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Mapping molecular information of organic amendments during their decomposition in soil derived from hyperspectral imaging

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Organic matter added to agricultural soil determines the C balance and the nutrient cycling in these ecosystems. Organic fertilisation can result in the accumulation of C in soil but can also stimulate the decomposition of the existing soil C pool, as the incorporation of an easily accessible energy-rich substrate often trigger the growth and activity of decomposer. We monitored the fate of two types of organic material (wheat straw and green manure) during the first stages of their decomposition into the soil. For this, we incubated 1-m soil columns amended with the two organic fertilisers either into the topsoil or into the subsoil. We measured changes in C and N contents, and used ^{13}C-NMR to resolve the structural group composition of the added organic material. We also scanned the incubated samples with a hyperspectral camera and developed predictive models for C to N and for alkyl to O-alkyl ratios at a very fine spatial resolution (53 x 53 µm^2 per pixel) for organic particles in the whole soil cores.

The approach based on hyperspectral imaging was successful to follow the decomposition dynamics of POM during the incubation, and the associated decreases in C to N and increases in alkyl to O-alkyl ratios at a very fine spatial resolution, showing how different parts of the organic particles underwent distinct decomposition. We also observed contrasting decomposition dynamics between the wheat straw and the green manure. This method can bring new information about the first steps of fresh organic matter decomposition in soils and develop our general understanding of the soil organic matter decomposition continuum.