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Modelling the impact of soil tillage on SOM turnover

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The CCB model of the soil organic matter (SOM) turnover has been proved to be valid over a wide range of site conditions and cropping systems. It is based on the aggregation of different fresh organic matter to the flux of SOM reproducing carbon (Crep) and on the aggregation of the complexity of site conditions as Biologic Active Time (BAT). Next to carbon input and site conditions the soil tillage is known to have an impact on SOM. The CCB model calculates the BAT value from a statistically based meta model using soil texture and climate data. The CANDY model as ancestor of CCB is also based on the BAT calculation - but under consideration of soil temperature, soil moisture and the depth of the reaction layer in the top soil. Especially the latter effect takes into account that gas exchange between the reaction space in the soil pores and the atmosphere may be hindered in deeper soil layers as well as the filling of pore space with water. Depending on soil type and soil moisture dynamics the BAT at the base of the plough layer may be considerably lower than in the layers above. If the soil is ploughed regularly, there are no long-term effects on SOM dynamics in the different depth steps (10 cm) of the top soil. In contrast, on ploughless systems with reduced cultivation depth we expect depth depending effects of SOM storage. The integration of this mechanism had to be based on a simplified approach because the CCB model is working in annual time steps and is based on very few soil parameters. An analysis of the general mechanisms of BAT calculation led to a simplified solution to calculate a site specific correction factor of the BAT estimation from the meta model. Therefore, we assume a texture dependent reduction of the turnover activity with depth, indicated by the coefficient alpha. A first examination of this approach has been performed using the dataset of the Fuchsenbigl experiment in Austria with three tillage variants (conventional ploughing, reduced and minimum tillage) that has been started in 1989. Here we find a reduction coefficient of alpha=2.1 leading to a reduced turnover activity of 56.7 % with BAT (ploughed)=23 d/a and BAT(not ploughed13 d/a). In 1998 started a regular observation of the Corg content of topsoil leading to an estimated initial value of 1.66 M% Corg. Despite the large variability of the observed Corg dynamics the application of the new concept resulted in a considerable improvement of the modelling results – especially for the relative effects taking into account the relation between the single treatments.