C-FARM: A Simple Model to Evaluate the Carbon Balance of Soil Profiles

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Introduction and Relevance

- The carbon cycle is biogeochemically of interest due to its reactions with other elements that undergo oxidation and reduction transformations.
- There is a strong demand for methods to compute and certify the soil carbon balance under different agricultural managements due to both environmental concerns and to support the carbon and environmental credits markets.
- Complex cropping systems simulation model are input intensive and often require local calibration if they were to be used to analyze the impact of different management scenarios in the soil carbon balance.

Objective

Develop a simple soil carbon model to compute the carbon balance of the soil profile with the following properties:
- no calibration requirements
- provide the carbon balance on a layer by layer basis
- accommodate the impact of different management practices on the carbon balance

Basic C-FARM equation for the soil carbon balance

\[ \frac{dC_s}{dt} = hC_s - kC_s \]

- \( h = h_0[1 - (C_s/C_x)] \)
- \( k = f_k k \) \( k \) depends on soil texture resembling Roth-C
- \( C_s \) Soil Carbon
- \( h \) humification rate
- \( k \) apparent soil carbon decomposition rate
- \( h \) depends on soil texture resembling Roth-C
- \( C_s \) depends on soil texture (Hassink and Withmorc, 1997)
- \( f_k \) soil temperature and water content factor controlling microbial activity
- \( f_k \) is a function of tillage tool and number of operations (NRCS) and soil texture

Model Inputs

- daily weather
- soil texture and organic carbon by layer
- cropping systems sequence (crop seeding and maturity dates)
- grain yield (max, min, average) for each crop
- tillage sequence (tools, date, depth of operation)
- irrigation scheme

Conclusions

- C-FARM carbon dynamic is scientifically sound
- Model successfully tested in two environments with different precipitation regimes and management systems
- The simple interface and limited input requirements make C-FARM useful for students, producers and consultants