Using simple spectral technology to engage farmers in building soil health to enhance environmental outcomes

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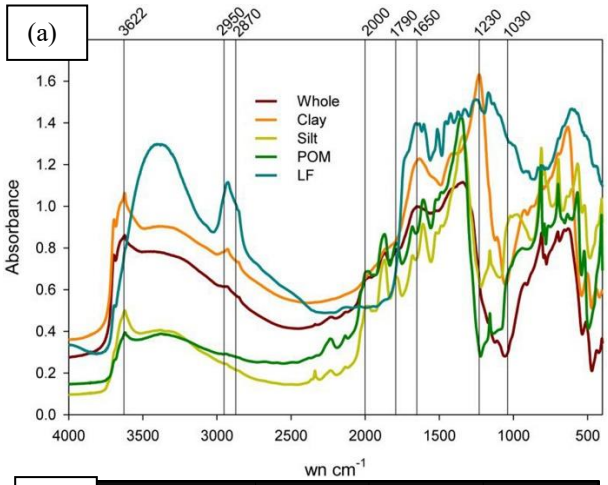
(a)



(b)

(c)

eld status	Organic C (g/kg)	Total N (g/kg)	pH (water)
Permanent pasture	29	2.3	5.5
Maize	10	1.5	7.0
Stubble with manure spread	14	2.1	6.0
5 year ley pasture	27	3.6	5.5

Figure 1(a) Spectral responses to soil fractions (b) pilot study with farmer operating scanner and (c) preliminary results across contrasting land uses selected by farmer.

Overview

The UN Food and Agriculture Organisation calculates that 33% of soils are degraded globally. In England and Wales this degradation costs £1.2 billion, primarily mainly linked to loss of organic content of soils (47% of total cost), via off site impacts on climate regulation, water regulation and quality [Graves *et al.* 2015]. Soil scientists insist managing soil organic matter is central to supplying ecosystem services such as climate mitigation, water storage and purification and nutrient cycling. It is essential we develop landscape-scale approaches to address this pressing problem. With the exit from the EU the new Environmental Land Management Scheme (ELMS) will seek to make payments for public goods such as enhanced ecosystem services via increasing soil organic

matter content. Developing cost-effective methods to measure soil health is vital to monitor impacts of the new scheme.

Our project partners and co-sponsors Affinity Water (AW) through the Water Industry National Environment Programme (WINEP) have been working with farmers in the River Lea catchment for the past 10 years. This landscape scale approach places soil health and management as the core of delivering effective outcomes. We will use this farmer network in conjunction with spectral analysis and statistical methods to determine the carbon content of soils and other soil health indicators.

The project addresses two key research questions:

1. Can spectral data provide robust high quality information on soil properties beyond soil carbon that can evaluate soil health?

2. Can spectral tools provide farmers and water companies with the appropriate information to improve catchment management?

Training opportunities:

This PhD offers excellent training opportunities from a multidisciplinary team team . There will close liaison with our project partners Affinity Water with a 3-6 month placement. This will provide a unique opportunity to understand and develop new skills in delivery regulatory outcomes via environmental initiatives.

Specific skills the successful candidate will develop are:

- Coordination and engagement with farmers and policymakers - to determine soil health measures and how simple technology can be adopted and used to support management decisions at the individual farm and landscape scale.
- Modelling the influence of soil parameters on catchment hydrology - to determine how improvements in land management can improve water regulation, to manage flows and reserves, and water quality by reducing suspended solids and enhanced retention of farm chemicals.
- Spectral analysis - Contrasting low cost spectral measurement of soil samples with tools of increasing complexity e.g. lab based VisNIR, nuclear magnetic resonance (NMR) and extracting patterns to develop novel assays of soil health.

Student profile:

The proposal would suit a student with expertise in any one the following areas: Environmental Chemistry, Environmental/Agricultural Policy, Soil science, Statistics. Full training will be provided to build the skills of the student across all areas to ensure they can deliver the work and have an excellent and diverse skill set on completion of the PhD.

References:

Fernandez-Romero, M.L.; Clark, J.M.; **Collins, C. D**. Parras-Alcantara, L.; Lozano-Garcia, B. (2016). Evaluation of optical techniques for characterising soil organic matter quality in agricultural soils. Soil and Tillage Research. 155:450-460.

Aidan M. Keith, Olaf Schmidt, Barry J.McMahon. Soil stewardship as a nexus between Ecosystem Services and One Health Ecosystem Services Volume 17, February 2016, Pages 40-42
https://doi.org/10.1016/j.ecoser.2015.11.008

Benisiewicz, B., A. Momblanch, **A. Leggatt** and I. P. Holman "Erosion and Sediment Transport Modelling to Inform Payment for Ecosystem Services Schemes." Environmental Modelling & Assessment: 14.