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N. Zarrineh
Agroscope, Institute for Sustainability Sciences, Oeschger Centre for Climate Change Research, University of Bern, ninazarineh@gmail.com

A. Holzkämper
Agroscope, Institute for Sustainability Sciences, Oeschger Centre for Climate Change Research, University of Bern

Karim C. Abbaspour
Eawag, Swiss Federal Institute of Aquatic Science and Technology

J. Fuhrer
Agroscope, Institute for Sustainability Sciences, Oeschger Centre for Climate Change Research, University of Bern

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Calibrating SWAT for multiple agro-ecosystem services at field scale

N. Zarrineh[a, b], A. Holzkämper[a, b], K.C. Abbaspour[c], J. Fuhrer[a, b]
[a]*Agroscope, Institute for Sustainability Sciences, Reckenholzstrasse 191, 8046 Zürich, Switzerland*
[b]*Oeschger Centre for Climate Change Research, University of Bern, Hochschulstrasse 4 3012 Bern, Switzerland*
[c]*Eawag, Swiss Federal Institute of Aquatic Science and Technology, P.O. Box 611, 8600 Dübendorf, Switzerland*
Corresponding author E-mail: ninazarineh@gmail.com

Abstract: The Soil and Water Assessment Tool (SWAT) is increasingly used to assess potential impacts on multiple ecosystem services. However, insufficient attention is given to crop growth processes in a field setting that are relevant drivers of important agro-ecosystem services such as crop yield, soil organic matter, or nutrient leaching. The aim of this study was to validate the SWAT model performance for multiple outputs related to agro-ecosystem services. In a Swiss case study, SWAT was set up to simulate a long-term field experiment including four soil tillage treatments with detailed records of management (e.g. sowing, harvesting, fertilizing and tillage). Observed data for crop yield, soil organic matter and soil nitrate content were used as the basis for model evaluation. According to data availability, the following performance metrics were selected: Willmott's index ∈ (0, 1) for crop yield, residuals of soil carbon trends and residuals of soil treatment effects on carbon content. We found that the initial model results for crop yield simulation with default crop parameters were not satisfactory (Willmott's index < 0.48 for all treatments and crops). Consequently, we developed a multi-objective calibration strategy to improve the performance of the model with regard to these metrics. Based on a sensitivity analysis, we determined sets of the most sensitive parameters to be included in the calibration. Different approaches for model calibration were compared: i) adjustment of crop parameters in the mono-crop application, or ii) within rotations. For the within-rotation case, crop parameters were calibrated either sequentially for single crops or in parallel for multiple crops. First results for corn show that Willmott's index was improved from approximately 0.43 (average value of mono-crop and all plots within rotation settings with default crop parameters) to 0.46 in mono-crop, 0.56 in single-crop and 0.57 in multi-crop settings. These preliminary results suggest that a calibration strategy in a multi-crop setting is most suitable approach. A comparison of multiple strategies will be presented for different crops. This will show the most suitable way forward to calibrate crop parameters in SWAT.

***Keywords**:* SWAT; crop parameters; sensitivity analysis; calibration; field scale.