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Land use change to *Miscanthus*: measured and modelled changes in soil carbon fractions

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Miscanthus is a lignocellulosic crop that uses the Hatch-Slack (C4) photosynthetic pathway as opposed to most C3 vegetation native to the UK. *Miscanthus* can be grown for a number of practical end-uses but recently interest has increased in its viability as a bioenergy crop; both providing a renewable source of energy and helping to limit climate change by improving the carbon (C) budgets associated with energy generation. *Miscanthus* distribution is very limited at present and therefore in most cases propagation will require land use change. Limited case studies have shown that changing land use to *Miscanthus* may increase stocks of soil organic carbon (SOC). However, the accuracy of simulating SOC dynamics under *Miscanthus* for scaling purposes is limited by empirical validation data regarding the longevity of newly sequestered SOC[1]. Consequently, in our work the size and turnover times of different SOC fractions have been quantified through physiochemical fractionation[2] under a *Miscanthus* plantation and an adjacent paired reference site.

Twenty-five 2 m^2 plots were set up in a three-year old 11 hectare commercial *Miscanthus* plantation in Lincolnshire, UK. From each plot monthly measurements of CO_2 emissions were taken at the soil surface between March 2009 and March 2013, and soil C from the top 30 cm was monitored in all plots over the same period. *Miscanthus*-derived SOC and CO_2 emissions resulting from *Miscanthus* plant matter were determined using the isotopic discrimination between C4 plant matter and C3 soil. Stable isotope techniques were also used in conjunction with soil fractionation performed annually to establish the rate of change to different soil fractions. Soil C and fractionation was also performed on five soils from an adjacent site with continued cropping of the prior land use.

There is a notable increase in SOC stocks under *Miscanthus* when compared with the adjacent reference site (2.05 tC ha^{-1} yr^{-1}) despite fractionation indicating the *Miscanthus*-derived SOC has fairly short mean residence times within the different fractions. Particulate organic matter and dissolved organic carbon fractions have the fastest turnover times whereas the fraction containing sand and aggregates has the slowest turnover time. Early results indicate that the majority of new *Miscanthus*-derived C is added to the non-resistant silt and clay fraction although the size of this fraction's C pool does not increase significantly. Using the data collected, the DayCent[3] and ECOSSE[4] models will be developed to improve predictions so uncertainties are reduced regarding how quickly SOC stocks beneath a newly established *Miscanthus* plantation can be expected to change.

References

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