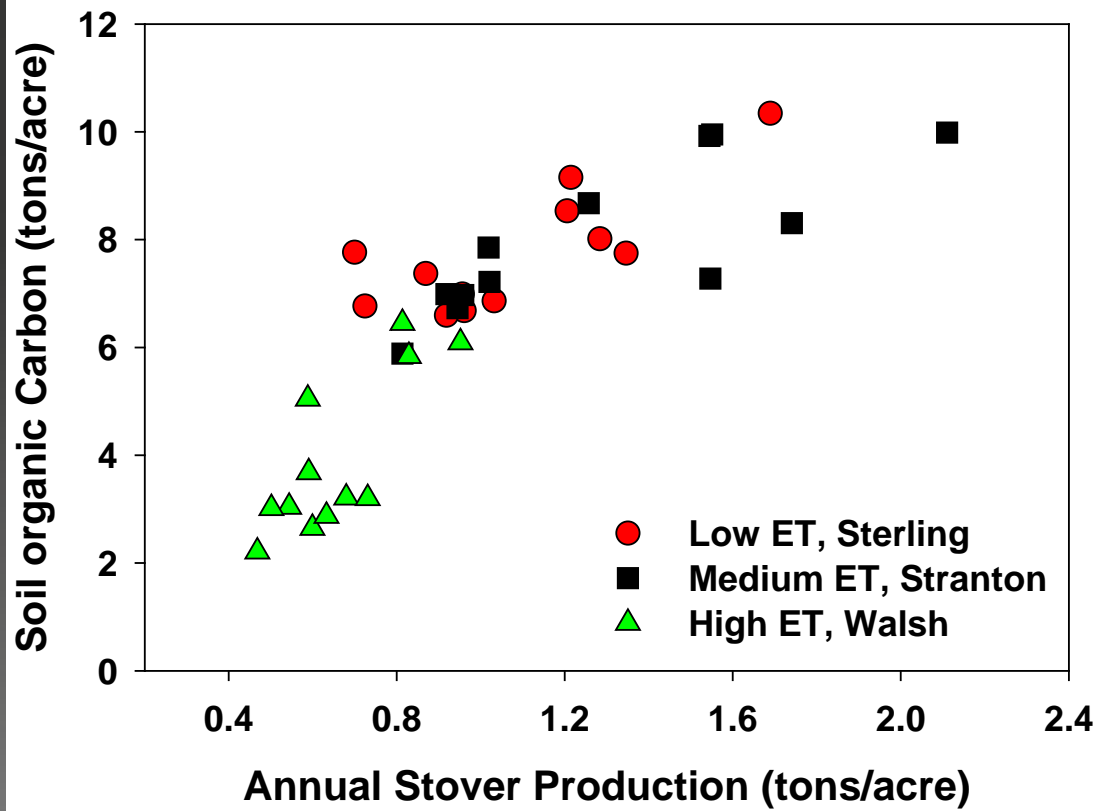
**Carbon storage is
reduced**

Alterations in residue input

- In a given field, residue input can be increased through:
 - > Increased crop rotation intensity (maybe)
 - > Optimization of crop yield (crop management)
 - > Crop type (Wheat vs Soybean)
- Residues can be decreased by:
 - > Burning
 - > Forage harvest
 - > Long fallow periods

Soil Carbon vs. Carbon Input in No-till

Dryland crop rotations
12-years, No-till
Eastern Colorado
0-4 inches
Sherrod et al. (2003)



Residue Quality influences Carbon Sequestration

- Residues with Low C/N ratios decompose rapidly
 - › Soybean 15/1, Hairy Vetch 12/1
- Residues with high C/N ratios decompose slowly.
 - › Wheat straw 80/1, Corn stover 60/1

Lets come back to Carbon Credits

- ◉ Soil carbon sequestration can offset CO₂ emissions
- ◉ This offset generates a Carbon Credit?

Carbon Credits

- Carbon Credits can be traded as a Commodity
 - › Carbon credits are purchased by entities who are interested in reducing net CO₂ emission
- Can provide an external revenue stream for landowners

No-till Crop Management

- Current estimate of CO₂ sequestration in OK is:
 - > 0.2-0.6 Mt of CO₂/acre/year
- Sequestration rate is highly dependent on rainfall
 - > 0.6 Mt in NE OK
 - > 0.2 Mt in SW OK



Some No-till Guidelines:

- ◉ Implements acceptable for use include:
 - No-till planter/drill
 - Subsurface disturbance implements:
 - Anhydrous applicator
 - Manure knife applicator
 - Subsoiler/ripper
- ◉ Residues can not be burned.
- ◉ Follow periods are restricted.



Grassland Establishment

- ◉ Conversion of cultivated cropland to grassland
 - > Harvests will be limited
- ◉ Current estimate of CO₂ sequestration in OK is:
 - > Most of Oklahoma
 - 1.0 Mt CO₂/acre/year
 - > SW Oklahoma
 - 0.4 Mt CO₂/acre/year



How are Carbon Credits Marketed?

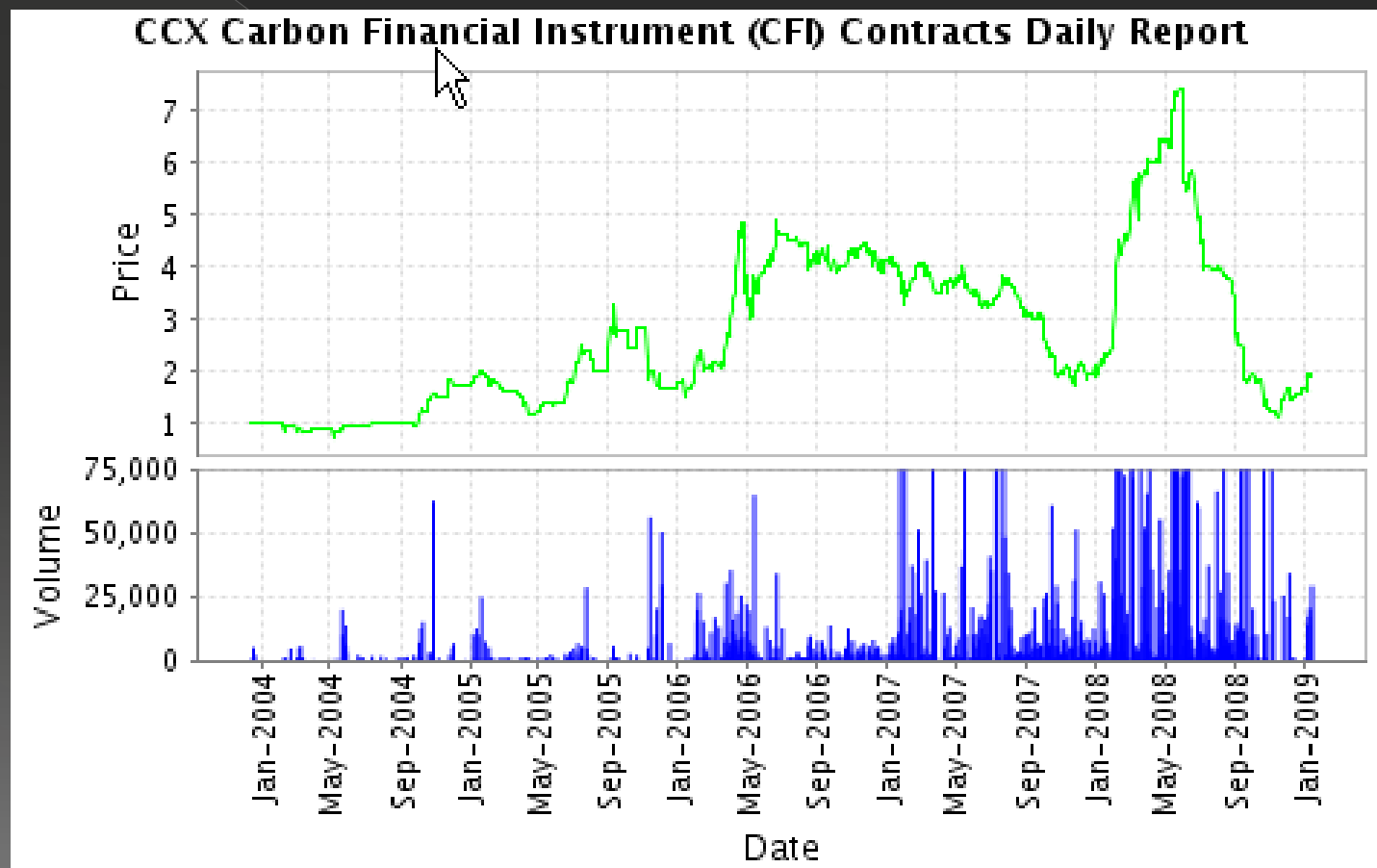
- Chicago climate exchange?
- Members can buy and sell carbon credits
- Agricultural carbon credits must be combined and sold as large individual units.
 - › They are combined by Aggregators

Aggregators:

- Oklahoma Carbon Initiative.
 - > www.okcarbon.com
- North Dakota Farmers Union
 - > www.carboncredit.ndfu.org
- Agragate
 - > www.agragate.com

How much is this deal worth?

- The Market has fluctuate drastically in the past year!



Revenue per Acre of No-till

- Current Price:
 - > ~\$1.20/Carbon Credit
- Aggregator Handling Fee:
 - > ~20%
- No-till sequesters:
 - > 0.2-0.6 Mt/acre
- At current price the Revenue is:
 - > \$0.20-.60 /acre

Oklahoma Carbon Program

- The Oklahoma Conservation Commission provides certification of Aggregators operating in the state.
- This is not mandatory
 - > State certification provides a level of protection against fraudulent aggregators
- Certification provides assurance that land practices are followed to sequester carbon

Potential impact of Cap and Trade?

- System in which CO₂ emissions are capped
- Example:
 - CO₂ emission from a coal fired electric power plant will be restrict
 - They can buy carbon credits to offset emissions
- There are other alternatives such as some form of carbon tax.
- Currently, carbon credits are purchased voluntarily

Potential impact of Cap and Trade?

- ◉ Europe has a cap on emissions
- ◉ Carbon Credits in Europe are worth \$20.30 per Mt
- ◉ This equates to \$3.25-9.75/acre for No-till

Final thoughts:

- Currently, the value of carbon credits is low
 - Oklahoma Carbon Initiative is working to get a premium for agricultural carbon credits in OK
 - Talk to your local Conservation District Office.
 - Cap and trade will dramatically influence value
 - Be cautious about signing long-term contracts

Question?