Soil Carbon Sinks and Sources in Intensively Managed Agricultural Landscapes

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INTRODUCTION, METHODOLOGY AND OBJECTIVES

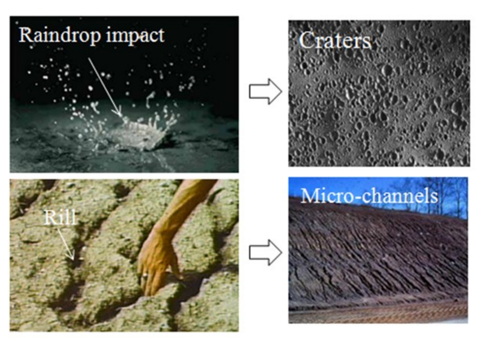
Problem Statement

- Millions of tons of rich topsoil are being lost each year through tillage and rainfall induced erosion while conducting agricultural land management

Large Scale Soil Erosion

- Carbon redistribution is highly variable within an agricultural watershed

Tillage Induced Erosion

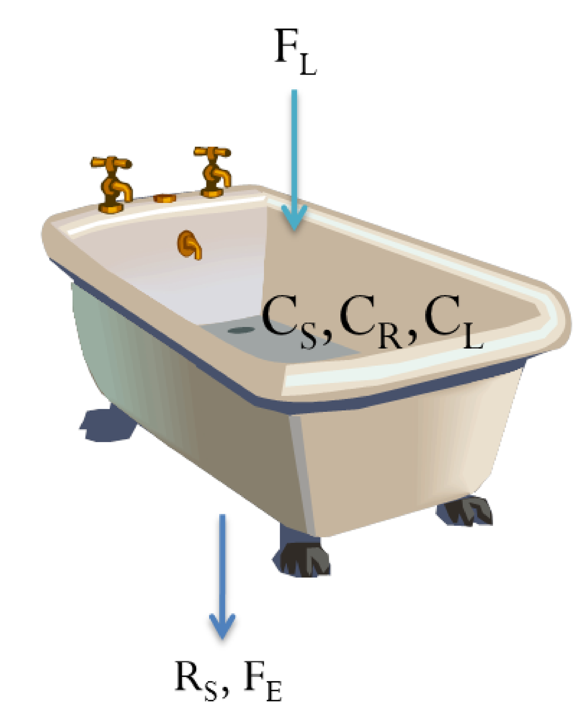


Rainfall Induced Erosion

Carbon Fluxes: Mass Balance Approach

Aboveground
- Biomass (plant) production
- Photosynthesis

Belowground
- **"Black Box Approach"**
- Total Belowground Carbon Allocation (TBCA)
- Mass balance approach has been used in forest ecosystems



$$TBCA = R_S + F_E - F_L + \Delta(C_s + C_R + C_L)/\Delta t$$

TBCA= Total Belowground Carbon Allocation
R_S= Soil Respiration
F_E=Loss of soil carbon due to erosion
F_L=Flux of litterfall
C_s=Carbon content of soil
C_R=Carbon content of roots
C_L=Carbon content of litter layer

Methodology: Field Work

Growing Season for Corn and Soybean Rotations

Biogeochemical
- Microbial biomass
- C:N ratio
- Crop biomass

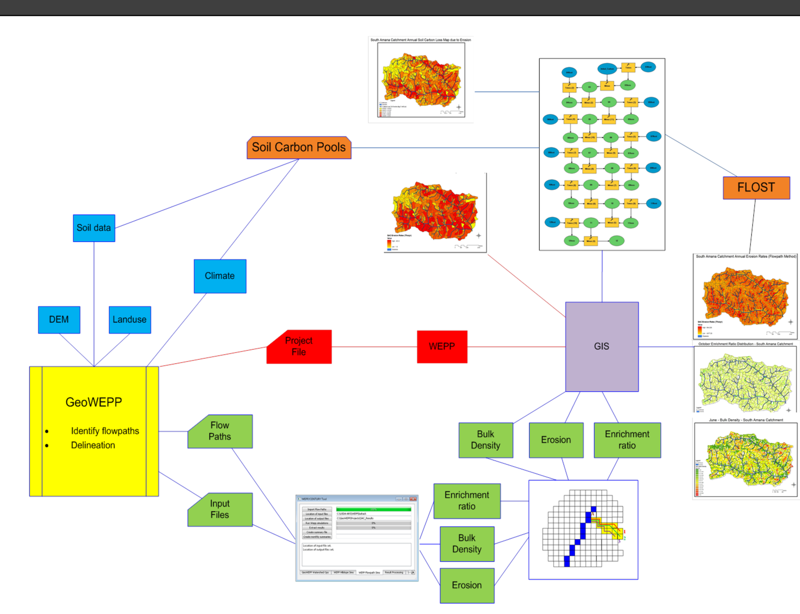
Soil Respiration
- Temperature and moisture relation
- Closed system chamber

Rainfall simulations
- Erosion & Deposition
- Runoff
- Enrichment ratio

Replicate Common Land Management Practices

Methodology: Numerical –Site Description

Site Description
- **Location:** South Amana Catchment, Iowa County, Iowa
- **Drainage Area:** ~ 26 km^2
- **Average gradient:** 5%
- **Main soil series:**
  - *Colo*– floodplains
  - *Tama*– uplands
- **Average precipitation:** ~890 mm/yr
- Over 80% of land is in Corn-Soybean rotation



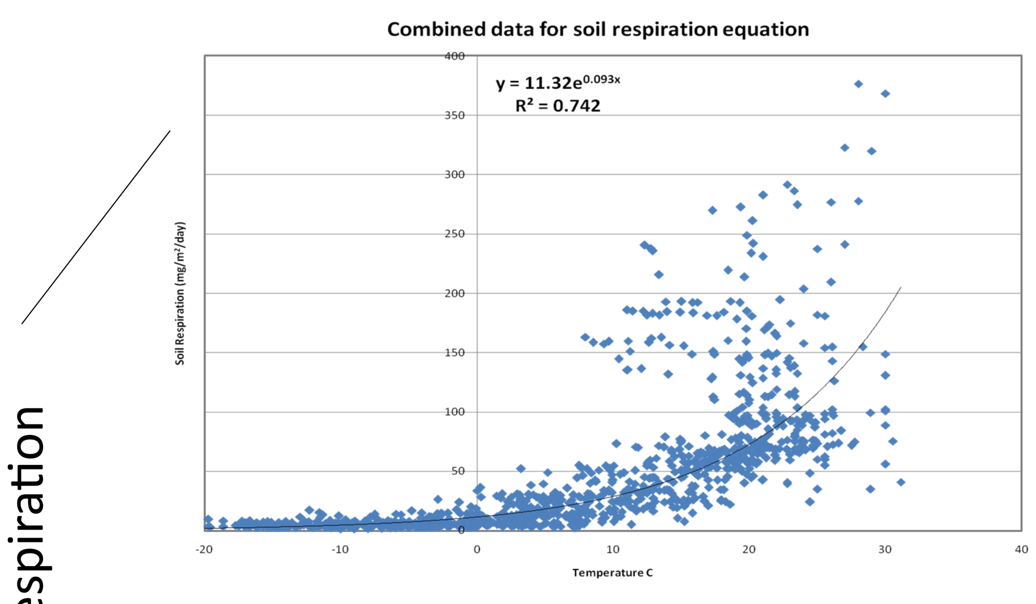
Objectives of Research

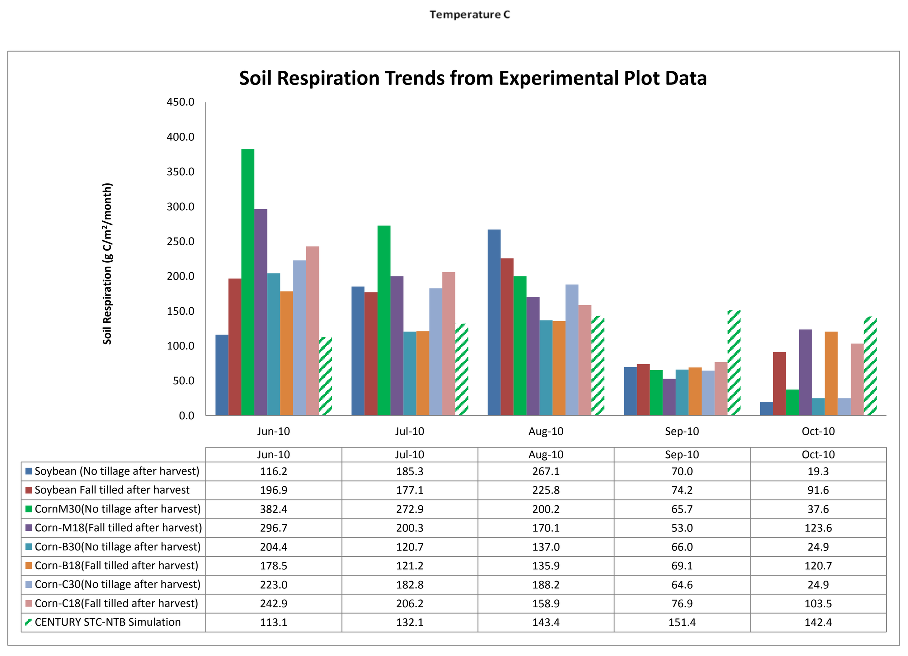
- Identify "Hotspots" of high variation in carbon fluxes
- Analyze temporal and spatial trends in carbon fluxes and isolate key parameters
- Use geospatial tools and numerical models for larger global prediction with verification from highly sensitive field data

RESULTS AND CONCLUSIONS

Experimental Results

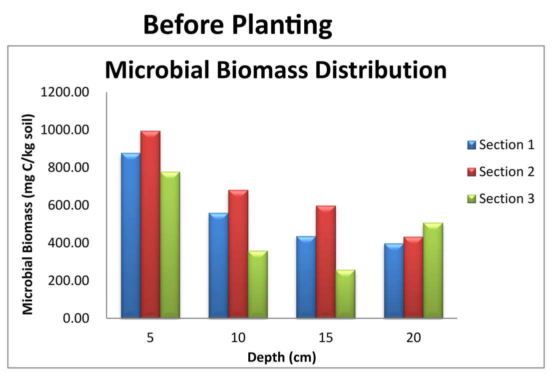
Soil Respiration



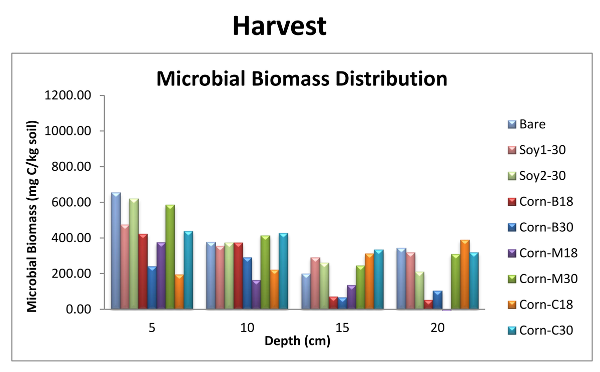


	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10
Soybean (No tillage after harvest)	116.2	185.3	267.1	70.0	19.3
Soybean Fall tilled after harvest	196.9	177.1	225.8	74.2	91.6
CornM30(No tillage after harvest)	382.4	272.9	200.2	65.7	37.6
Corn-M18(Fall tilled after harvest)	296.7	200.3	170.1	53.0	123.6
Corn-B30(No tillage after harvest)	204.4	120.7	137.0	66.0	24.9
Corn-B18(Fall tilled after harvest)	178.5	121.2	135.9	69.1	120.7
Corn-C30(No tillage after harvest)	223.0	182.8	188.2	64.6	24.9
Corn-C18(Fall tilled after harvest)	242.9	206.2	158.9	76.9	103.5
CENTURY STC-NTB Simulation	113.1	132.1	143.4	151.4	142.4

Before Planting



Harvest

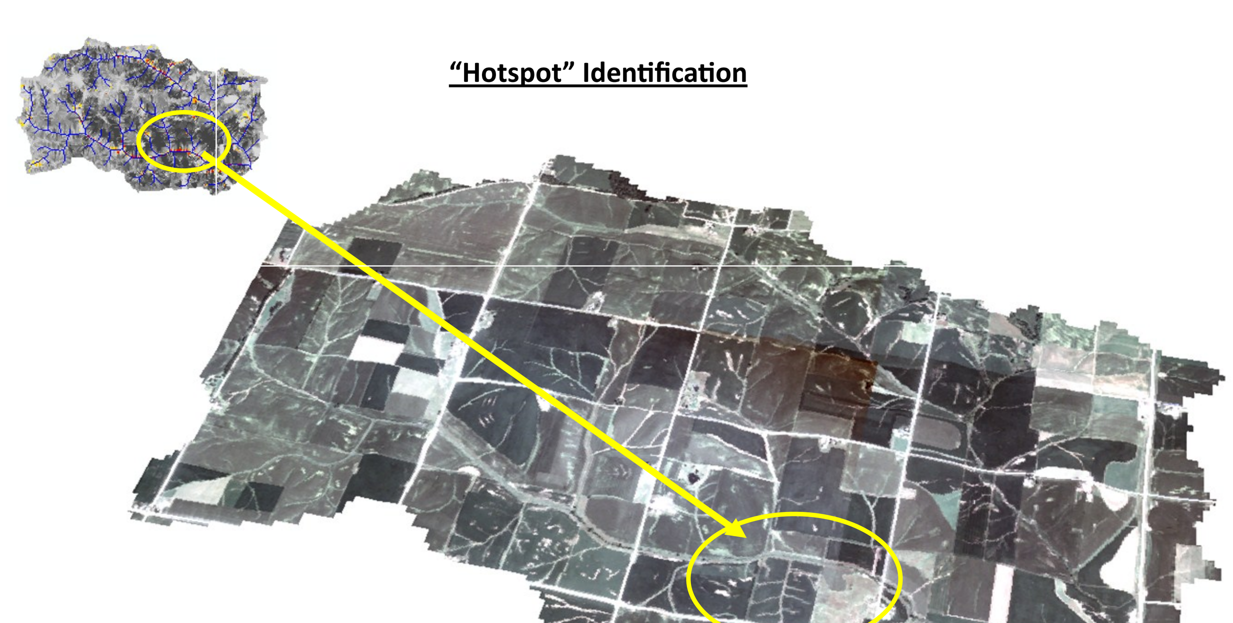


Spatial Trends
- Soil respiration rates vary with hillslope position
- Microbial populations are highest in the topsoil

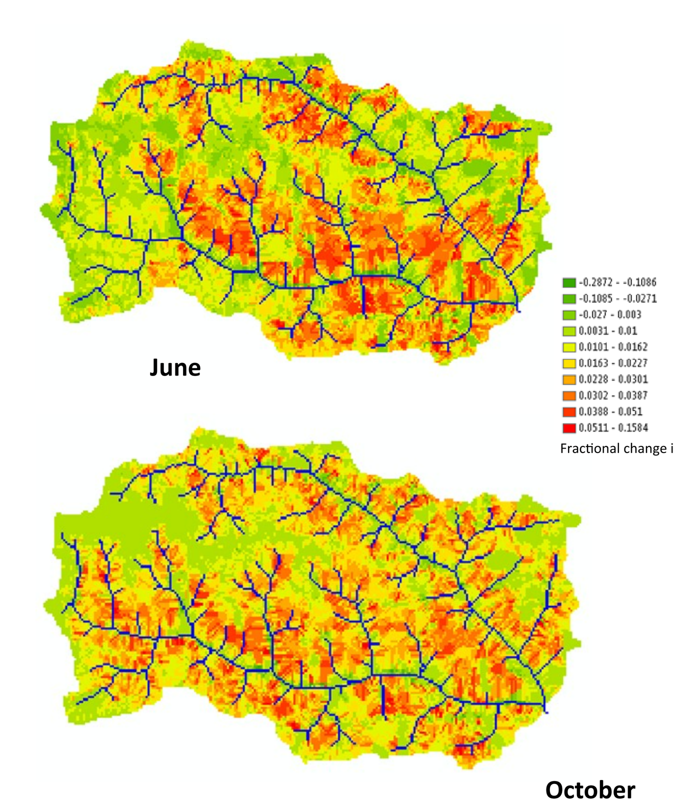
Temporal Trends
- Soil respiration rates fluctuate during growing season
- Fertilizer application sparks microbial activity

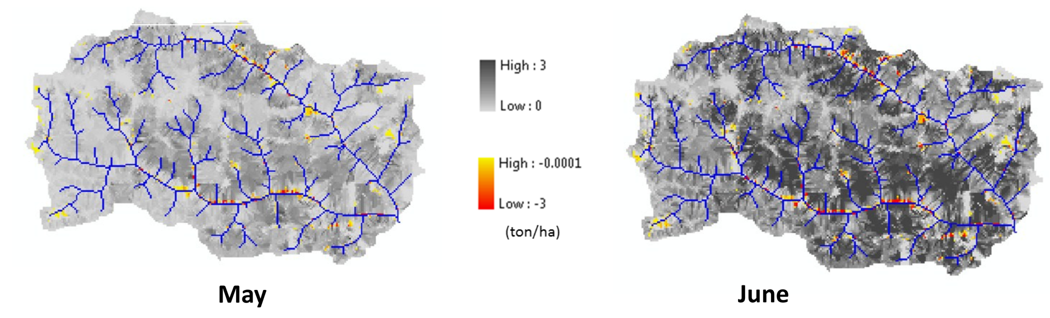
Numerical Results

"Hotspot" Identification



Soil Redistribution Temporal Trends
- May soil erosion related to tillage
- June has combined affects of tillage and rainfall





Changes in Soil Carbon
- Affected by bulk density, enrichment ratio and soil loss/gain
- Combined effects of tillage and rainfall induced erosion can be seen

Conclusions

- Agricultural landscapes are highly dynamic in the interaction of aboveground and belowground processes
- Geospatial tools can be used to isolate erosion prone landscapes
- Highly accurate testing plan can be developed with these preliminary results to implement agricultural best management practices