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Simulating greenhouse gas emissions from C3 and C4 bioenergy crops using the soil carbon model ECOSSE

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Bioenergy crops are seen as a possible 'green' alternative to fossil fuels due the fact that carbon released during combustion has been recently fixed from the atmosphere and does not release fossil carbon. However, the net greenhouse gas (GHG) emission is largely determined by the management methods and characteristics of the crops involved. Soils have a major influence on the atmospheric loading of GHGs, in particular, approximately 70% of N2O emissions are accounted for by soils. Therefore, understanding these fluxes is important as they may significantly affect GHG emission targets. The effect of energy crop growth and management on production of N2O, NO and CO2 and on the oxidation of CH4 from the soil is largely unknown at present. Hence, we have used the measured data of gas fluxes of the soil beneath two bioenegry crops, a perennial rhizomatous C4 grass Miscanthus giganteus and short rotation coppice (SRC) willow (C3), to aid in the parameterisation of the soil carbon/nitrogen module ECOSSE, included in the JULES (Joint UK Land Environment Simulator) model. Optimisation of the pertinent parameters representing the main physical processes and sensitivity analysis was carried out using Monte-Carlo techniques. We use the simulation outputs to discuss and compare the implications of different bioenergy crops for GHG emissions under current and different climatic conditions.