

Soils' Dirty Little Secret: Depth-Based Comparisons can be Inadequate for Quantifying Changes in Soil Organic Carbon and Other Mineral Soil Properties

Background/objective

The ecological sustainability of bioenergy cropping systems is partly dependent upon changes in soil organic carbon (SOC) stocks. Measurements of SOC stock changes are typically performed at fixed depth (FD) intervals, but this technique may be misleading if concurrent changes in soil bulk density or soil organic matter (SOM) occur.

Approach

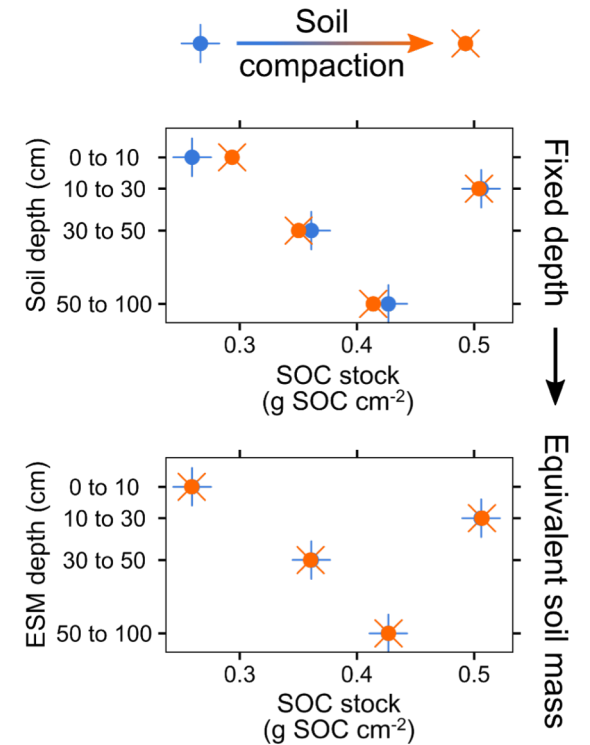
- ❖ Visually demonstrate how errors arise from bulk density or SOM changes.
- ❖ Use soil data collected from bioenergy cropping systems to simulate errors when soil bulk density changes over time.
- ❖ Compare the FD method with an equivalent soil mass (ESM) approach.

Results

- ❖ FD-based errors were greatest for SOC stocks, but errors for SOC mass percent, C:N ratio, and $\delta^{13}\text{C}$ are also evident.
- ❖ Errors increased with degree of bulk density change.
- ❖ Errors were typically much smaller for ESM compared to the FD method.

Significance

ESM provides more reliable quantification of changes in SOC stocks and other mineral soil properties compared to FD. We recommend the ESM method for studies evaluating changes in SOC stocks or other mass-based soil properties in bioenergy cropping systems.



A comparison of SOC stocks using the FD method (top) and the ESM method (bottom) in a scenario where only bulk density changed through time.