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Impact of climate change on carbon pools variation in cultivated Alfisols and on CO2 emissions: performance and application of the Rothamsted carbon model in Togo

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This study was carried out to evaluate the performance of the Rothamsted Carbon Model in simulating the C pool in cultivated Alfisols, while also assessing the impact of climate change on C pool variation patterns and on carbon dioxide (CO_2) emission. The model input data was from two 30 year experiments conducted at Elavagnon (**N** 7˚58', E 1˚21') and Dalanda (N 8˚38', E 1˚00') in Togo. The model performance was evaluated on the basis of the consistency of the simulated parameters as compared to those observed in the field using the R^2 statistic, root mean square error (RMSE), model efficiency (EF) and quotient of variance (QV). The parametered version of the model was used to assess the impact of global warming, late onset and early cessation of the rainy season, as observed in recent years in the West African region. The Rothamsted Carbon Model accurately described the observed C pool variations in these Alfisols after altering certain parameters, especially annual decomposition rates of active C compartments. Annual simulated decomposition rates were 10, 0.28, 0.47 and 0.015, respectively, for the decomposable plant material (DPM), resistant plant material (RPM), microbial biomass (BIO) and humified organic matter (HUM) fractions, whereas for RPM, BIO and HUM they were slightly low in comparison to the Rothamsted parametered nominal values. Simulated R^2 values were 80% at Elavagnon and 79% at Dalanda. RMSE was 8% at Elavagnon and 7% at Dalanda. EF was positive and QV was above 1 in 25% of the simulations conducted at Elavagnon and in 50% of those conducted at Dalanda. The model simulated C losses (in the form of CO_2) of 1.41 and 1.21 t C ha^{-1} $year^{-1}$at Elavagnon and Dalanda, respectively. This study revealed that a 1˚C monthly temperature increase would accelerate the loss of C stocks in these tropical Alfisols by 27%, while increasing C losses (CO_2) by 2.3%. For the same annual rainfall level, late onset and early cessation of the rainy season would have very little impact on the soil C pool or on the quantity of emitted CO_2.

Keywords: **Models, sandy tropical soil, climate change, carbon pool, CO_2 emission.**