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Integrating a Carbon Routine in a mesoscale Watershed Model

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Quantifying CO_2 emissions from landscapes is relevant to mitigate greenhouse gas emissions and to develop environmental credit markets. Tools like ecological or eco-hydrological models, such as the Soil and Water Assessment Tool (SWAT), are useful to calculate watershed scale carbon balance. SWAT currently lacks a carbon routine to quantify CO_2 and GHG-emissions on the watershed scale, since in the current version of SWAT the C-Balance of the soil is not represented and the nutrient pools are N driven.

A simple model for carbon cycling was integrated into SWAT along with a modification of the tillage routine. The single pool carbon model with variable turnover rate is controlled by the actual pool size in relation to a saturation carbon concentration for a given layer, texture, environmental conditions, and tillage intensity. The humification of incorporated residues depends on the input properties and the current organic carbon content in that layer. The organic carbon turnover rate also depends on the current carbon content. Carbon cycling has been linked with the N and P turnover, which can control the decomposition rate of the residues.

In the new tillage module, the soil bulk density in the tilled soil layers depends on the tillage event and decreases after every tillage event. After tillage, soil bulk density increases because of the compaction of the soil aggregates depending on the rainfall

intensity and quantity.

Preliminary testing of the model and calculation of carbon balances for the intensely used Wetter watershed in Hesse, Germany are presented. Accurate calculations of carbon and nitrogen balances at the watershed scale can increase the applicability of SWAT for agro-ecological and global change studies, providing also relevant information to land use managers and policy makers.