

# SWAT Output Plotting and Graphing Tools (SWATPlot and SWATGraph)

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# 1 Introduction

SWATPlot and SWATGraph are companion tools to the MWSWAT tool that generates inputs for and runs the SWAT watershed modelling tool. SWATPlot is a tool designed to make it easy to select SWAT output values from the files output.rch, output.sub, output.hru, output.rsv and output.wtr. (The last two only include output values if you have reservoirs and ponds respectively in your SWAT model.) The normal way to plot such values is to import the SWAT output file into Excel, use an Excel filter to select the reach, subbasin, hru, reservoir or hru, respectively, and then use Excel graphing facilities to draw graphs or histograms. This is a relatively tedious process, especially if you want to use outputs from different runs to compare them. SWATPlot makes this process much simpler. It also allows you to include a file of observed results if you have them.

SWATPlot generates a comma-separated (.csv) file of the results of which you want to draw a graph or histogram. It automatically invokes the second tool SWATGraph to display the graph or histogram. However, if you wish to do some further processing, or use Excel's graphing or calculational capabilities, you can import this intermediate .csv file into Excel, or any other tool you may have.

The design philosophy of both tools is maximum simplicity, to keep the interface clean and easy to use. They are not intended to replace all the features of tools like Excel, but to make the normal display of comparative results simple and fast.

Like MWSWAT, SWATPlot and SWATGraph are free, open source tools produced by the WaterBase project <http://www.waterbase.org>.

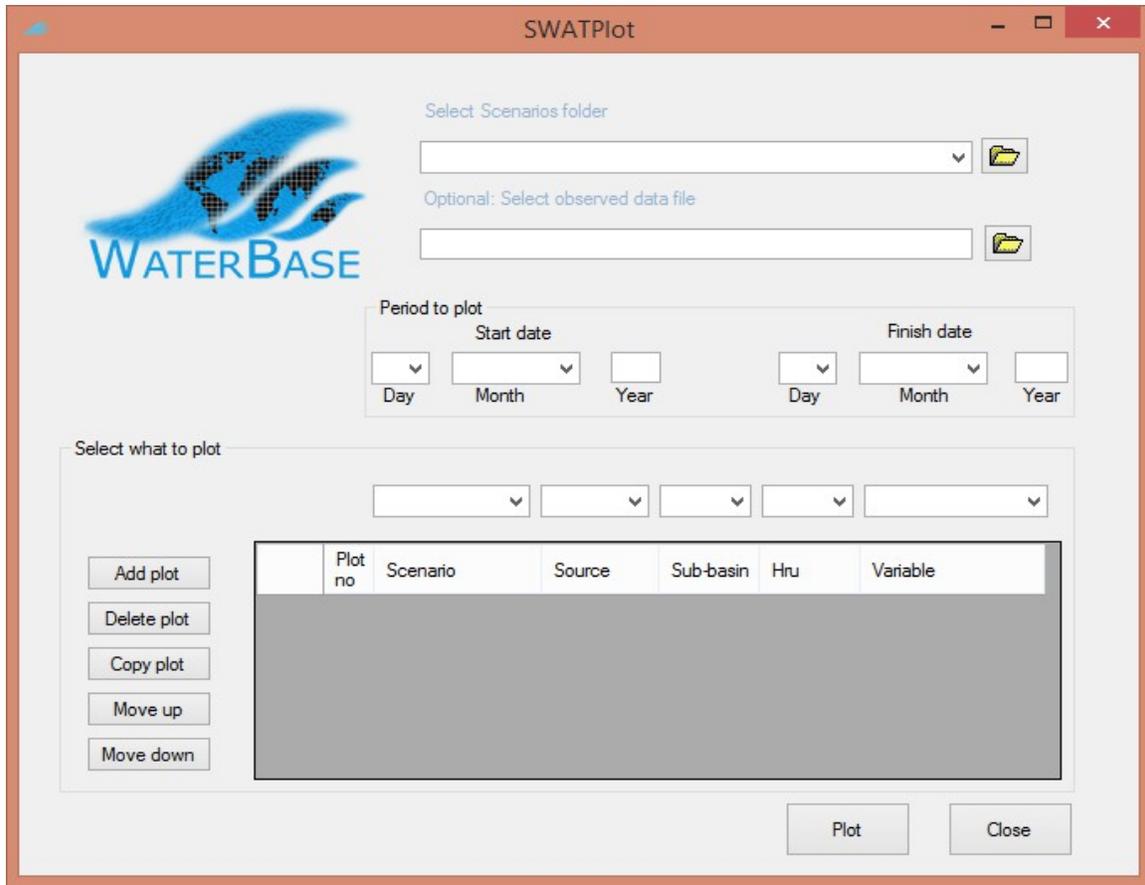
## 2 Installation

The tools come in a self installing executable. They use two files, mschrt20.ocx and msflxgrd.ocx, that are if necessary installed in your C:\WINDOWS\system32 folder and registered. This means that if you don't already have these files you will need administrator privileges to do the installation.

The installer suggests the folder C:\Program Files\MapWindow\Plugins\MWSWAT as the installation folder (C:\Program Files (x86)\MapWindow\Plugins\MWSWAT on a 64-bit machine), but you may choose somewhere else if you wish. A shortcut to SWATPlot will appear on your desktop.

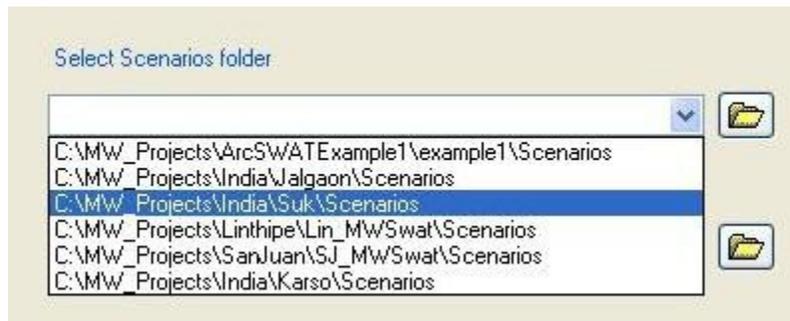
## 3 Running SWATPlot

When you start SWATPlot you see the view in Figure 1.



**Figure 1: Initial screen**

The first thing to do is to select the Scenarios folder, which is contained in the SWAT project folder. You can find it using the folder search button. The tool keeps a list of up to 10 Scenarios folders, so you can later select one you worked with previously. You select one from the drop-down list as in Figure 2



**Figure 2: Selecting a previously used scenario**

Selecting the Scenarios folder of a SWAT project allows you to input data from any scenarios you have produced with SWAT in that project. The latest one is always called Default, but you may have saved earlier runs as part of the same project, and you can combine data from any of

them. We will see later how compatible these runs need to be (in terms of how you have divided the watershed into subbasins and HRUs, and the periods and reporting intervals of the runs).

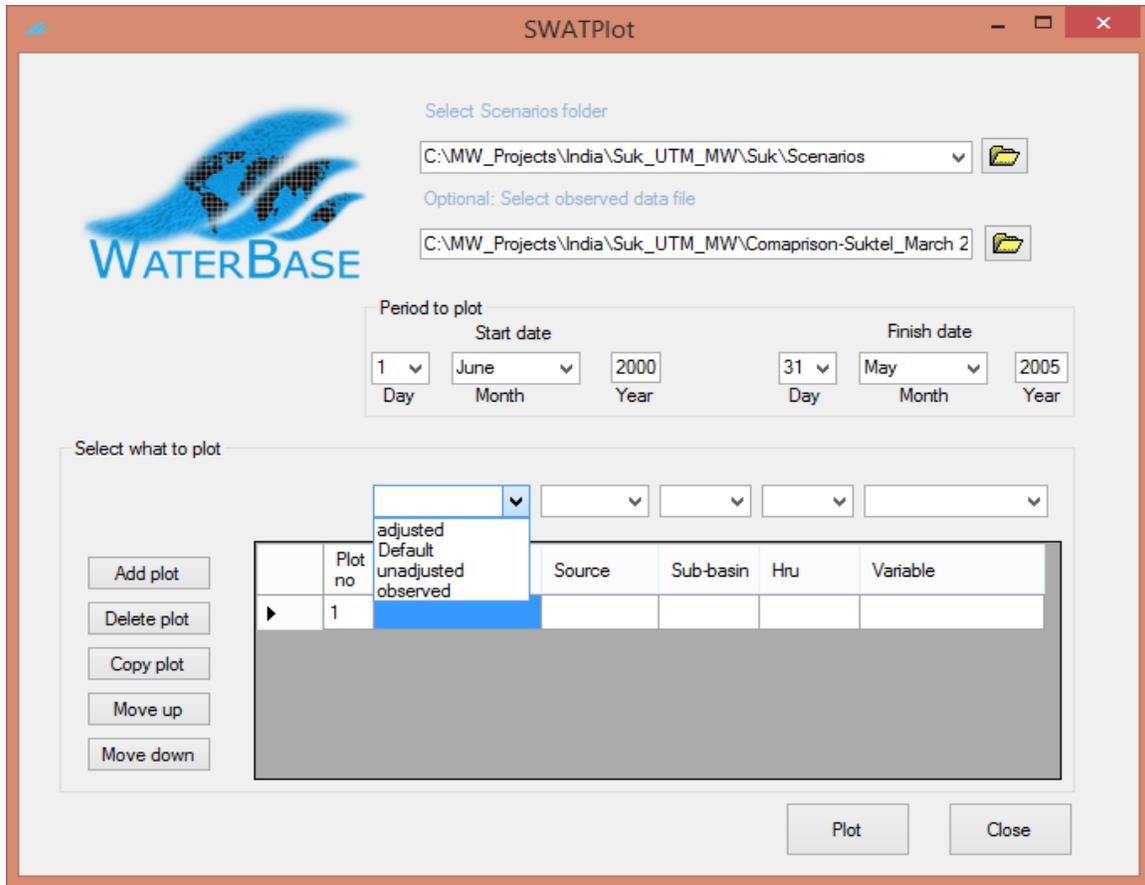
The period to plot is initially set to the period of the output in the Default folder (the period of the simulation less any initially skipped years). You can leave this as it is to plot the whole output, or change the dates to plot a shorter period within the original one.

There is also an option to include a file of observed outputs. We will deal with this later in Section 5.

When you have selected the scenarios folder you are ready to choose your data for the first plot. Click *Add plot* and an empty line appears in the table. Now click the arrow in the leftmost of the pull-down boxes above the table, the one above the heading *Scenario*, and you will see something like Figure 3. Here, as well as the *Default* scenario we have saved two earlier ones, called *adjusted* and *unadjusted*. We are going to compare the flows out of the watershed for these two runs.

We select *unadjusted* for the first plot. We now proceed from left to right choosing the next value from each pull-down box in turn. The second one, *Source*, offers a choice of *reach*, *subbasin*, and *hru*. In addition, if there are ponds (water impoundments) in your model you will see the possible source *water*, and if there are reservoirs you will see the possible source *reservoir*. These sources refer to the SWAT output files *output.rch*, *output.sub*, *output.hru*, *output.wtr*, and *output.rsv* respectively. We choose *reach*.

Now in the Sub-basin pull-down box we have a choice of all the sub-basins in the watershed. We would have the same choice here if we had chosen *subbasin* or *hru* as the source. If we had chosen *water* or *reservoir* we would only see the numbers of the sub-basins containing ponds or reservoirs respectively. We want to compare the final flows from the watershed, so we check in the MapWindow display for the project the most downstream sub-basin, which in our case is 21.



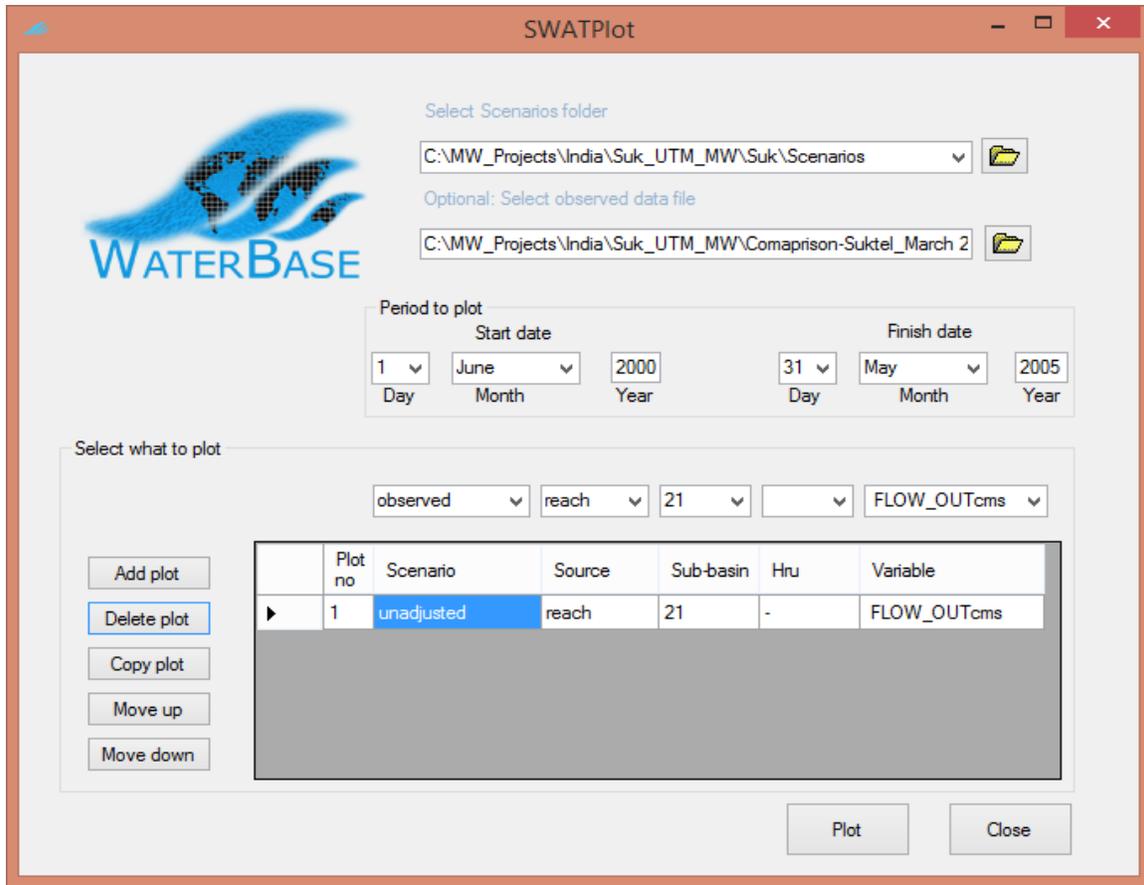
**Figure 3: Ready to choose the scenario**

Sources *reach*, *subbasin*, and *reservoir* are based on sub-basins, so the *Hru* box is not needed – it is marked by “-”. If we had chosen *hru* or *water* we would choose from the *Hru* pull-down box one of the *hrus* within the chosen sub-basin.

Finally we choose which variable we want to plot. The Variable pull-down box gives us a choice of all the variables in the output file selected by our choice of Source. We select *FLOW OUT cms* and we see something like Figure 4.

Our first plot definition is complete. Now we want to add the second. We could use *Add plot* and continue as before. But since the second will be mostly like the first, instead we click *Copy Plot*. This makes a copy of the selected plot (shown by ►), and we then just use the Scenario pull-down box to change the scenario for this one to *adjusted*. We get Figure 5.

We can now add more plots, change the selections we have made, or delete ones we decide we don't need. We can also change the order using the *Move up* and *Move down* buttons: the horizontal ordering of histograms in the graph display will be plots numbered 1 2 etc left to right.



**Figure 4: First plot completed**

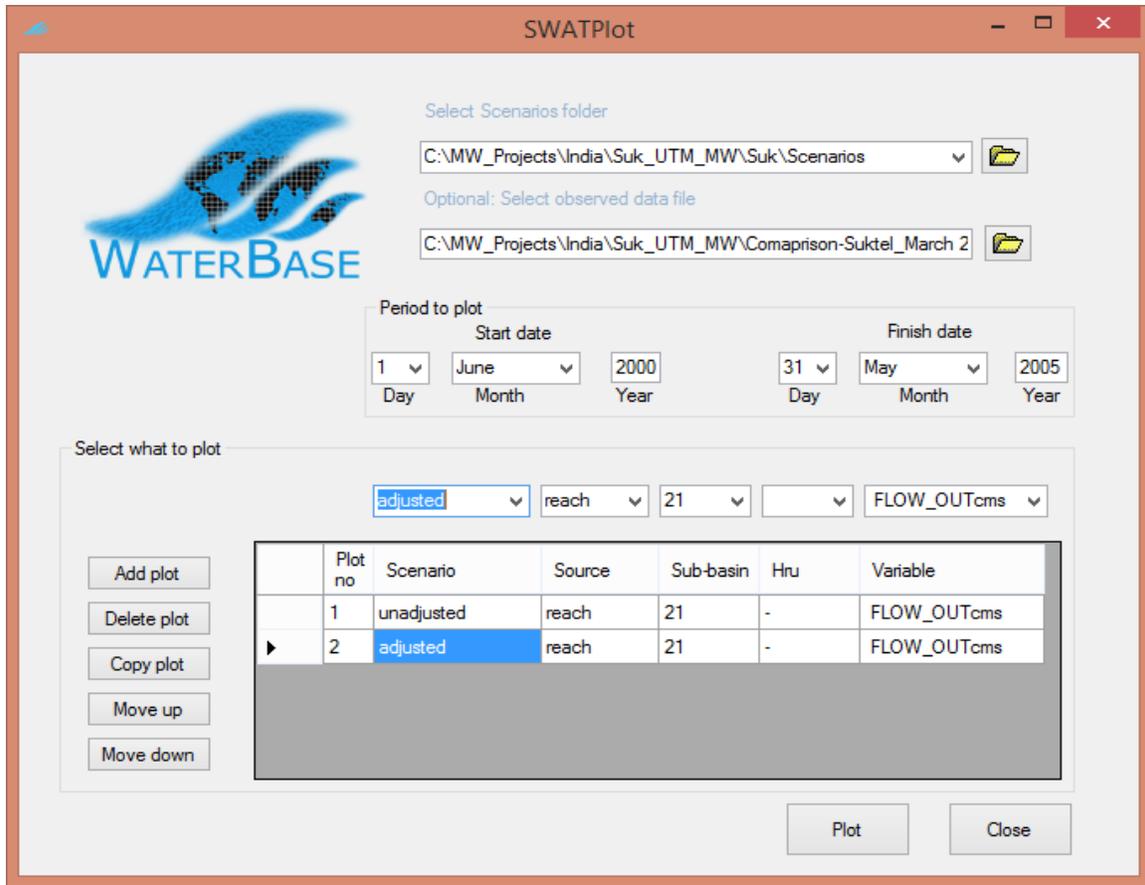
When we have completed the plot selections we click *Plot*. This invites us first to choose a .csv file to save the data. We can if we wish later import this into, for example, Excel if we wish to do further manipulations or use Excel’s graphing tools.

Once the data is written to the .csv file SWATGraph is automatically started to display the data graphically: see Figure 6. The data has been displayed as histograms, labelled by months as that was the time interval of our SWAT output. We can change the display to lines using the *Chart Type* pull-down box and clicking *Update Graph*.

Other options include importing another (similarly created) .csv file, using *New File to Plot*, and saving the graph to the clipboard, using *Copy chart to clipboard*, so we can then for example paste it into the Paint tool to make an image file.

The data from the .csv file is also displayed. The column headings, also shown in the graph legend, take the form *Scenario-Source-Number-Variable*, where *Number* is the sub-basin number if the source is reach, subbasin or reservoir, and the hru number if the source is hru or water.

You can fill in the *Chart Title* and *Y Axis Titles* if you wish, and change the *X Axis Title*.



**Figure 5: Second plot completed**

At the bottom of the screen some statistics are displayed. These are Pearson product-moment correlation and Nash-Sutcliffe model efficiency coefficients for pairs of plots. Correlation is calculated for all pairs, efficiency only for pairs in which one is observed: see section 5. Some of these may be meaningless, of course, if for example you choose to plot four things that are really two pairs, but it is quicker as well as simpler to calculate them all than it is to ask the users what they want.

#### **4 How compatible do different scenarios need to be?**

Obviously, they need to use the same time period, and the same time interval (monthly, daily or yearly). In fact, the number of records in the data is determined by the first plot, so if necessary this can be shorter. Start dates are assumed to be the same; they are not checked.

You also need to be reasonably confident that the things you want to compare are indeed comparable, so if you are comparing hrus, for example, they should be the same hru in each scenario. But if you are comparing the outlet reach in each scenario, which gives figures for the whole watershed, it doesn't matter how the sub-basins and hrus in each were selected.

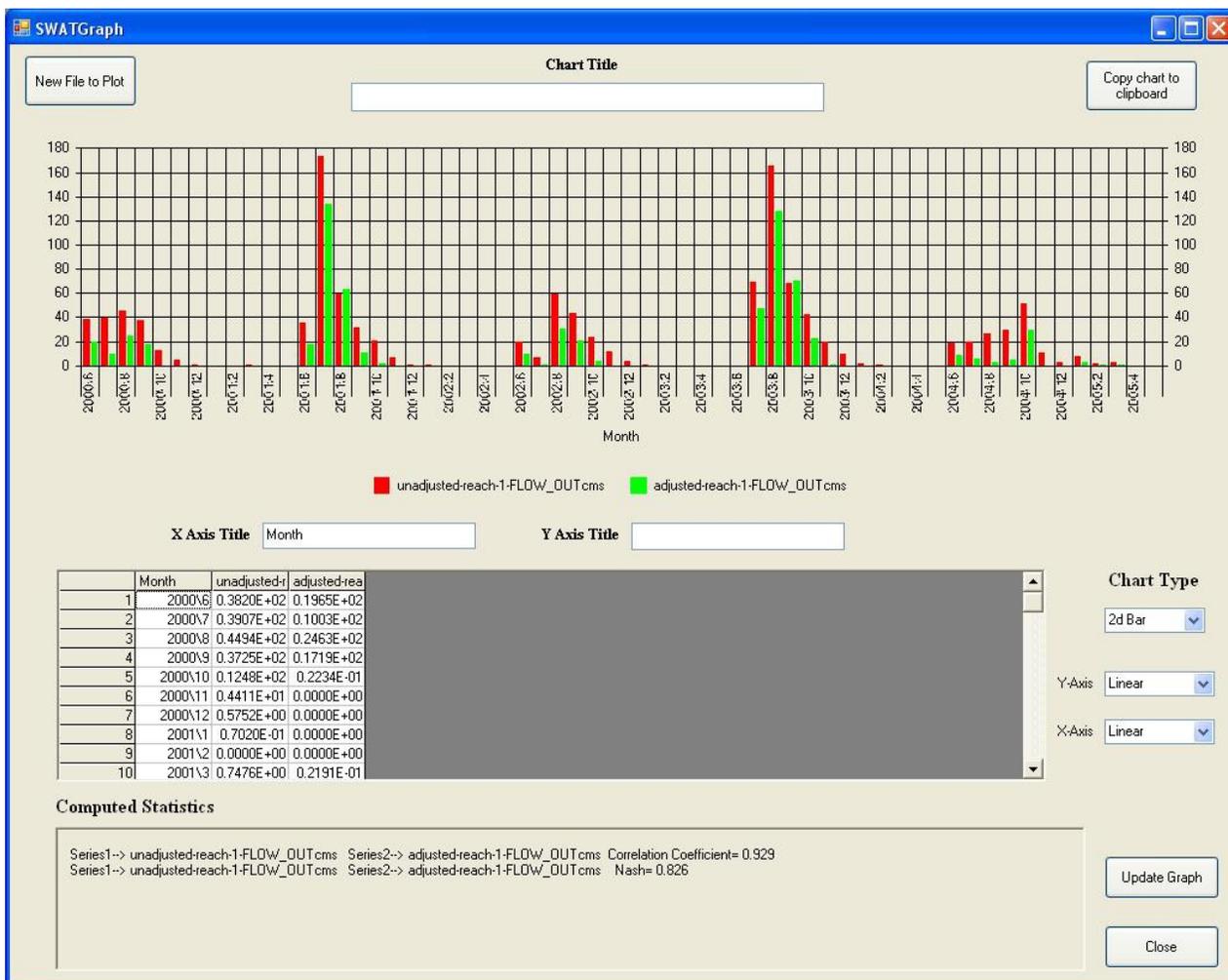


Figure 6: SWATGraph

## 5 Including observed data

To include observed data you need to prepare a .csv file, i.e. a text file where each line consists of the same number of items (one or more), separated by commas.

The first line should be comma-separated text strings, which will be used as the labels in the graph. If the first string is DATE, or Date, or indeed these four letters in any case, it and the data in the first column are ignored. The dates are assumed to be the same as in the SWAT output files; they are not checked. Note this means that if you select a later start date than that initially offered, say a year later, and your output data is monthly, then the first 12 records will be ignored both from your SWAT outputs and your observed data.

The data on lines two to the end should be numeric.

If you include such an observed data file in SWATPlot then *observed* will appear as an additional Scenario in its pull-down box, as we saw in Figure 3. (You will be asked to rename one of your SWAT scenarios and start again if it is also called *observed*.) Source, Sub-basin and Hru boxes will then be unavailable, but you need to choose a Variable. The choices in the Variable pull-down box will be the labels in the first line of the .csv file.

## **6 Reporting problems**

If you have problems or suggestions send them to [waterbase.contact@waterbase.org](mailto:waterbase.contact@waterbase.org).