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# Challenges of Measuring and Managing Soil C Sink for Mitigating Climate Change

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# MEASUREMENT OF SOC FOR AGRONOMIC PURPOSES

**Quantity:** Concentration (% , g/kg)

**Depth:** Plow depth (0-20 cm)

**Frequency:** Rotation cycle (1 to 3 yrs)

**Precision:** One decimal place when expressed as %

**Scale:** Plot scale, pedon scale



# SOC MEASUREMENT FOR TRADING CARBON CREDITS

**Quantity:** SOC pool (Mg C/ha)

**Depth:** 1-m or more

**Frequency:** 2-5 yrs depending on land use

**Precision:** Whole # in Mg/ha

**Scale:** Landscape or farm scale

# SCALING ISSUES IN SOC STOCK ASSESSMENT





# RECENT ADVANCE IN SOIL CARBON ANALYSES

- Accelerator Mass Spectrometry (AMS)
- Pyrolysis Molecular Beam Mass Spectrometry (Py-MBMS)
- Laser Induced Breakdown Spectroscopy (LIBS)
- Mid and near-infrared diffuse reflectance spectroscopy
- Inelastic neutron scattering



## CRITERIA FOR GOOD METHODS

1. Economic and cost-effective
2. Field and laboratory based
3. Rapid
4. Routine and simple
5. Standardizable
6. Adaptable in a wide range of soils (wetlands, tropical, Vertisol, gravelly, Andisols, etc.)
7. Assess total system C
8. Precision of at least 0.5 g/kg
9. Assess pool rather than concentration alone
10. Differentiate between SOC and SIC



# MANAGING CARBON SEQUESTRATION IN SOILS AND TERRESTRIAL ECOSYSTEMS

**C Sequestration** =  $C_{\text{input}} > C_{\text{output}}$

**C Depletion** =  $C_{\text{input}} < C_{\text{output}}$

**$C_{\text{output}}$**  = **Erosion, Decomposition,  
leaching, Harvest**

**$C_{\text{input}}$**  = **Residues, Mulch, Compost,  
Amendment, Deposition**



# CREATING A POSITIVE CARBON BUDGET

## Gains by:

- NPK
- Manure
- Residues
- Cover crop

## Losses by:

- Erosion
- Leaching
- Decomposition

**“You can manage what you can measure”**

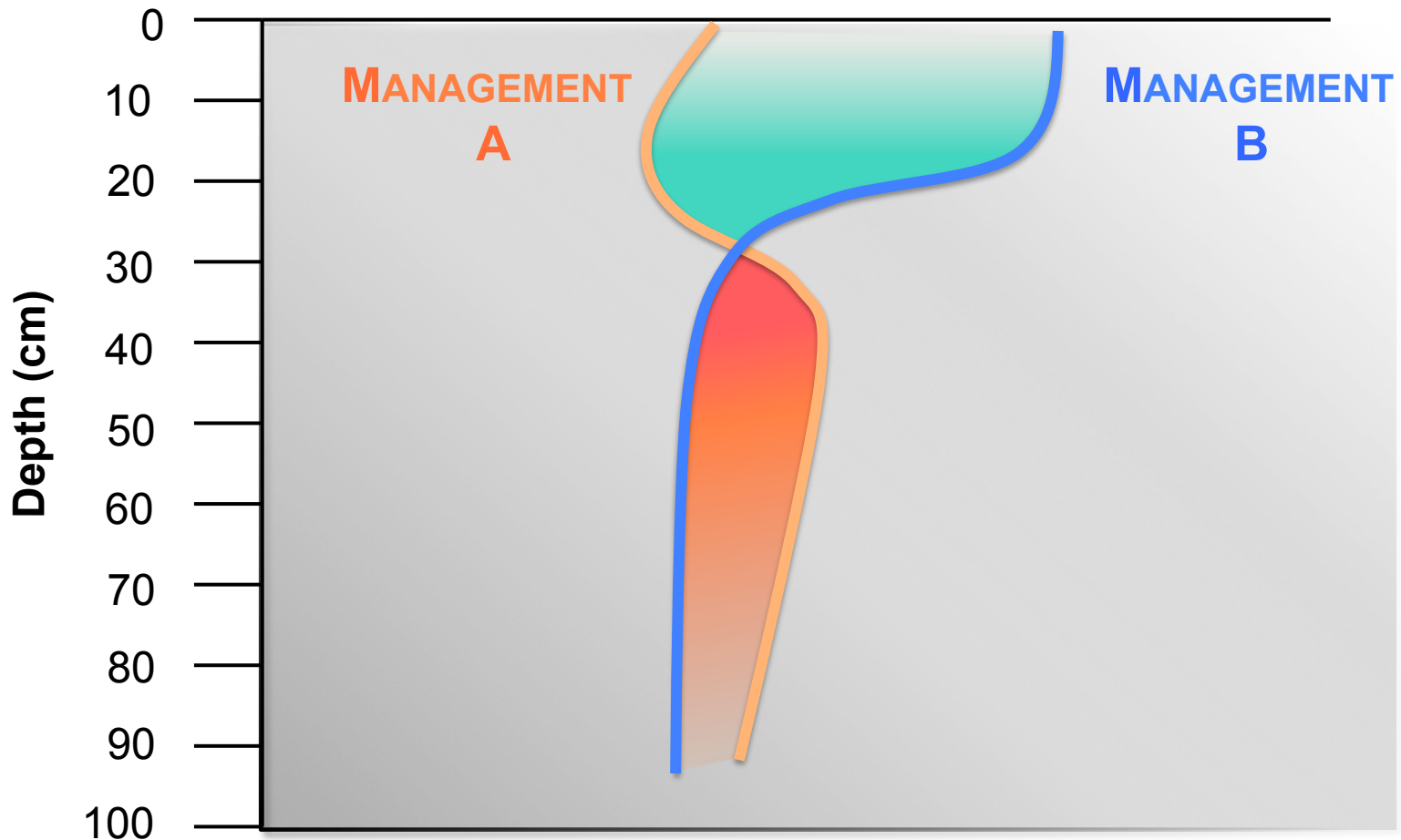
**So, what part of SOM should we measure or model?**

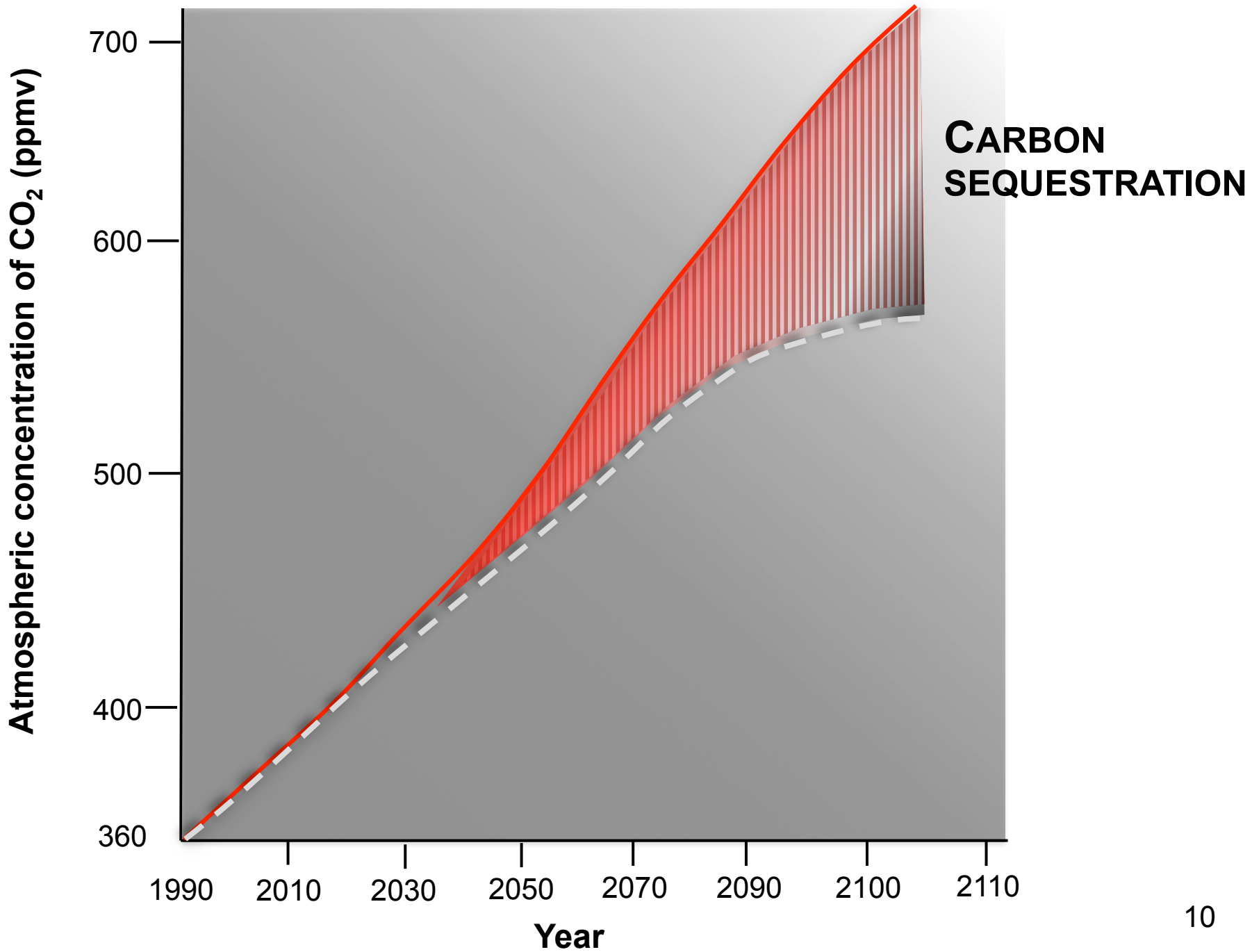




# DEPTH OF MEASUREMENT

SOC Concentration 







# CAN SOIL C SEQUESTRATION MITIGATE CLIMATE CHANGE?

- No, C sink capacity of soils of agro-ecosystems is finite ( $\sim 1$  PgC/yr for 50-100 years).
- But, it has numerous co-benefits and is the more cost-effective option.
- Restoring soil quality, of which SOC pool is the important determinant, is essential to human wellbeing and nature conservancy.



## CAPACITY OF SOIL CARBON SINK

- Total SOC pool to 2-m depth = 2400 Pg
- Increasing SOC pool by 1% = 24 Pg
- 1 Pg = 0.47 ppm

**C sink capacity for every 1% increment  $\approx$  11 ppm**