Geophysical Research Abstracts
Vol. 16, EGU2014-313-1, 2014
EGU General Assembly 2014

Evaluation of approaches focused on modelling of organic carbon stocks using the RothC model

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The aim of current efforts in the European area is the protection of soil organic matter, which is included in all relevant documents related to the protection of soil. The use of modelling of organic carbon stocks for anticipated climate change, respectively for land management can significantly help in short and long-term forecasting of the state of soil organic matter. RothC model can be applied in the time period of several years to centuries and has been tested in long-term experiments within a large range of soil types and climatic conditions in Europe. For the initialization of the RothC model, knowledge about the carbon pool sizes is essential. Pool size characterization can be obtained from equilibrium model runs, but this approach is time consuming and tedious, especially for larger scale simulations.

Due to this complexity we search for new possibilities how to simplify and accelerate this process. The paper presents a comparison of two approaches for SOC stocks modelling in the same area. The modelling has been carried out on the basis of unique input of land use, management and soil data for each simulation unit separately. We modeled 1617 simulation units of 1x1 km grid on the territory of agroclimatic region Žitný ostrov in the southwest of Slovakia. The first approach represents the creation of groups of simulation units based on the evaluation of results for simulation unit with similar input values. The groups were created after the testing and validation of modelling results for individual simulation units with results of modelling the average values of inputs for the whole group. Tests of equilibrium model for interval in the range 5 t.ha-1 from initial SOC stock showed minimal differences in results comparing with result for average value of whole interval. Management inputs data from plant residues and farmyard manure for modelling of carbon turnover were also the same for more simulation units. Combining these groups (intervals of initial SOC stock, groups of plant residues inputs, groups of farmyard manure inputs), we created 661 simulation groups. Within the group, for all simulation units we used average values of inputs. Export of input data and modelling has been carried out manually in the graphic environment of RothC 26.3 v2.0 application for each group separately. SOC stocks were modeled for 661 groups of simulation units. For the second possibility we used RothC 26.3 version for DOS. The inputs for modelling were exported using VBA scripts in the environment of MS Access program. Equilibrium modelling for more variations of plant residues inputs was performed. Subsequently we selected the nearest value of total pool size to the real initial SOC stock value. All simulation units (1617) were automatically modeled by means of the predefined Batch File.

The comparison of two methods of modelling showed spatial differentiation of results mainly with the increasing time of modelling period. In the time sequence, from initial period we mark the increasing the number of simulation units with differences in SOC stocks according to selected approaches. Observed differences suggest that the results of modelling obtained by inputs generalization should be taken into account with a certain degree of reserve. At large scales simulations it is more appropriate to use the DOS version of RothC 26.3 model which allows automated modelling. This reduces the time needed for model operation, without the necessity to look for the possibilities of minimizing the simulated units.

Key words
Soil organic carbon stock, modelling, RothC 26.3, agricultural soils, Slovakia

Acknowledgements
This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0580-10 and APVV-0131-11.