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Assessment of fluorescence EEM vs. Liquid-state 1H-NMR spectroscopy for the characterization of natural OM in agricultural soils from the UK and Spain

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Humification is the group of biological and chemical reactions that leads to the formation of humus, which contributes to nutrient and water retention, as well as to the accumulation of carbon. Here, we assess the potential to measure the degree of humification of organic matter by fluorescence spectroscopy, by comparing indices calculated from the fluorescence emission-excitation matrix (EEM) with measurements of aromaticity determined by Nuclear Magnetic Resonance (NMR).

In this study, two contrasting European soils were compared: cambisols with from agricultural land in eastern Andalusia (South Spain, Mediterranean climate) and Reading, (South-East England, Temperate climate). Both the Mediterranean and British soils were managed with conventional tillage. Samples were collected at depths ranging from 13.3cm to 60cm down the soil profiles. All samples were then dried and sieved to 2mm. Fluorescence measurements were taken for the whole soil profile. Prior to fluorescence, the supernatant of the samples was extracted with the Ghani et al. (2003) method. This was followed by a hot water extraction (80oC) which is considered more exhaustive. Fluorescence was measured at an emission wavelength from 300 to 600nm at 5-nm increments and an excitation of 240-450nm at 5-nm increments.

Fluorescence indexes were calculated as the ratio of intensities at 450 over 500nm with an excitation of 370nm, as described by Cory et al. (2010), NMR was applied to the first horizon (A depth between 5.7cm and 12cm in this case), due to time constraints. The method for extracting the supernatant was the same as per the hot extraction for the fluorescence samples.

The aromaticity of isolated fulvic acid samples was calculated as the ratio of the area of aromatic hydrogen region to the total area of the H-NMR spectrum (% aromaticity).

Other soil parameters measured were dissolved organic carbon (DOC), absorbance, texture, carbonates, pH, total carbon, and total nitrogen.

Assessment of whether a regression model can be applied to the fluorescence indices to effectively predict the aromatic fraction of organic matter from NMR in both soils will be presented. If robust relationships can be found, there may be potential for fluorescence spectroscopy as a fast and more cost effective method of organic matter characterisation.