APPLICATION OF THE SWAT MODEL IN ROMANIA: DATABASE ADAPTATION

APLICAREA MODELULUI SWAT ÎN ROMÂNIA. ADAPTAREA BAZEI DE DATE

ELENA LUMINITA GRIGORE*, IOANA PANOIU*, S.UDRESCU, C. SIMOTA***

**National Research and Development Institute for Soil Science, Agrochemistry and Environment Protection – ICPA Bucharest*
*** University of Agriculture and Veterinary Medicine, Bucharest*

Abstract: *SWAT (Soil and Water Assessment Tool) is a complex hydrologic model developed for water balance evaluation at basin catchments. SWAT simulates the runoff process, and water quantity / quality to predict the impact of land management practices on water and sediment.*

Rezumat: *SWAT (Soil and Water Assesment Tool) este un model hidrologic complex, dezvoltat pentru evaluarea bilanţului apei la nivel de bazin hidrografic, simularea procesului ploaie-scurgere la scara bazinului, a cantităţii şi calităţii apei, pentru preconizarea impactului practicilor de management agricol asupra apei etc.*

Key words**:** *SWAT model, soil database.*
Cuvinte cheie: *Modelul SWAT, baza de date de sol.*

INTRODUCTION

The *Soil and Water Assessment Tool (SWAT)* is a physically-based continuous-event hydrologic model developed to predict the impact of land management practices on water, sediment, complex watersheds with varying soils, land use, and management conditions over long periods of time. For simulation, a watershed is subdivided into a number of homogenous sub basins (hydrologic response units or HRUs) having unique soil and land use properties. The input information for each sub basin is grouped into categories of weather; unique areas of land cover, soil, and management within the sub basin; sediment, nutrient and pesticide loadings to the main channel in each sub basin is simulated considering the effect of several physical processes that influence the hydrology.

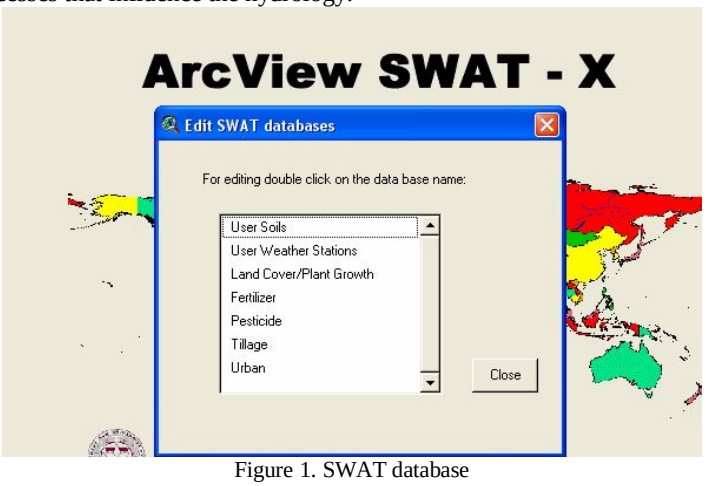

Figure 1. SWAT database

MATERIALS AND METHOD

The soils data used by SWAT can be divided into two groups, physical characteristics and chemical characteristics. The physical properties of the soil govern the movement of water and air through the profile and have major impact on the cycling of water within the HRU. Inputs for chemical characteristics are used to set initial levels of the different chemicals in the soil. The soil input file defines the physical properties for all layers in the soil and will hold data for up to 25 layers.

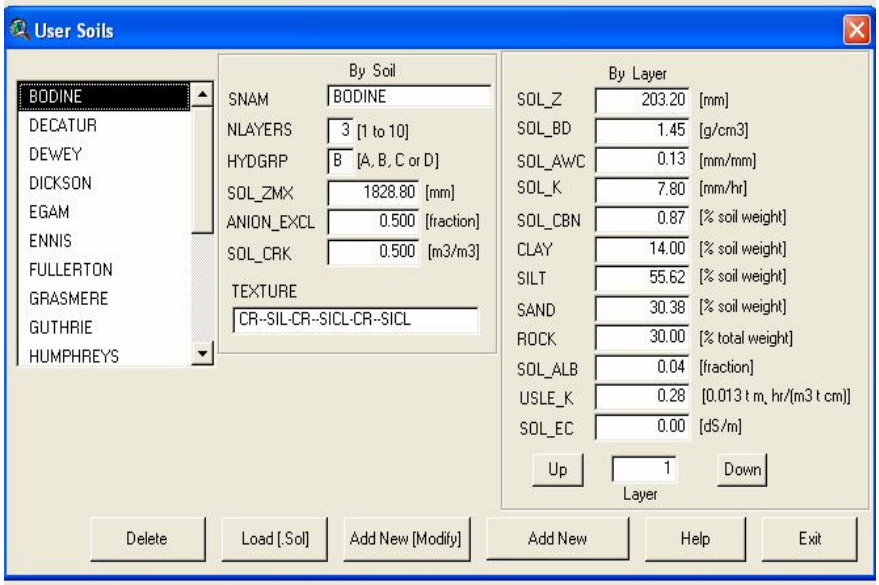

Figure 1. SWAT soil database

By soil:

SNAM – Soil name. The soil name is printed in HRU summary tables. It is optional.

NLAYERS – Number of layers in the soil. Min 1 Max 10

HYDGRP – Soil hydrologic group (A, B, C or D). Required only for the SWAT Arc View interface. The U.S. Natural Resource Conservation Service (NRCS) classifies soils into four hydrologic groups based on infiltration characteristics of the soils. NRCS Soil Survey Staff (1996) defines a hydrologic group of soils having similar runoff potential under similar storm and cover conditions. Soil properties that influence runoff potential are those that impact the minimum rate of infiltration for a bare soil after prolonged wetting and when nor frozen. These properties are depth to seasonally high to a very slowly permeable layer. The definitions for the different classes are:

A. Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of sands or gravel that are deep and well to excessively drained. These soils have a high rate of water transmission (low runoff potential).

B. Soils having moderate infiltration rates even when thoroughly wetted, chiefly moderately deep to deep, moderately well to well drained, with moderate fine to moderately coarse textures. These soils have a moderate rate of water transmission.

C. Soils having slow infiltration rates when thoroughly wetted, chiefly with a layer that impedes the downward movement of water or of moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission (high runoff potential).

D. Soils having very slow infiltration rates when throughout wetted, chiefly clay soils with a high swelling potential; soils with a clay pan or clay layer at or near the surface; and shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

SOL_ZMX – Maximum rooting depth of soil profile (mm). Min 0.00 max 3500.00. If no depth is specified, the model assumes the roots can develop throughout the entire depth of the soil profile. Required.

ANION_EXCL – Fraction of porosity (void space) from which anions are excluded. Min 0.010 Max 1.00. Most soil minerals are negatively charged at normal pH and the net interaction with anions such as nitrate is a repulsion from particle surfaces. This repulsion is termed negative adsorption or anion exclusion. Optional.

SOL_CRK – Potential or maximum crack volume of the soil profile expressed as a fraction of the total soil volume. To accurately predict surface runoff and infiltration in areas dominated by Vertisols, the temporal change in soil volume must be quantified. Bronswijk (1989, 1990) outlines methods used to determine the maximum crack volume. Optional.

TEXTURE – Texture of soil layer. This data is not processed by the model and the line may be left blank. Optional.

By layer:

SOL_Z – Depth from soil surface to bottom of layer. Min 0.00 max 3500.00. Required.

SOL_BD – Moist bulk density (Mg/m^3 or g/cm^3). Min 1.10 max 2.50. Required.

SOL_AWC – Available water capacity of the soil layer (mm H_2O/mm soil). Min 0.00 max 1.00. Required.

SOL_K – Saturated hydraulic conductivity (mm/hr). Min 0.00 Max 2000.00. The saturated hydraulic conductivity, K_{sat}, relates soil water flow rate (flux density) to the hydraulic gradient and is a measure of the ease of water movement through the soil. K_{sat} is the reciprocal of the resistance of the soil matrix to water flow. Required.

SOL_CBN – Organic carbon content (% soil weight). Required.

CLAY – Clay content (% soil weight). The percent of soil particles which are < 0.002 mm in equivalent diameter. Required.

SILT – Silt content (% soil weight). The percentage of soil particles which have an equivalent diameter between 0.05 and 0.002 mm. Required.

SAND – Sand content (% soil weight). Min 0.00 max 100.00. The percentage of soil particles which have a diameter between 2.0 and 0.05 mm. Required.

ROCK – Rock fragment content. (% total weight). Min 0.00 max 100.00. Required.

SOL_ALB – Moist soil albedo. The ratio of the amount of solar radiation reflected by a body to the amount incident upon it, expressed as a fraction. The value for albedo should be reported when the soil is at or near field capacity. Required.

USLE_K – USLE equation soil erodibily (K) factor. Min 0.00 max 0.65

SOL_EC – (not currently active) Electrical conductivity. Min 0.00 max 100.00

By soil (Romania):

- Soil type
- Erosion rate
- Gleization rate. Gleization occurs in regions of high rainfall and low-lying areas that may be naturally waterlogged.
- Pseudo-gleization rate
- Texture

By layer (Romania):
We don't have centralization information by layers.

RESULTS AND DISCUSSION

The SWAT database include a very large amount of physical information like Saturated hydraulic conductivity, Organic carbon content, Silt content, Sand content, Rock fragment content, Moist soil albedo, USLE_K – USLE equation soil erodibily (K) factor and SOL_EC – (not currently active) Electrical conductivity.

USLE equation soil erodibility (k) factor (units: 0.013 (metric ton m2 hr)/(m3 – metric ton cm)). Direct measurement of he erodibility factor is time consuming and costly, for this reason is more efficient to use the Wischmeier et al. (1971). Electrical conductivity is not currently active.

CONCLUSIONS

Computer models have become increasingly important tools for analyzing complex problems involving water flow and contaminant transport in the soils and groundwater. SWAT is a river basin scale model developed to quantify the impact of land management practices in large, complex watersheds.

The database used by SWAT is very complex and is necessary to know the value of parameters by soil profile and by layers. While the physical properties are required, information on chemical properties is optional.

In this moment we don't have enough information to develop a map (shape) by layers.

LITERATURE

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