Carbon Analysis in Estuarine Ecosystems: A New *In Situ* Non-destructive Approach

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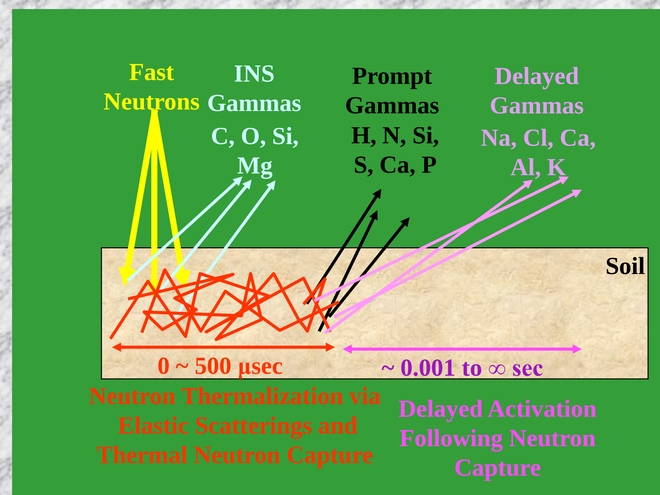
The inelastic neutron scattering (INS) instrument is based on INS- and thermal neutron capture-induced gamma ray spectroscopy. Due to nuclear reactions involved it is element specific, independent of its chemical state., and

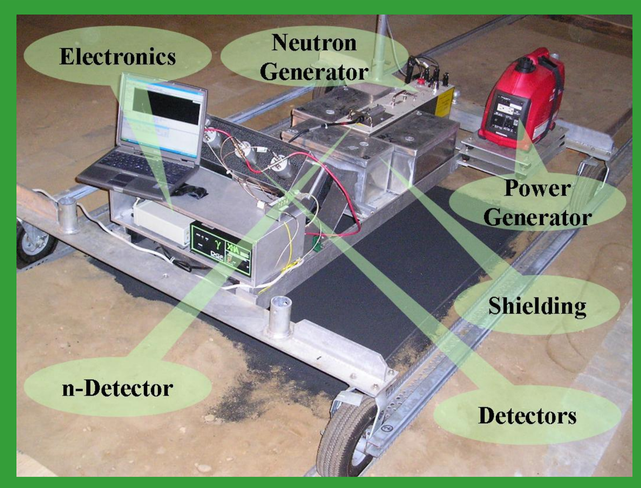
The INS key system characteristics are:

1. ***In Situ*, Non-destructive.**
2. **Large footprint, of about 2 m^2, large sampling mass, >200 kg, to a depth of about 30 cm.**
3. **Provides multi-elemental analysis, e.g., H, C, N, O, P, Cl, Na, K…**
4. **Can be operated in a stationary and contiguously scanning modes.**
5. **Instantaneous results at the end of the data acquisition time.**
6. **Provides true multilevel, spot, transact and aerial, temporal measurements.**
7. **Operates under complete soil water saturation conditions covered with water layer.**
8. **Can be redesigned as a submersible unit.**

Thus:- The INS revolutionizes the wisdom of the conventional sampling paradigm with an extensive reduction in labor, time, and costs..



Basic physical principles of soil irradiation with fast n-neutrons and detection of characteristic gamma ray.



An Alpha prototype of an INS - Inelastic Neutron Scattering system for stationary and scanning field measurements.

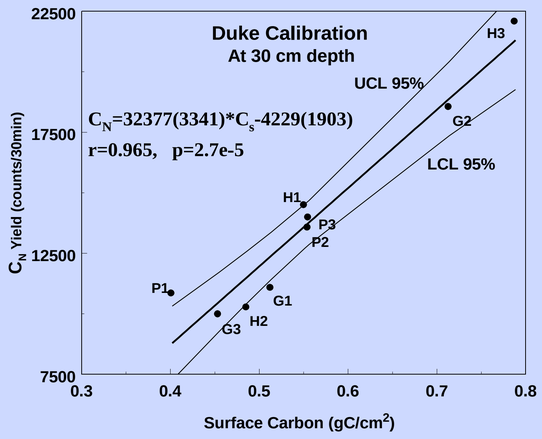
Enon silt loam (a low fertility Hapludalf typical of the SE US piedmont)

Grass Field

Pine Forest

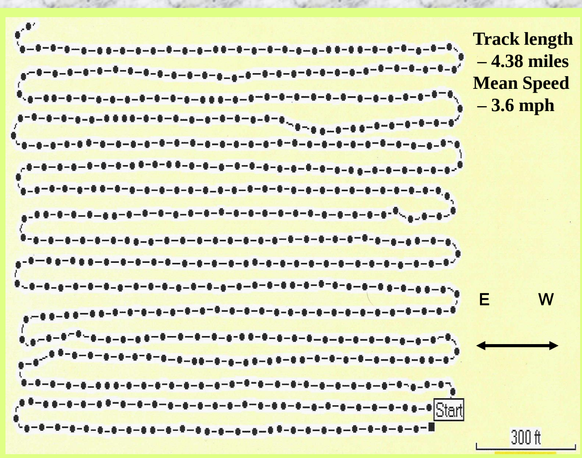
Oak Forest

Measurement sites at Duke Forest NC. Pits 40x40x40 cm^3 were excavated for C analysis.

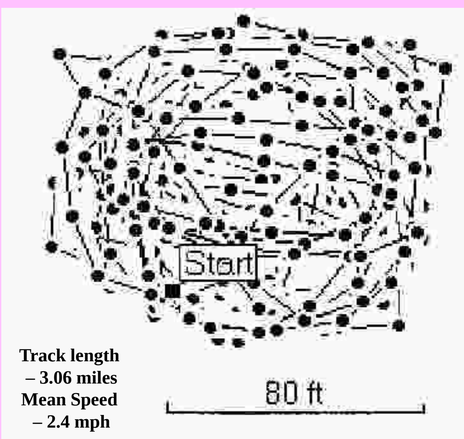


Duke Forest calibration, the three sites; G-Grass, P-Pine, and H-Hardwood were combined. The sits were covered with standing water and the solid fraction approached 30%.

INS measurement of a forest site with standing water.



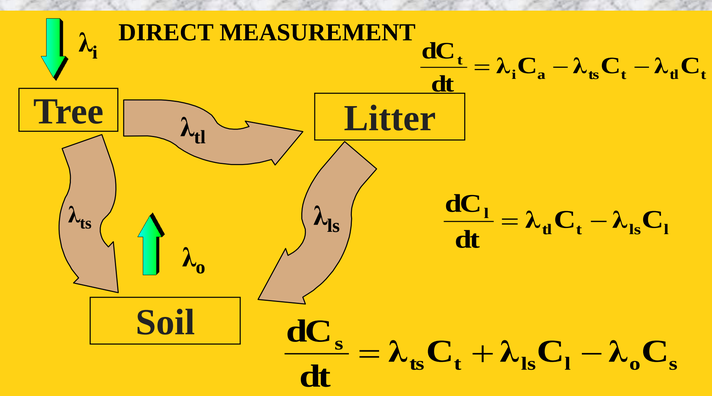
Montana: wheat field in which three static measurements and a scan were taken; and a GPS trace of a scan.



Maryland: corn field and GPS trace of a scan.

New Applications of the INS System:

- **Integration into US Geological surveys for large scale regional soil carbon mapping.**
- **Independent joint measurements to improve the carbon data base required for modeling carbon climate change in support for policy making decisions**
- **Independent assessment of the changes in the carbon predictions made by the FACE and AmeriFlux facilities.**
- **Independent validation data for the "bottom-up" approach in order of reducing the discrepancy with the "top-down" approach.**
- **Possibly calibrating satellite land images with large scale area assessment with INS.**



Instead of measuring the difference between λ_i and λ_o to assess carbon in soil (C_s), measure C_s and assess lambdas.

New Applications of the INS System in the Estuarine:

- **Surveys of large scale regional coastal carbon mapping.**
- **Validation of modeling complex sediment processes; dynamics and transport, for modelers and policy making decisions.**
- **Direct measurement of the effects of major disturbances on the seabed characterization.**
- **Calibration of satellite images and aircraft CO_2 flux maps with costal area assessment using INS on identical pixel size.**
- **Independent validation of data bases.**
- **Extensive reduction in labor, time and cost in carbon and other elements mapping over large areas.**
- **Complements assessment of the soil carbon as determined by flux measurements that underestimate lateral (surface) flows.**