Configuring and Running the SWAT Model

Written by Laura Briley, 2010
University of Michigan/NOAA/CIRES

Table of Contents

Background

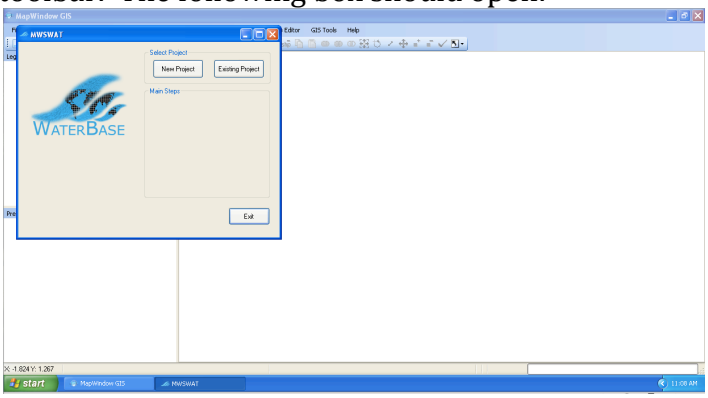
The Soil Water and Assessment Tool (SWAT) is very easy to run if all of the input files are prepared properly. The Data Pre-Processing for SWAT document gives instruction for preparing your data, but these are not the input files for SWAT. For official documentation of SWAT input/output files, see http://swatmodel.tamu.edu/documentation. There is a plug-in to MapWindow that will create the necessary files for you by using the pre-processed data. This document demonstrates how to utilize this software, MWSWAT, in order to run SWAT.

1. Software: MWSWAT

Download MWSWAT and install in the default location (C:\Program Files\MapWindow\Plugins\MWSWAT)
http://waterbase.org
The present version of MWSWAT includes the 2005 version of SWAT but later versions of SWAT are available and may be installed in its place if the user chooses this option.

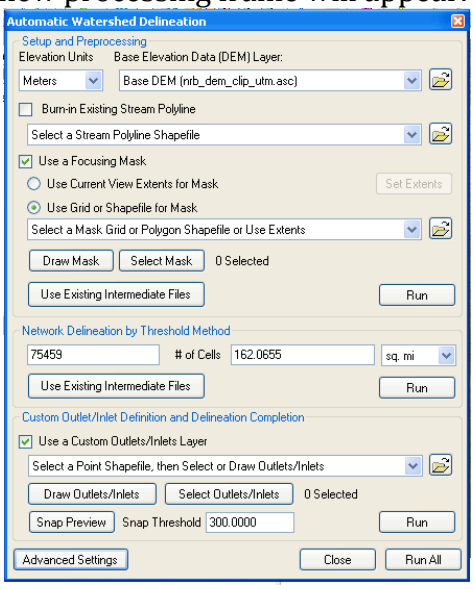
2. Delineate Watershed

Start MapWindow and under the plug-ins window turn on the MWSWAT and Watershed Delineation options. MapWindow may need to be restarted in order for them to appear across the top toolbar. Select the MWSWAT plug-in in the top toolbar. The following box should open:



Select "New Project" and create a name for the project. This will create a new folder in the directory named after the new project as well as a MapWindow project file. The MWSWAT interface will direct you through the data processing steps.

Select Step 1: Delineate Watershed and pull up your clipped DEM file created earlier. Then select "Process DEM". This will place your DEM in the new map window and a new processing frame will appear:



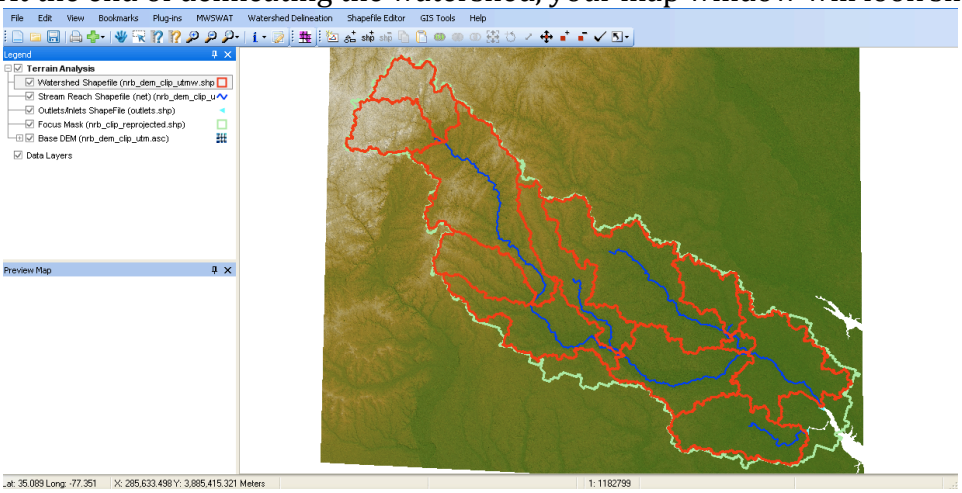
The first section of options allows you to specify the DEM layer and its characteristics. Either use Current View Extents for the mask or cancel Use a Focus Mask. Note: make sure that all the layers you throughout the process are of the same projection. Click "Run" for the top section.

The second section consists of defining the network delineation using the threshold method. This is the threshold in area units flowing into a given point before it is

designated as a stream. The lower the number, the more streams and sub-basins will be created*. Once defined, select "Run".

Lastly, you must either select an inlet/outlet file or create a new one. If creating a new one, first zoom in to the DEM region where the streams cross the boundary of your region (for example, watershed). Then select "Draw Inlets/Outlets". Name your new file and then click on the map where the streams enter (exit) your region and define them as inlets (outlets). Run the final section.

At the end of delineating the watershed, your map window will look similar to:

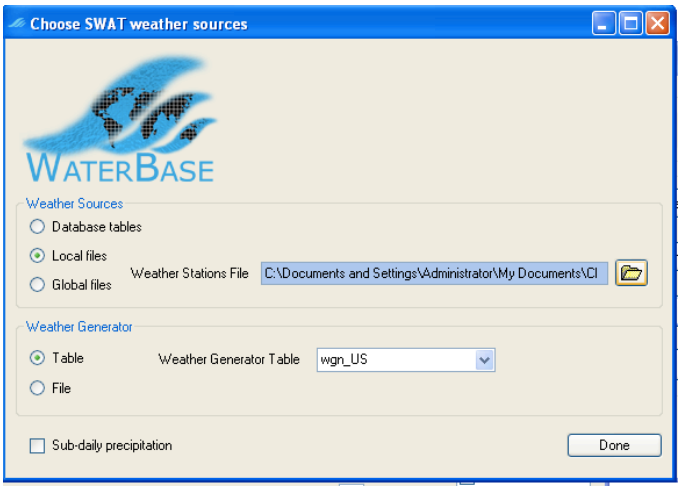


3. Create Hydrological Response Units (HRUs)*

Select "Create HRUs". A new window will appear where you will upload your landuse data and soil data. If using the data provided on Waterbase.org, you may use the tables global_landuses and global_soils. If using data that does not follow these table assignments, please see page 64 of the MapWindow Interface for SWAT document:
http://www.waterbase.org/documents.html
Once the tables are selected, "Read" the data. You will notice many dropdown menus and options available when creating the HRUs. You may read in more detail about these options in the document listed above. See section 5.2 of the document for additional help. After all of your selections are made, "Create [the] HRUs".

4. SWAT Setup

The last stage before running SWAT is to define a few more selections for the various options offered. First define the time frame of the simulation. Next, under Weather Sources, select "Choose".



MWSWAT has a template database that is the initial database for all new projects. This database has built in weather station data that may be used by selecting "Database tables" and weather_sources in the dropdown. For measured weather data (precipitation [.pcp], temperature [.tmp], solar radiation[.slr], wind [.wnd], and humidity [.hmd]) it is possible to either edit the tables in the database or read in the text files created in the SWAT Pre Processing document.

a. Weather Sources

i. **Importing Your Data** In the "Choose SWAT weather sources" window, select to use a local file and upload the station file you created. This selection indicates that you will use data in the model run and MWSWAT will go line by line through the station file and find the associated data files and condense them. For example, .pcp files will be condensed into pcp1.pcp. Up to 6 stations will be included in one pcp1.pcp file and remainders will be in pcp2.pcp, pcpn.pcp.

ii. **The Weather Generator** The weather generator fills in any gaps in your measured weather data or it may be used if you do not have any weather data. Each new MWSWAT project is supplied with a weather generator table for the US and may be used if your watershed is within the US.

iii. Select "Done" once your weather sources are chosen.

b. Rainfall/Runoff/Routing

i. Runoff

1. Runoff Curve Number (CN) is an empirical parameter used for predicting direct runoff or infiltration from excess rainfall.[1]
2. Green and Ampt (G&A) assume water infiltrates dry soil as a sharp wetting front. [2]

---

[1] http://en.wikipedia.org/wiki/Runoff_curve_number

[2] http://www.alanasmith.com/theory-Calculating-Effective-Rainfall-The-Green-Ampt-Method.htm

c. Rainfall Distribution

Used to generate daily precipitation values.

i. Skewed normal
ii. Mixed exponential

d. Potential ET Method

i. Priestley-Taylor is "an empirical approximation of the Penman combination equation… to eliminate the need for input data other than radiation."[3]
ii. Penman-Monteith is an "equation [that] requires daily mean temperature, wind speed, relative humidity, and solar radiation to predict net evapotranspiration."[4]
iii. Hargreaves is useful when "estimating ET in situations where data banks are limited and only maximum and minimum air temperature data are available."[5]
iv. Read in

e. Crack Flow

i. This is a new feature to SWAT and has had limited testing. It should only be activated on soils classified as Vertisols.

f. Channel Water Routing Method

i. Variable storage causes the outflow volume to be a function of the storage coefficient, volume flowing in, and the volume stored.[6]
ii. Muskingum method considers a linear change in depth along the reach.[7]

g. Channel Dimensions

i. This is a new (and undertested) feature of SWAT that allows channel dimensions to be updated as a result of degradation. It is recommended to keep dimensions constant.

h. Stream Water Quality Processes

i. If turned on, in-stream transformations of nutrients and pesticides are allowed.

5. Write SWAT Input Files

a. Once all of the options have been configured, check the "Write all files" box and then "Write files".

---

[3] http://www.civil.uwaterloo.ca/watflood/Manual/02_03_1.htm
[4] http://en.wikipedia.org/wiki/Penman-Monteith
[5] Hydrology handbook By American Society of Civil Engineers. Task Committee on Hydrology Handbook
[6] www.brc.tamus.edu/swat/.../ChannelSedimentPositionPaper.pdf
[7] Design hydrology and sedimentology for small catchments By Charles Thomas Haan

b. A window will appear if your watershed is in the US asking for plant growth heat units. Values are provided for US regions. If you wish to use a default value, this will have to be obtained elsewhere.

6. Run SWAT

a. After the message appears that your files have been written, "Run SWAT" and save your run.

7. Helpful Resources

MapWindow Interface for SWAT
WaterBase: SWAT in an open source GIS
http://www.waterbase.org/documents.html