

WGNmaker4.xlsm

About:

This Excel macro is designed to calculate the weather station statistics needed to create user weather station files for SWAT. These files are used by SWAT's weather generator to fill in missing information or simulate weather data.

This macro requires Microsoft Excel to run. There are two versions of the macro, one with a .xls extension which is compatible with all versions of Excel, and one with a .xlsm extension which is only compatible with versions from 2007 or newer. Running the macro in older versions of Excel appears to be faster than using Excel 2007. However, the .xls version is not as flexible as the .xlsm version in terms of automatically reading different data formats, and may not be able to handle very large datasets. When relevant, the differences between the two versions are explained in the instructions below.

This calculates the same statistics as the wxparm program, but uses Excel. Also, this macro can handle missing data and data from different years (i.e. if rainfall data is available for 50 years but solar radiation data is only available for 20 years).

For details on the statistics calculated by this macro, see the SWAT user manual or the "Soil and Water Assessment Tool Input/Output File Documentation".

Input Data:

The macro reads information about each weather station and its associated data files from a master list with the following format (the same as in the worksheet labeled "FileListFormat" within the macro workbook). There must be a header row, and the columns must be in the same order as in the "FileListFormat" worksheet. This may be either an Excel file or a tab-delimited text file. For Excel versions from 2007 or later, the file names do not need to include a suffix. For older Excel versions, a suffix such as ".xls" or ".txt" is required. Also, for older Excel versions, if a file name is left blank then the macro will only look for Excel files with the default name, and will not find text files.

Column Letter	Entry Description	Specifications
A	Station Name – The output files will be saved under the station name with "wgn" at the end (i.e. If the station name is "station1" then the output file will be "station1wgn.xls".)	Required
B	Output File Title – This will be included in the first line of the output file. If this is left blank, then the output file title will be the station name with the date and time that the macro was run.	Optional, 80 character limit.

C	Latitude of weather station	Optional, must be between -90 and 90 degrees.
D	Longitude of weather station	Optional, must be between -180 and 180 degrees.
E	Elevation of weather station	Optional, must be between 0 and 5000 meters.
F	Rainfall file name. If this space is left blank, then the input file name must be the same as the station name with “_pcp” at the end. For example, if the station name is “station”, then the default rainfall file name will be “station_pcp”.	Optional
G	Temperature file name. If this space is left blank, the file name must be the station name with “_tmp” at the end.	Optional
H	Solar radiation file name. If this space is left blank, the file name must be the station name with “_slr” at the end.	Optional
I	Wind speed file name. If this space is left blank, the file name must be the station name with “_wnd” at the end.	Optional
J	Dew point file name. If this space is left blank, the file name must be the station name with “_dwp” at the end.	Optional
K	Maximum half-hour rainfall file name. If this space is left blank, the file name must be the station name with “_hr” at the end.	Optional

It is recommended to use data from at least 20 years to calculate the weather station parameters. For the maximum half-hour rainfall**, SWAT will not accept fewer than five years of data.

There are two options for the input data file format. The first option is to use data in two or three columns as shown in the table below. The first column contains the dates and data is in the second column (and third column for temperature). The columns can either have headers or not, but the second row should not be blank or the macro will assume there is no data associated with the file. The dates must be in the format month/day/year. Files from any version of Excel will work, or text files with tabs separating the columns. The individual daily data sets are:

Data Type	Units	Column Format		
Rainfall	millimeters	mm/dd/yyyy	Precip.	
Temperature	Degrees Celsius	mm/dd/yyyy	max. temp.	min. temp.
Solar Radiation	MJ/m ² /day	mm/dd/yyyy	Sol. Rad.	
Wind Speed	m/s	mm/dd/yyyy	Average Speed	
Dew Point *	Degrees Celsius	mm/dd/yyyy	Dew Point	
Max. 1/2 Hour Rainfall **	millimeters	mm/dd/yyyy	Max. Rain	

The second format option for input files is to use text files. Text data files must have:

- The word "Text" on line 1 (make sure the T is capitalized)
- The start date on line 2
- The end date on line 3
- All daily data following in chronological order, one day per line, as shown below. (For temperature files, separate the maximum and minimum temperatures for each day with a comma. Maximum temperature comes first.)
- Either -99 or a blank line for each missing data value.

Note: If your version of Excel does not read dates in the month/day/year format (for example, if the date format is day/month/year) then using text input files may not work correctly.

```
Text
1/1/1900
12/31/1910
40
35
-99
20
.
.
```

Sample of format for a text input file.

```
Text
1/1/1900
12/31/1910
20,15
24,19
-99,-99
20,14
.
.
```

Sample of format for a text input file for temperature data.

*Note on Dew Point:

For the 2009 version of SWAT, relative humidity may be used instead, if it is entered as a decimal less than 1. Otherwise, if observed data for dew point is not available, the SWAT website provides a program for estimating dew point at <http://swatmodel.tamu.edu/software/links-to-related-software> .

The dew point estimation program uses average daily humidity (%) and either average daily temperature or maximum and minimum daily temperatures (°C) as input.

****Note on Maximum Half-Hour Rainfall:**

This is not one of the usual weather input files needed to run SWAT, but it is required for the weather generator.

This macro automatically calculates the number of years of maximum half-hour rainfall data used. However, it does so by looking at the earliest and latest dates only, so if there is a missing year somewhere in the middle then the user will need to manually change this number in the .wgn file or when uploading the file into SWAT.

Output Files:

Calculation Files

The macro will generate an Excel calculation file, with name wgnCalculations.xlsx. This is where the calculations actually take place for the values placed in the final .wgn file.

Excel Output Files with Statistics

Each station will generate one output file with all of the calculated statistics. The format is identical to that of the worksheet labeled "Format" within the macro workbook. The file name will be the same as the station name but with "wgn" at the end.

- Row 1: Title, not read by SWAT
- Row 2: Latitude and longitude in degrees
- Row 3: Elevation in meters
- Row 4: Number of years used to calculate the maximum half-hour rainfall. (highest year in half-hour rainfall input file minus the lowest year)

Starting at row 5, each column (1-12) contains the statistics for each month (January-December).

- Row 5: average daily maximum temperature
- Row 6: average daily minimum temperature
- Row 7: standard deviation of daily maximum temperature
- Row 8: standard deviation of daily minimum temperature
- Row 9: pcpmm = average total monthly precipitation
- Row 10: pcpsd = standard deviation for daily precipitation in month
- Row 11: pcpskw = skew coefficient for daily precipitation in month
- Row 12: pr_w(1) = probability of a wet day following a dry day
 - o Given by: $(\# \text{ of wet days following dry days in month}) / (\text{total } \# \text{ of dry days in month})$

- Row 13: pr_w(2) = probability of a wet day following a wet day
 - o Given by: (# of wet days following wet days in month)/(total # of wet days in month)
- Row 14: pcpd = average number of days of precipitation in month
 - o Give by: (# wet days in month)/(# years)
 - o The number of years is found by subtracting the first year of the input data from the last year of the input data and adding one, so be sure that there are no years missing in the middle and no years with all blank data values.
- Row 15: rainhr = most extreme 30-minute rainfall intensity recorded in month for entire period of record
- Row 16: solarav = average daily solar radiation in month
- Row 17: dewpt = average daily dew point temperature for each month. For SWAT Version 2009, relative humidity can be input as a fraction here instead, and if all 12 months have a value less than 1 then SWAT will assume the input values are relative humidity.
- Row 18: windav = average daily wind speed in month

Output Files from Text Input

For any input files which were formatted using the single-column text file option, Excel versions of the data will be saved in the same folder as that in which the macro is saved.

Text Output File for ArcView

This is the same as the Excel output file, but saved as a .prn (space delimited) text file. There are asterisks in front of some of the numbers; this is necessary for it to be read correctly by ArcView. This is in the format of the .wgn files needed by the ArcView SWAT interface.

Excel Output File for ArcMap

This file has all the statistics from the original Excel output file and puts them in one row, in order to easily create a geotadabase table in ArcMap.

Instructions:

Save all input files in the same directory. Write this directory path in the appropriate box in the macro's start page (cell B7). Include a "\ " at the end.

Create an excel spreadsheet with the format of the tab labeled "FileListFormat." This is your input data file master list. The macro will start reading on line 2. The only required field to fill in is "Station Name". Write the desired output file titles in row B. This will appear at the top of the generated files and can include more detail than the file name. (If the space for output file title is left blank, then the file title will be the station name and the date and time at which the macro was run.) Either fill in the names of your data files, or make sure your data files have the default names associated with the station name, as described in the section on input data. If you do not have data for a specific variable, create a blank

data file with the correct name. File suffixes such as .xls or .txt are not required as long as the working directory does not contain multiple files with the same name but different suffixes. Do not leave blank rows in the master list. Anything written below the first blank row will not be read.

Enter the name of the input data file master list in cell B8 of the macro's start page.

Make sure that cell C17 on the macro's start page is empty, unless you want to keep a list of previously run files.

Press "START"

The output files will be saved in the same directory as your input files.

If the macro has already been run in the current directory, then you will be prompted as to whether to replace the calculation file or not. Most users will probably prefer to select "yes" and overwrite the calculation file. If not, you can select "no" and save the file under a different name.

It may take up to 10 minutes for the Excel 2007 version of the macro to complete all calculations for each station. A message will appear once all calculations are complete and the results have been saved in Excel files with the station names specified in the master list plus "wgn" at the end.

Each time the macro begins calculations for a new station it writes the name of the output file in cell C17. More file names can be added by the user, or else names can be deleted.

Once all weather stations have been run, click on either "Save output for Arcview" or "Save Output for Arcmap." If you choose the second option, make sure you have entered a file name in cell C19. The results of each option are explained below:

For Arcview Interface:

A separate file will be created for each station listed in cell C17.

Once the macro has finished running, open the .prn file in notepad. Save this text file as a .wgn file by clicking on "file" and then "save as". Add ".wgn" to the end of the file name, select file type "all files," and click save.

To upload this file into the SWAT Arcview interface, select "User Weather Stations" under "Edit SWAT Database". Click on "Load(.wgn)".

For GIS ArcMap Interface:

The Arcmap output file has one station in each row (the stations listed in cell C17), in the format needed to load the statistics into a database table for SWAT. To do this, open the Excel sheet in ArcCatalog. Right click on the sheet with the name entered on the start page, then select "Export" to create a geodatabase table.

Use the "Append" tool in ArcCatalog to append the new table to the existing user weather station personal geodatabase.

Alternatively, the numbers can be input by hand. Under "Edit SWAT Input", select "Databases," then "User Weather Stations," then "Add New." Fill in the numbers in the output file generated by this macro.

Technical Details:

Missing Data

If a day has missing data, the macro does not include that day in its calculations. This way the missing data points don't get counted as zeros or otherwise included in the statistical calculations. This is simply the normal way that Excel handles blank cells. Note that a large number of days with missing data will lead to imprecise statistics. For the daily rainfall and maximum half hour rainfall input data, there can not be a whole month with missing data. Calculations with both of these inputs involve a year count, so if a year is missing then the count will be wrong. For example, pcpmm is given by the sum of all daily rainfall amounts for each month, divided by the number of years. If one month has no data, then unless that month truly had no rainfall this will lead to an underestimate of the actual mean monthly rainfall.

For pcpd and pcpmm, this means that a day with missing data is treated as a dry day. For the precipitation probabilities, it is not counted toward wet or dry days.

Rainfall

The W/W column in the calculation file counts the number of wet days (>0mm rain) which are followed by a wet day. The W/D column calculates the number of dry days (0mm rain) followed by a wet day. A wet day following a day with no data is not counted toward either one. The macro does not take breaks between months into account for this (i.e. if January 31st is dry and February 1st is wet, then January 31st will be counted in the W/D column).

This information is used to calculate the probability of a wet day following a dry day and the probability of a wet day following a wet day, denoted as pr_w(1) and pr_w(2), respectively, in the "Format" tab.

These results were compared to the results from the pcpstat.exe program that comes with SWAT and calculates the precipitation statistics needed for the .wgn files. Most of the outcomes were identical, but some individual numbers were off by up to .05 units, which can mean about 50% off for the

probability values (pr_w1 and pr_w2). This is not an effect of leap years, and it may simply be a rounding error.

Contact:

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