SIMULATION OF SOIL ORGANIC CARBON STOCK AND GREENHOUSE GASES EMISSION FROM PERENNIAL ENERGY CROPS CULTIVATION CYCLE IN ITALY WITH ECOSSE MODEL: FROM ESTABLISHMENT TO REMOVAL

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Introduction

Soil organic carbon (SOC) is an important carbon pool sensitive to land use change (LUC). There are concerns that at the end of Perennial Energy Crops (PECs) cultivation cycle, the conversion of these crops back to arable land could negatively impact the SOC stock. However, a positive effect of conversion on SOC is possible. Assessment of the fate of C sequestered after the conversion is essential to understand the long terms effects of PECs conversion on soil carbon (C).

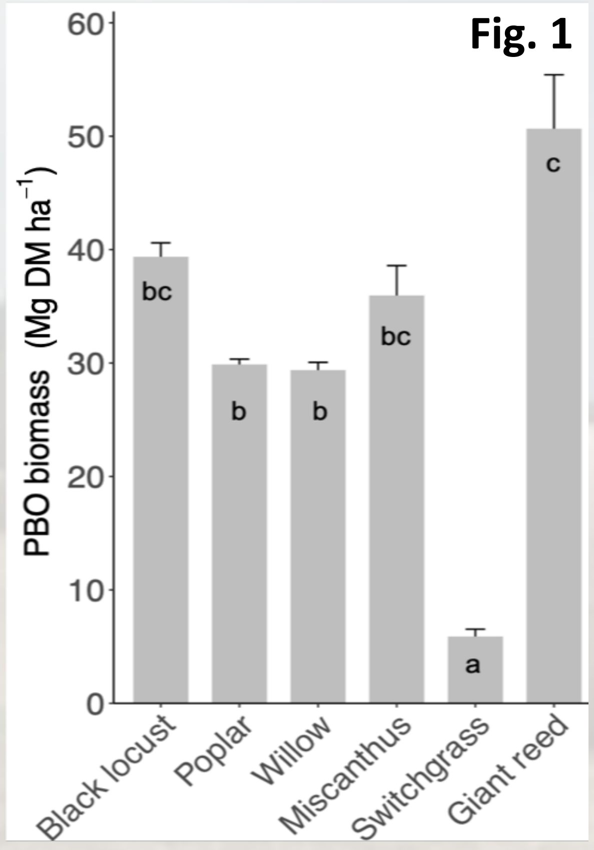
Matherials and Methods

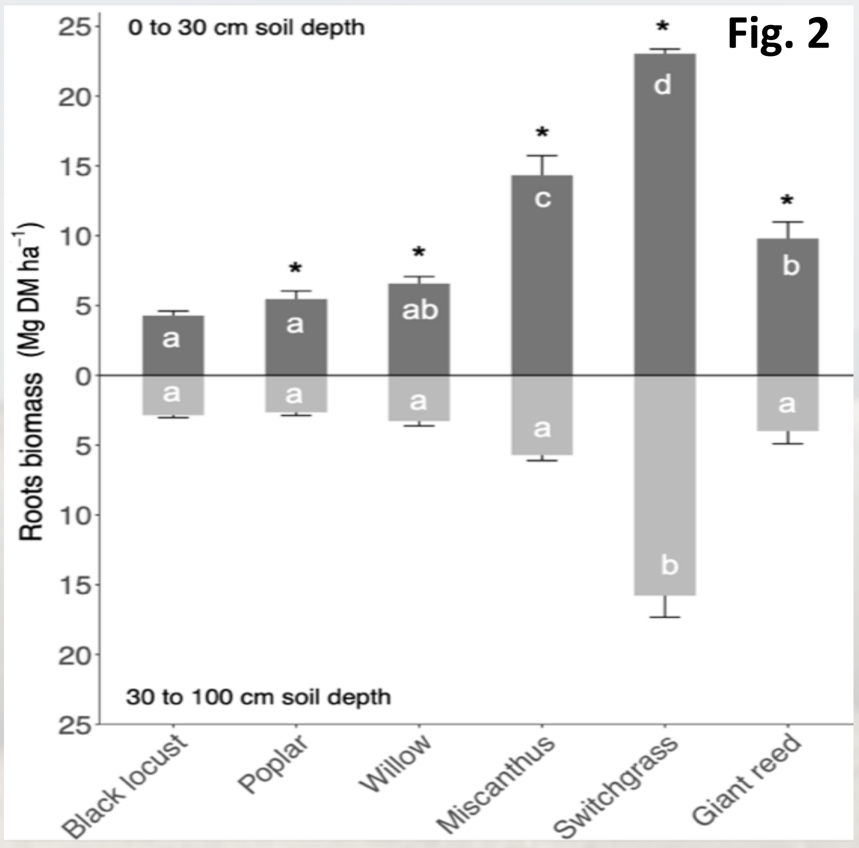
A 11y-old multispiecies trial, located in Piacenza (NW Italy) (Amaducci et al. 2017, Chimento et al., 2016) on a marginal soil (FAO - chromic luvisols) and cultivated with the following six PECs, has been used for this study: three herbaceous crops, giant reed (*A. donax* L.), switchgrass (*P. virgatum*), and miscanthus (*Miscanthus x giganteus*), and three woody crops, poplar (*Populus* spp), willow (*Salix* spp), and black locust (*R. pseudoacacia*). In 2018, the conversion of the soil was performed to a depth of 30 cm with a forestry mulcher. A rotation of annual crops, composed of forage sorghum (*Sorghum x sudangrass),* setaside, soybean (*Glycine max*) and winter wheat (*Triticum aestivum, subsp aestivum*) was cultivated in reduce tillage (RT) regime. Soil cores were taken to a depth of 50 cm before the conversion and after each annual crop for SOC. A precise assestment of the below ground biomass (BGB) before the conversion was performed (Martani et al. 2020).

C emission were measured after the convertion for two years with a portable Infra Red Gas Analyzer (IRGA) (EGM-5, PP System).

Preliminary results and conclusion

PECs showed signficant differences in the amount of BGB after 11 years (Fig 1-2). Giant reed showed the highest value of BGB (Roots + Plant belowground Organs (PBO)), while switchgrass the lowest. ECOSSE model was able to simulate the SOC dynamics along the cultivation cycle of PECs and in the 2 years after the conversion (Fig. 3). ECOSSE was able to simulate the C emissions in the first two years after the conversion (Fig. 4). In conclusion, ECOSSE model can simulate the fate of C after the conversion of PECs. The balance between C sequestration and emission after the conversion depends on the quantity and quality of C input at the conversion as main drivers of PECs legacy. Our experiment shows that the C increase persists beyond the first growing season.





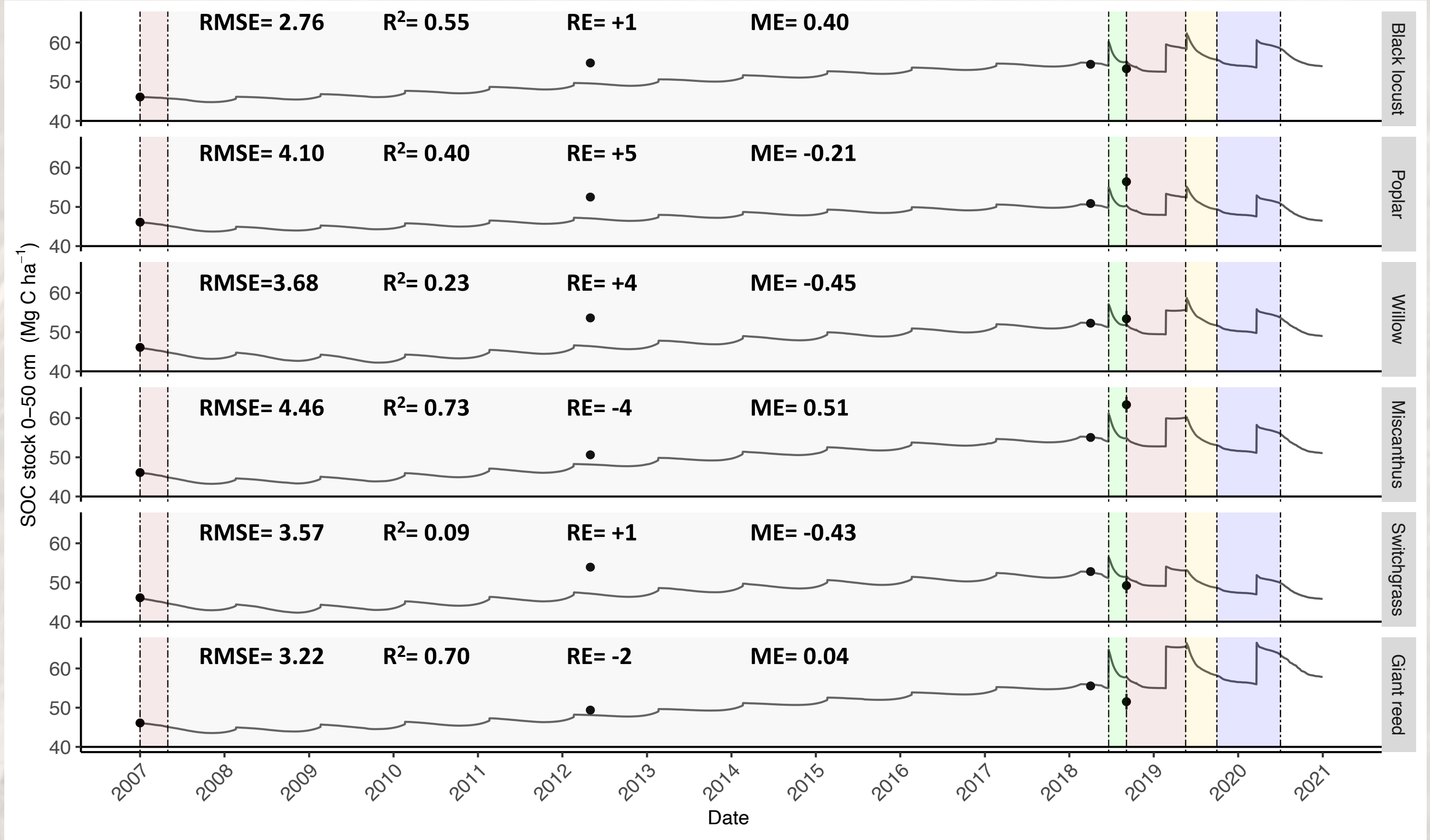


Fig. 3 Measured vs modelled SOC dynamics in the 0-50 cm depth layer of the soil, as influenced by the establishment of PECs on the former marginal arable land no their removal and in the first two years after the conversion. Crop colors: **Brown:** Arable land in 2007 or setaside between in winter 2018-2019, **Grey:** PECs, **Green:** Forage Sorghum, **Yellow:** Soybean , **Blue:** Winter wheat. Statistical analysis results displayed in bold are: root-mean square error (RMSE), correlation coefficent (R^2), relative error (RE) and Nash-Sutcliffe model efficency (ME).

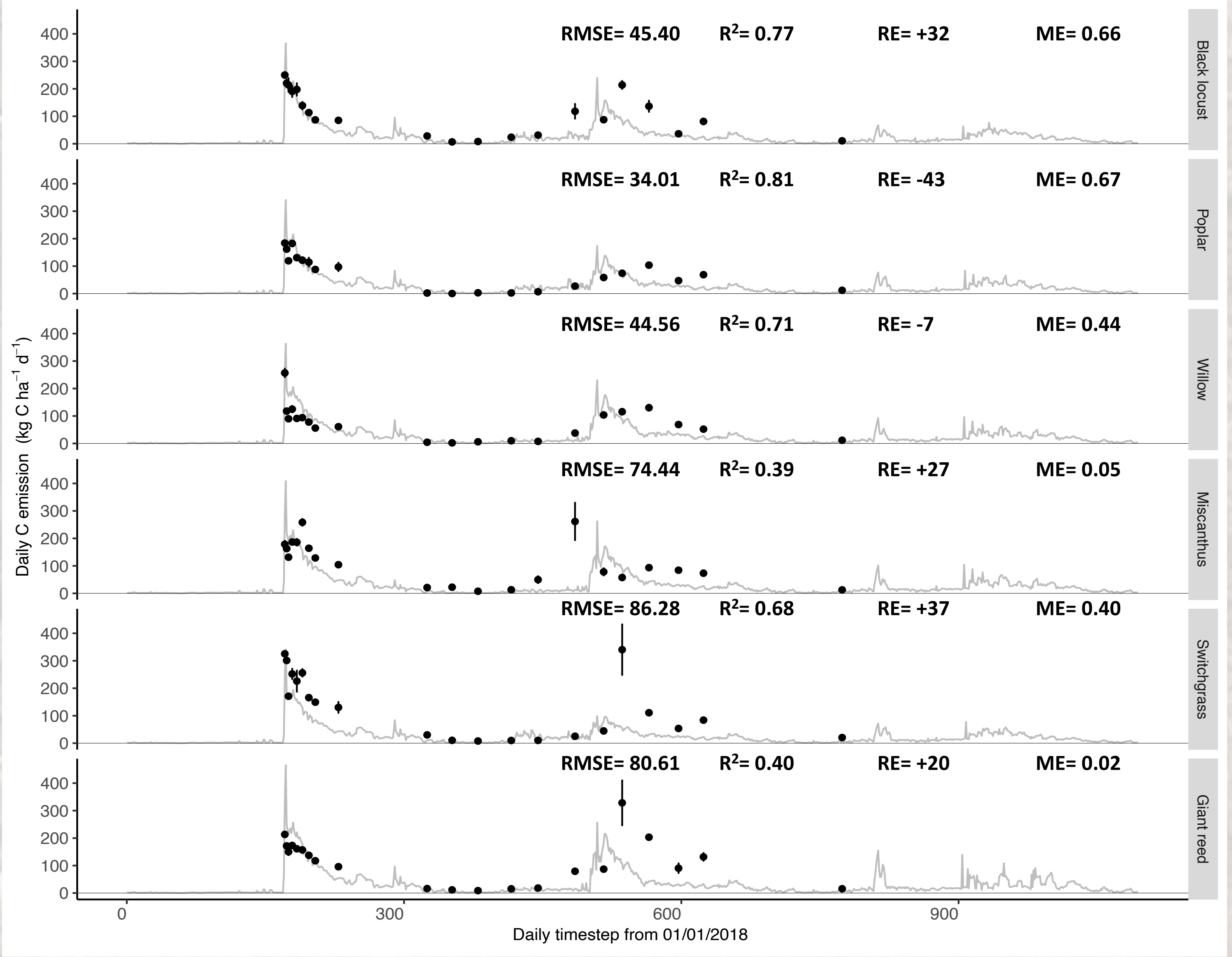


Fig. 4 Measured vs modelled daily C emission from soil (kg C ha^{-1} d^{-1}) after the conversion of PECs. Statistical analysis results displayed in bold are: root-mean square error (RMSE), correlation coefficent (R^2), relative error (RE) and Nash-Sutcliffe model efficency (ME).