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DayCent modelling of Swiss cropping systems

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There is a growing need to identify and evaluate sustainable greenhouse gas (GHG) mitigation options, their bio-economic feasibility in the agricultural sector, and support implementation of agricultural GHG mitigation activities that are an integral part of climate change strategies. In recent years, several ecosystem biogeochemical process-based models and comprehensive decision making tools integrated with these models have been developed. The DayCent model simulates all major ecosystem processes that affect soil C and N dynamics, including plant production, water flow, heat transport, SOC decomposition, N mineralization and immobilization, nitrification, denitrification, and methane oxidation. However, if the model is to be reliably used for identification of GHG mitigation options and climate change strategies across the EU agricultural regions, it requires site- and region-specific calibration and evaluation. Here, we calibrated and validated the model to Swiss climate and soil conditions and management options using available long-term experimental data. Data on crop productivity, soil organic carbon and N2O emissions were derived from four field sites located in Thervil (1977-2013), Frick (2003-2013), Changins (1971-2013), and Reckenholz (2009-2013) that have evaluated the effects of agricultural input systems (specifically, organic, biodynamic, and conventional with and without manure additions) and soil management options (various tillage practices and cover cropping). The preliminary results show that the DayCent model was able to reproduce 76% of variability in the crop productivity (n = 1 316) and 75% variability in measured soil organic carbon (n = 402) across all long-term trials. Model calibration was evaluated against independent proportions of the data. The uncertainty in model predictions induced by model structure and uncertainty in the measured data still needs to be further evaluated using the Monte Carlo approach. The calibrated model will be used to identify and evaluate the feasibility of GHG mitigation options for the agricultural sector at the regional and national scales, and the model parameterisation is expected to be applicable to other modelling studies under Swiss conditions. This is an essential step to develop the “COMET Global” tool incorporated with DayCent for full soil GHG accounting, which will be operational at the scale of an individual farm.