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Simulated soil C changes over sugarcane expansion in Brazil

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In recent years, the increase in Brazilian ethanol production has been based on expansion of sugarcane cropped area, mainly by the land use change (LUC) pasture-sugarcane. However, second generation (2G) cellulosic-derived ethanol supplies are likely to increase dramatically in the next years in Brazil. Both these management changes potentially affect soil C (SOC) changes and may have a significant impact on the greenhouse gases balance of Brazilian ethanol. To evaluate these impacts, we used the Daycent model to predict the influence of the LUC native vegetation (NV) - pasture (PA) - sugarcane (SG), as well as to evaluate the effect of different management practices (straw removal, no-tillage and application of organic amendments) on long-term SOC changes in sugarcane areas in Brazil. The DayCent model estimated that the conversion of NV-PA caused SOC losses of 0.34±0.03 Mg ha^{-1} yr^{-1}, whilst the conversion PA-SG resulted in SOC gains of 0.16±0.04 Mg ha^{-1} yr^{-1}. Moreover, simulations showed SOC losses of 0.19±0.04 Mg $ha^{-1}yr^{-1}$ in SG areas in Brazil with straw removal. However, our analysis suggested that adoption of some best management practices can mitigate these losses, highlighting the application of organic amendments (+0.14±0.03 Mg C ha^{-1} yr^{-1}). Based on the commitments made by Brazilian government in the UNFCCC, we estimated the ethanol production needed to meet the domestic demand by 2030. If the increase in ethanol production was based on the expansion of sugarcane area on degraded pasture land, the model predicted a SOC accretion of 144 Tg from 2020-2050, whilst increased ethanol production based on straw removal as a cellulosic feedstock was predicted to decrease SOC by 50 Tg over the same 30 year period in Brazil.