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Modification of the RothC model for simulating soil organic matter turnover in double rice cropping systems in southern China

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We modified the Rothamsted carbon model (RothC) to simulate soil carbon (C) dynamics in double rice cropping systems in China by adding a parameter to account for the effect of carbon input amounts on the decomposition rate of soil organic carbon (SOC). Three long-term experiments (28-31 years) were conducted under various amounts of C inputs and different fertilizer types in double rice systems in southern China and were used for the calibration and validation of the modified RothC model. The results showed that the previous RothC model, with a soil moisture modifying factor of 0.2 for the rice phase in summer and 0.6 for the upland cropping phase in winter for paddy soils, could not adequately simulate the SOC dynamics of all treatments in double rice soils. In particular, the simulations were worse with high C inputs, which produced a normalized root mean squared error (*NRMSE*) and model efficiency (*EF*) ranging from 18.0 to 53.5% and -95.20 to -1.42, respectively, for the treatments with C inputs ranging from 4.20 to 8.29 t C ha^{-1}. We used an inverse modelling approach to calibrate one site for an additional factor p and found this factor was well described as a function of the amount of C input ($p = 0.146C^2 + 0.697C + 0.175$, R^2=0.997). The modified version with the p function greatly improved the simulations, resulting in an *NRMSE* of 2.6 –15.3% and *EF* of -1.05 – 0.69 for the three sites. We concluded that this modified RothC model can be used to estimate soil carbon dynamics in double rice cropping systems with a large amount of organic carbon inputs, at least in Chinese paddy soils where the application of harvested crop residues and animal manure is commonly practiced.