The Methodology for Farm-Scale Modelling for Spatio-Temporal Prediction of Soil Carbon Sequestration under Climate Change

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A methodology for region-specific adaptation of existing soil carbon (C) models was developed by integrating location-specific automated data with local farm-based knowledge. The aim was to optimise the balance between scientific accuracy and farm-scale practicality of C modelling tools to identify the most influential location-specific variables. The methodology identified region-superfluous inputs (through automation and region-insensitive data omission), incorporation of additional inputs to improve region-specific accuracy, tuning the regional model, and development of a Tool that could be used on-farm. The methodology was evaluated in south-western Australia using the RothC soil C turnover model. Automation and rainfall-based tuning of the RothC model were used to produce the south-western Australian RothC modelling (SWARM) Tool. The criticality of rainfall within the region provided both tuning direction and additional inputs for improving the accuracy of the automated “monthly rainfall” impact, through location-specific rainfall utilisation (e.g. accounting for water repellence) and compounded rainfall impacts (e.g. plant growth, soil cover, erosion). Integration of manual adjustments for high sensitivity inputs for this region with additional considerations of field-scale rainfall utilisation characteristics provided a soil C content potential relative to the location-specific tuned base case. The SWARM Tool delivers soil C modelling to the farm gate, facilitating estimation and education under the challenging future of agriculture-based incomes. The methodology presented in the creation of the SWARM Tool provides a template for adaption to any region across the globe for the provision of an accessible, practical and appropriately accurate information on the potential impact of climate change.