



## **A simple rule based model for scheduling farm management operations in SWAT**

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For many interdisciplinary questions at the watershed scale, the Soil and Water Assessment Tool (SWAT; Arnold et al., 1998) has become an accepted and widely used tool. Despite its flexibility, the model is highly demanding when it comes to input data. At SWAT's core the water balance and the modeled nutrient cycles are plant growth driven (implemented with the EPIC crop growth model). Therefore, land use and crop data with high spatial and thematic resolution, as well as detailed information on cultivation and farm management practices are required. For many applications of the model however, these data are unavailable.

In order to meet these requirements, SWAT offers the option to trigger scheduled farm management operations by applying the Potential Heat Unit (PHU) concept. The PHU concept solely takes into account the accumulation of daily mean temperature for management scheduling. Hence, it contradicts several farming strategies that take place in reality; such as: i) Planting and harvesting dates are set much too early or too late, as the PHU concept is strongly sensitivity to inter-annual temperature fluctuations; ii) The timing of fertilizer application, in SWAT this often occurs simultaneously on the same date in in each field; iii) and can also coincide with precipitation events. Particularly, the latter two can lead to strong peaks in modeled nutrient loads.

To cope with these shortcomings we propose a simple rule based model (RBM) to schedule management operations according to realistic farmer management practices in SWAT. The RBM involves simple strategies requiring only data that are input into the SWAT model initially, such as temperature and precipitation data. The user provides boundaries of time periods for operation schedules to take place for all crops in the model. These data are readily available from the literature or from crop variety trials. The RBM applies the dates by complying with the following rules: i) Operations scheduled in the spring planting season and fall harvesting season are temperature dependent. Warmer than usual conditions trigger the setting of respective operations earlier in spring and later in fall to prolong the cropping season. ii) Operations are randomized within a time span  $\pm 5$  days around the calculated dates and iii) are only set on days where no rainfall occurs. Advantages offered by the RBM framework are the implementation of farmers undertaking different farming strategies, such as conventional or conservative farming, and the consideration of the prevailing weather conditions on the planting periods, thus the shifting management operations due to climate change will also be considered over the long term.

By applying these rules to the available data we were able to establish a simple framework developing more realistic crop management schedules for SWAT which are an improvement over the current PHU concept implemented in SWAT. The outlined framework is easily extendible and adaptable to many other applications in SWAT. Case studies have yet to demonstrate the applicability and the validity of the proposed RBM.