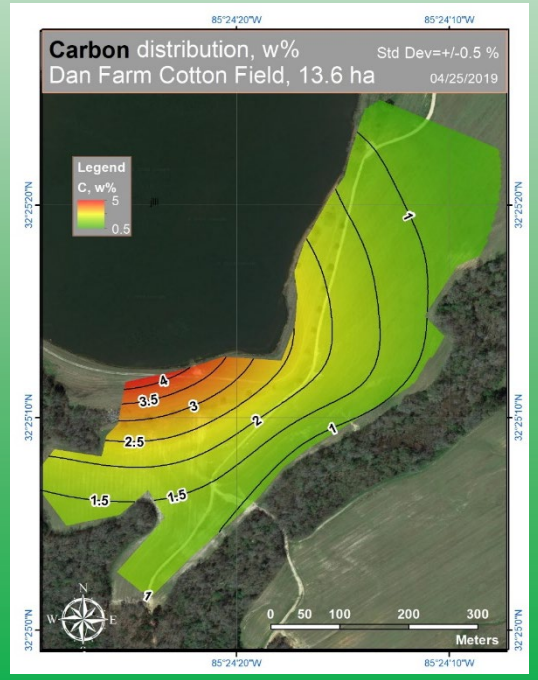
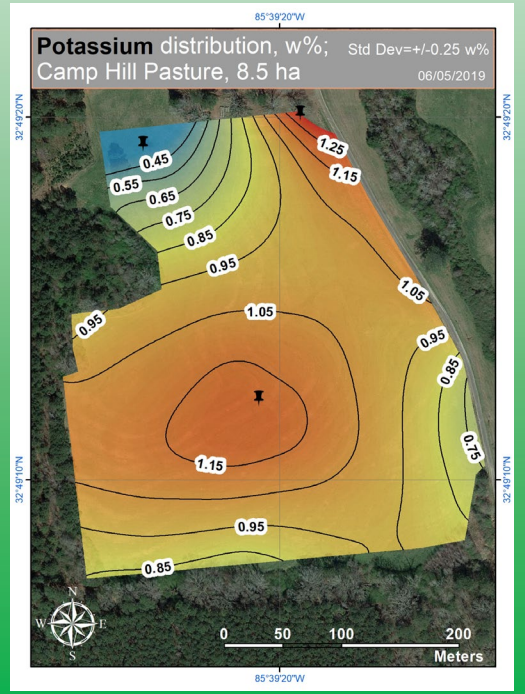
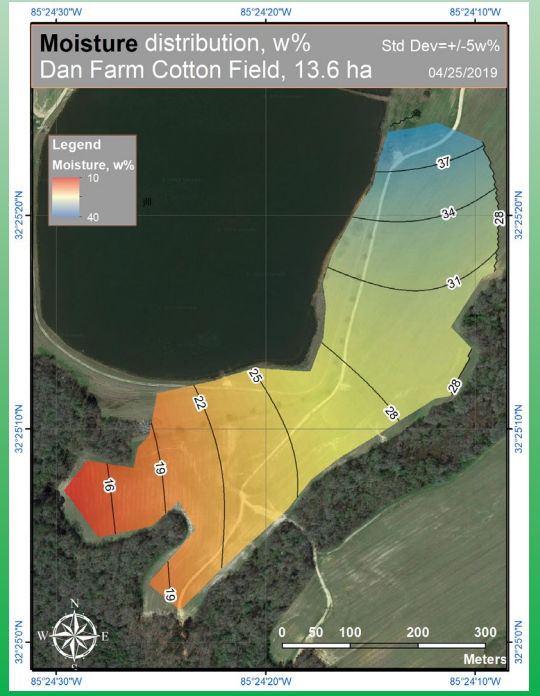
USDA-ARS National Soil Dynamics Laboratory Auburn, Alabama

Mobile Inelastic Neutron Scattering (MINS) Soil Scanning system "*In Situ*" Soil Analysis

H. Allen Torbert



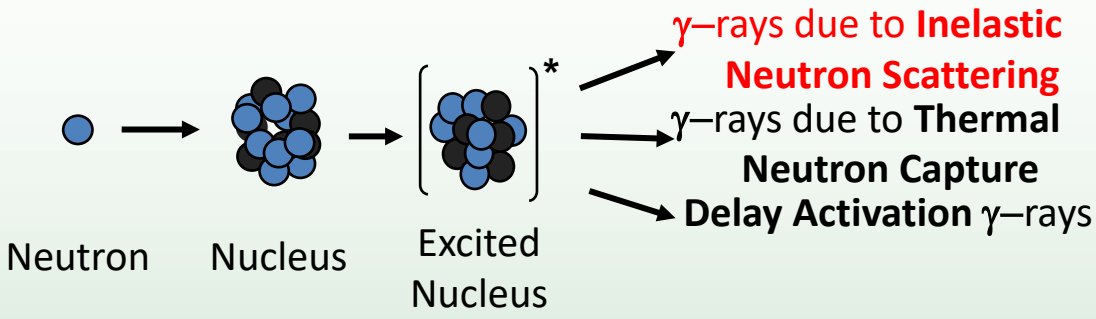




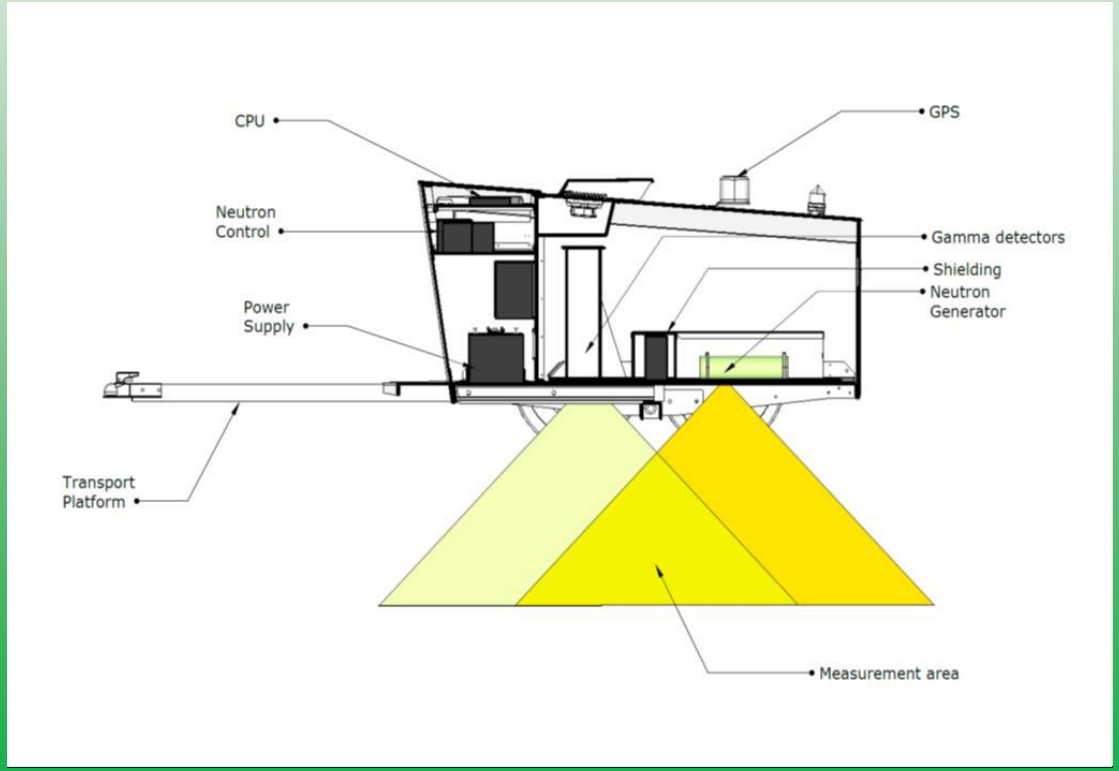
MINS technology overview

- Pulsed low energy neutron beam stimulates C atoms in the soil
- Reflected signatures are captured by three gamma detectors
- Continuous scan across surface scans 1.5m wide and 30 cm deep
- Atomic level carbon measurement with geospatial data recorded
- Bulk density measurements taken in field correlate gamma results and deliver total C by weight (t/acre)
- Soil Carbon Measurement is based on 14 MeV **inelastic neutron scattering** from carbon nuclei

Neutron interaction with an atomic nucleus

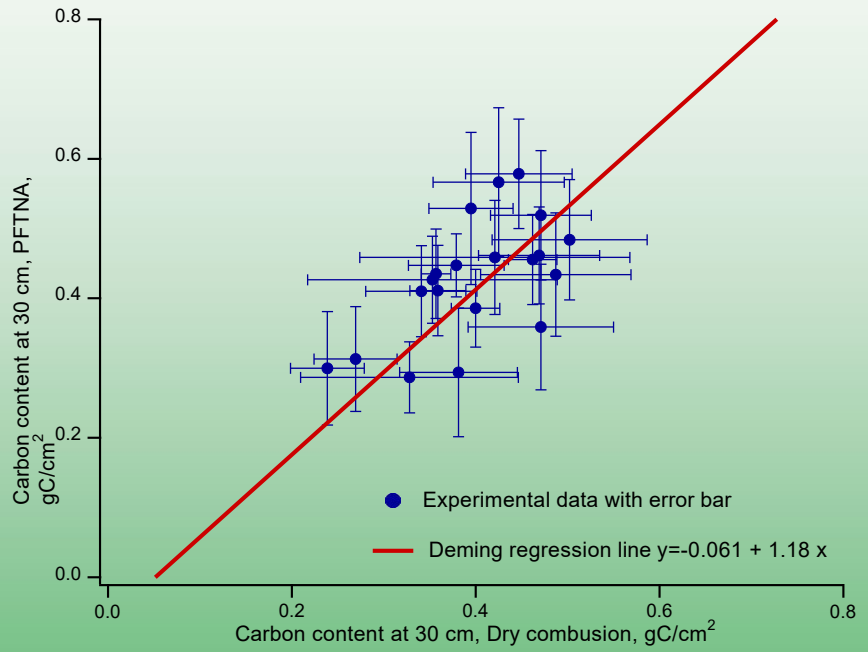


Each kind of nucleus and process produces gamma-rays of a particular energy



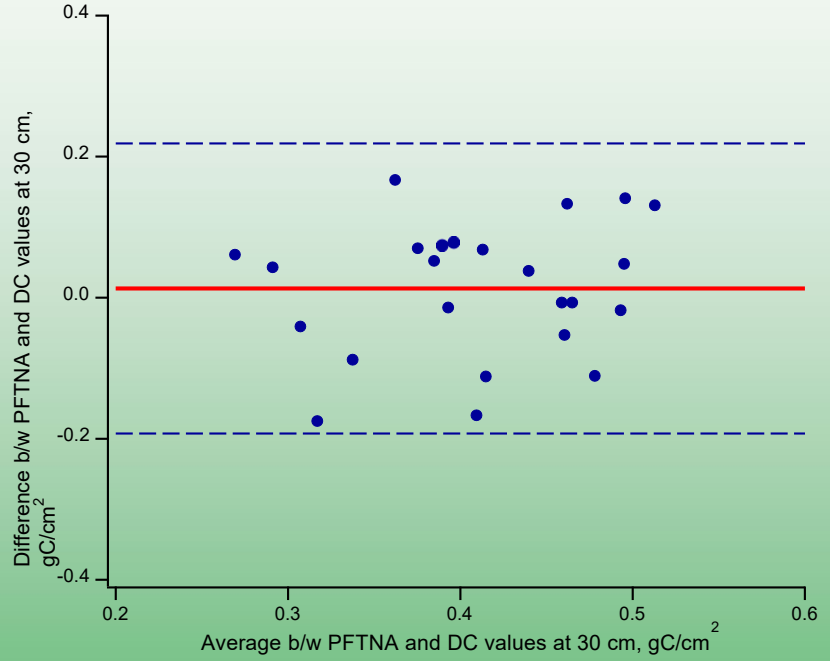
Verification of MINS for Soil Carbon Analysis of 30 cm soil layer (static mode)

Deming Regression Plot



Deming regression plot of surface density in upper 30 cm soil layer measured by MINS and DC methods

Bland-Altman Graph



Bland-Altman graph of measured surface density in upper 30 cm soil layer by MINS and DC methods

Jarque-Bera test for normality

JBStatistic = 1.28
Critical value = 3.35
at 0.05 significance level

These statistics methods support the workability of neutron stimulated gamma spectroscopy for soil carbon analysis in the 30 cm soil layer

Data Acquisition, Processing and Mapping in Scanning Mode

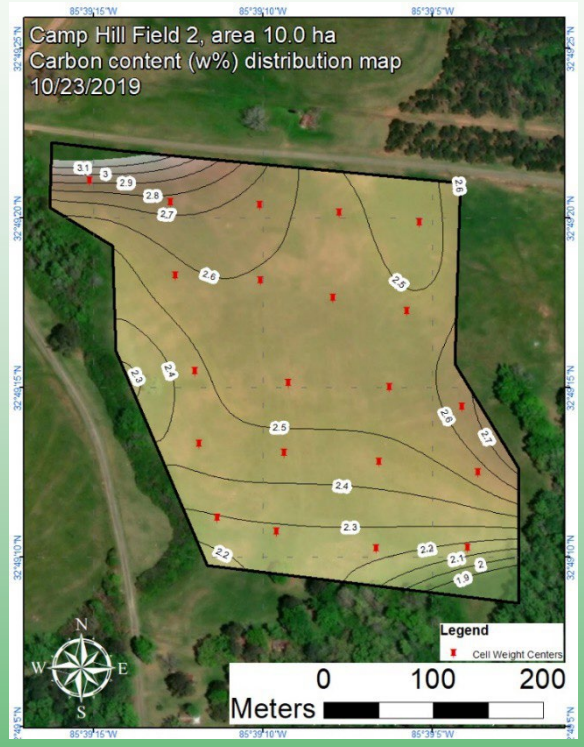
Tracking paths, data saving points, and midpoints

Midpoint spectra = difference between neighboring spectra

Sites sorted by midpoints and weighted centers

Weighted center spectra = sum sorted by site midpoint spectra

Carbon distribution map created by ArcMap



Carbon content is determined from weighed spectra. Map is plotted using weighed center coordinates and carbon content

Scanning mode measurements are less time consuming compared to static mode and eliminated uneven carbon distribution over the field surface