SWAT
Weather Database

A Quick Guide

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Contents

1.   Introduction

SWAT Weather Database is designed to be a friendly tool to store and process daily weather data to be used with SWAT projects. It is capable of:

- Storing relevant daily weather information;
- Easily creating .txt files to be used as input information during an ArcSWAT project setup;
- Efficiently calculating the WGEN statistics of several weather stations in one-step run.

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      pagetotal = {14},
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      doi = {10.13140/RG.2.1.4329.1927}
}
```

2.   Installing and Opening the Database

i.   System Requirements

In order to run SWAT Weather Database, the following should be met:

- 32-bit or 64-bit Windows operating system;
- A recent Microsoft Access version installed (2010-onwards should be fine), and;
- A .pdf reader (e.g. Adobe Acrobat Reader).

ii.   Installation Steps

To install the Metadata Database, just extract the contents of the compressed file **SWATWeatherDatabase.7z** file anywhere in your computer (e.g. C:\SWAT\SWATWeatherDatabase). Inside the installation directory, you should be able to find the file named **WeatherDatabase.accdb** and two folders, namely **Documentation** and **Tables**.

Obs: Do **not** change the structure of the folder (e.g. rename the folders or files, move files outside the main folder, etc.) as, by doing so, the **WeatherDatabase.accdb** will not be able to correctly find the required references.

The folder **documentation** stores relevant .pdf documents to be consulted during the use of the Weather Database. The folder **Tables** stores the WeatherDatabase_be.accdb database, which actually stores the weather data to be used by the application.

Obs: Users more experienced in using Microsoft Access can fill the **WeatherDatabase_be.accdb** directly, without using the developed GUI to do so. However, in order to create the input .txt ArcSWAT weather files and to calculate the WGEN statistics, it is recommended to use the GUI interface.

iii.   Opening the Database

In order to start the SWAT Weather Database GUI, just double-click on the **WeatherDatabase.accdb** file on the main installation folder. You should be greeted with a screen similar to Figure 1.
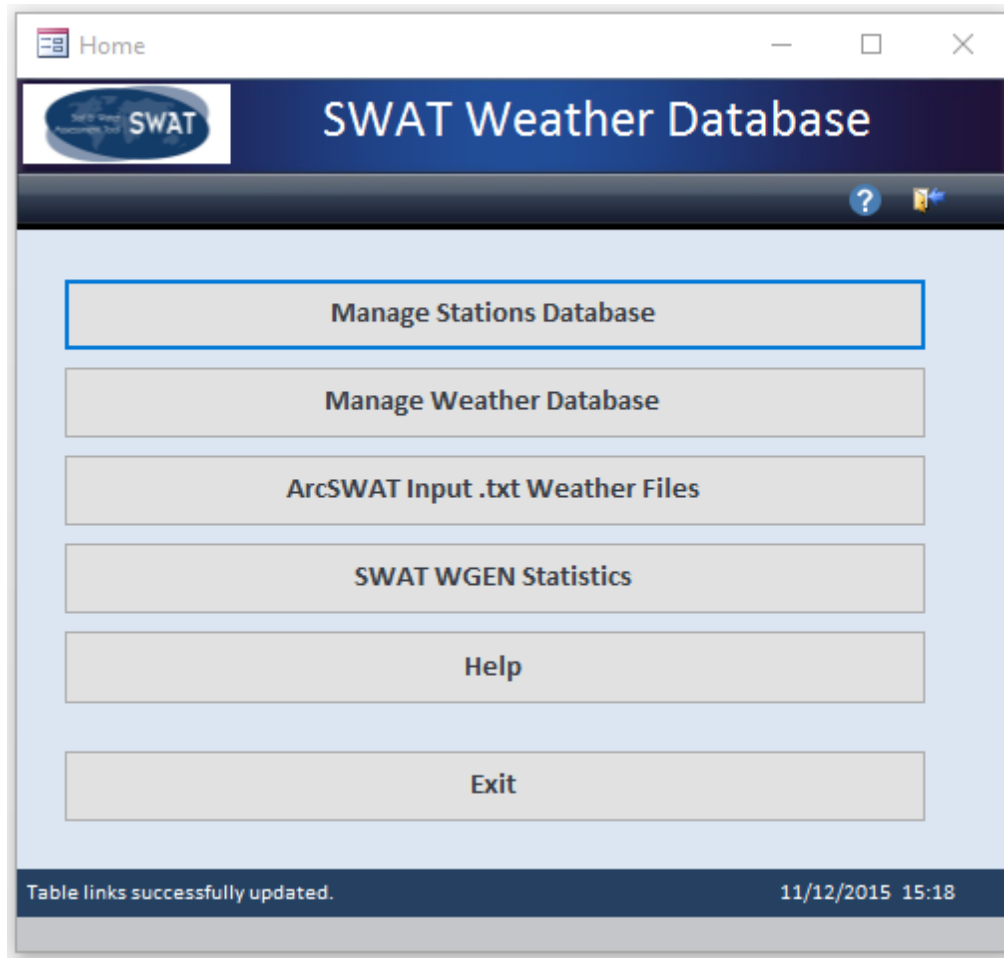
Figure 1 - The Home window.

Obs: If you get a security warning asking you if you would like to enable the use of macros and vba codes, please do so, otherwise some parts of the application will not work. By doing so, the WeatherDatabase.accdb will close itself. Just reopen it to use it again with all the functionalities enabled. If the message *"Table links successfully updated."* appears on the bottom of the screen, then everything is correctly enabled.

3.   Database Structure

This section describes the structure of the SWAT Weather Database. In general terms, the database is composed of one table to store the weather stations data and other five tables to store the weather variables data, such as temperature and precipitations.

i.   The Weather Stations Table

The following table summarises the structure of the weather stations table:

Table 1 - The Weather Stations table structure.

FIELD NAME	DATA TYPE	MAX CHARACTER FIELD LENGTH	REQUIRED	DUPLICATES ALLOWED
Station Code	Text	255	Yes	No
Station Name	Text	255	Yes	Yes
Latitude	Double	28	Yes	Yes
Longitude	Double	28	Yes	Yes
Elevation	Double	28	Yes	Yes
Station Description	Text	255	No	Yes
Other Information	Text	255	No	Yes

The field **"Station Code"** must not contain any duplicate values, otherwise it will not be imported to the database. The field **"Station Name"** is the one used by the SWAT Weather Database on the output files. If the user prefer, both the fields **"Station Code"** and **"Station Name"** can have the same values. When importing data to the weather stations table the column headers should be the same as the field names shown on Table 1. An example file can be found in:

(installation folder)\ExInputs\stations.csv

ii.   The Weather Variables Tables

The SWAT Weather Database stores daily weather data for five different weather variables:

- Relative Humidity (HMD);
- Precipitation (PCP);
- Solar Radiation (SLR);
- Maximum and Minimum Temperature (TMP);
- Wind Speed (WND).

All the weather variables tables have the fields **"Date"** and **"Station"**. The field **"Date"** is defined as the U.S. date format (i.e. 1st March 1990 = 03/01/1990). The field **"Station"** must have the same value as the field **"Station Code"** previously stored in the weather stations table (see **The Weather Stations Table**).

Obs: If a record being inputted in the weather database does not have a **Station-StationCode** match, the database will refuse to import it. The weather stations database must be filled before importing the actual weather information.

Although the structure of the weather variable table allows duplicate values for the fields **"Date"** and **"Station"** alone, it will **not** accept duplicate values for a combination of both. In other words, the combination **Date-Station** must be unique.

As for any SWAT project, missing values must be entered as **-99.0**. Such values will not be used during the calculation of the WGEN statistics. They will, however, be written to the ArcSWAT input *.txt* files.

a. The Relative Humidity Table (HMD)

The following table summarises the structure of the HMD table:

Table 2 - The HMD table structure.

FIELD NAME	DATA TYPE	MAX CHARACTER FIELD LENGTH	REQUIRED	DUPLICATES ALLOWED
Date	Date mm/dd/yyyy	10	Yes	Yes
Station	Text	255	Yes	Yes
HMD	Double	28	Yes	Yes

When importing data to the HMD table, if the source file has a first row header, the column names should be the same as the field names shown on Table 2. An example file can be found in:

(installation folder)\ExInputs\hmd.csv

b. The Precipitation Table (PCP)

The following table summarises the structure of the PCP table:

Table 3 - The PCP table structure.

FIELD NAME	DATA TYPE	MAX CHARACTER FIELD LENGTH	REQUIRED	DUPLICATES ALLOWED
Date	Date mm/dd/yyyy	10	Yes	Yes
Station	Text	255	Yes	Yes
PCP	Double	28	Yes	Yes

When importing data to the PCP table, if the source file has a first row header, the column names should be the same as the field names shown on Table 3. An example file can be found in:

(installation folder)\ExInputs\pcp.csv

c. The Solar Radiation Table (SLR)

The following table summarises the structure of the SLR table:

Table 4 - The SLR table structure.

FIELD NAME	DATA TYPE	MAX CHARACTER FIELD LENGTH	REQUIRED	DUPLICATES ALLOWED
Date	Date mm/dd/yyyy	10	Yes	Yes
Station	Text	255	Yes	Yes
SLR	Double	28	Yes	Yes

When importing data to the SLR table, if the source file has a first row header, the column names should be the same as the field names shown on Table 4. An example file can be found in:

(installation folder)\ExInputs\slr.csv

d. The Temperature Table (TMP)

The following table summarises the structure of the TMP table:

Table 5 - The TMP table structure.

FIELD NAME	DATA TYPE	MAX CHARACTER FIELD LENGTH	REQUIRED	DUPLICATES ALLOWED
Date	Date mm/dd/yyyy	10	Yes	Yes
Station	Text	255	Yes	Yes
TMPmax	Double	28	Yes	Yes
TMPmin	Double	28	Yes	Yes

When importing data to the TMP table, if the source file has a first row header, the column names should be the same as the field names shown on Table 5. An example file can be found in:

(installation folder)\ExInputs\tmp.csv

e. The Wind Speed Table (WND)

The following table summarises the structure of the WND table:

Table 6 - The WND table structure.

FIELD NAME	DATA TYPE	MAX CHARACTER FIELD LENGTH	REQUIRED	DUPLICATES ALLOWED
Date	Date mm/dd/yyyy	10	Yes	Yes
Station	Text	255	Yes	Yes
WND	Double	28	Yes	Yes

When importing data to the WND table, if the source file has a first row header, the column names should be the same as the field names shown on Table 6. An example file can be found in:

(installation folder)\ExInputs\wnd.csv

4.   The Graphical User Interface

The GUI was developed to help users during the process of managing data stored by the SWAT Weather Database and during the generation of the output files. It has a clear look and is the easiest way to import, edit or remove data stored in the database.

All the windows in this application are divided into three parts: the header, which contains quick-access buttons related to the current opened window; the body, contains some navigation options, and; the footer, which displays messages and warnings.

Basically, all the windows have the following navigation buttons on the header section:

- The button displays information about the application, as its version and contacts;
- The button return the application focus to the Home window;
- The button closes the current window.

i.   The Home window

The Home window is the main window of the SWAT Weather Database. Think of it as the main menu of the application, which guides the user to access all the functionalities of the database. It should look similar to Figure 1.

The Home window body has five buttons:

- The button **"Manage Stations Database"** calls a window which helps the user to import, edit, export and delete weather stations data;
- The button **"Manage Weather Database"** calls a window which helps the user to import, edit, export and delete weather variables data;
- The button **"ArcSWAT Input .txt Weather Files"** calls a window which helps the user to export stored weather data as .txt files ready to be used as input for your ArcSWAT project;
- The button **"SWAT WGEN Statistics"** calls a window which helps the user to calculate the WGEN statistics based on the stored weather data and export it as an output file;
- The button **"Help"** calls a window which display relevant documentation, such as this guide;
- The button **"Exit"** closes the application.

ii.   The Manage Stations Database window

The Manage Stations Database window allows the user to import, edit, export and delete weather stations data. On the body section, it displays a table with all the stations data, while the header section display different possible actions, such as import, export and delete data. It looks like Figure 2.
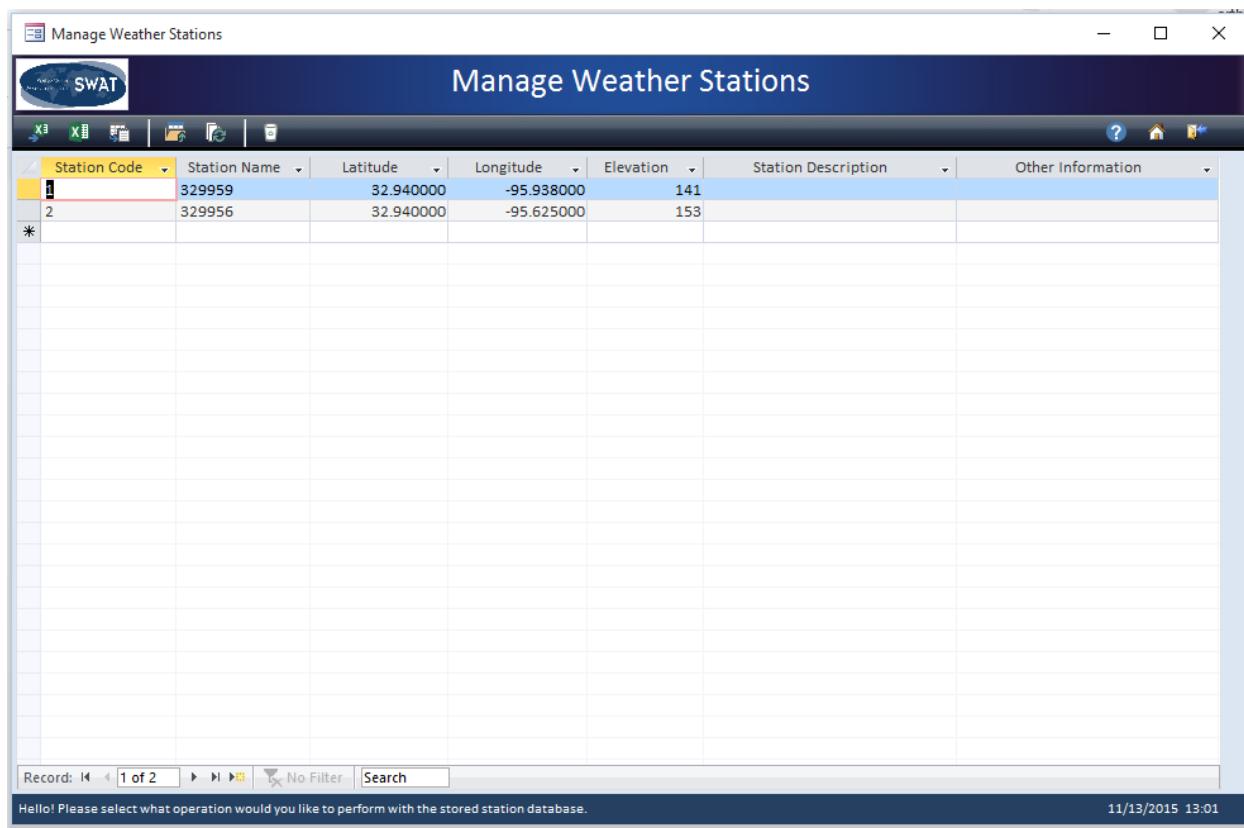
Figure 2 - The Manage Stations Database window.

Obs: Please remember that in order to maintain the data integrity, it is recommended to store the weather stations data **prior to** storing other related weather data.

The Manage Stations Database window header has six buttons:

- The ⬛ button exports the stored stations data as **.xls** file;
- The ⬛ button exports the stored stations data as **.xlsx** file;
- The ⬛ button exports the stored stations data as **.csv** file;
- The ⬛ button imports external stations data from a **.csv** or **.txt** file;
- The ⬛ button updates the stored stations data from an external **.csv** or **.txt** file;
- The ⬛ button deletes all the stations data stored in the database.

Obs: Please note that by pressing the button **"Import stations data"** only new information will be imported to the database. Previous stored unique Station Code will **not** be updated. To do so, please use the update button (see **The Weather Stations Table** for more details on how the stations data table is defined).

iii.   The Manage Weather Database window

The Manage Weather Database window allows the user to import, edit, export and delete weather variables data (e.g. humidity, precipitation, etc.). On the body section, it displays a field called **"Weather Data"**, which must be filled before performing any management actions. The window looks like Figure 3.
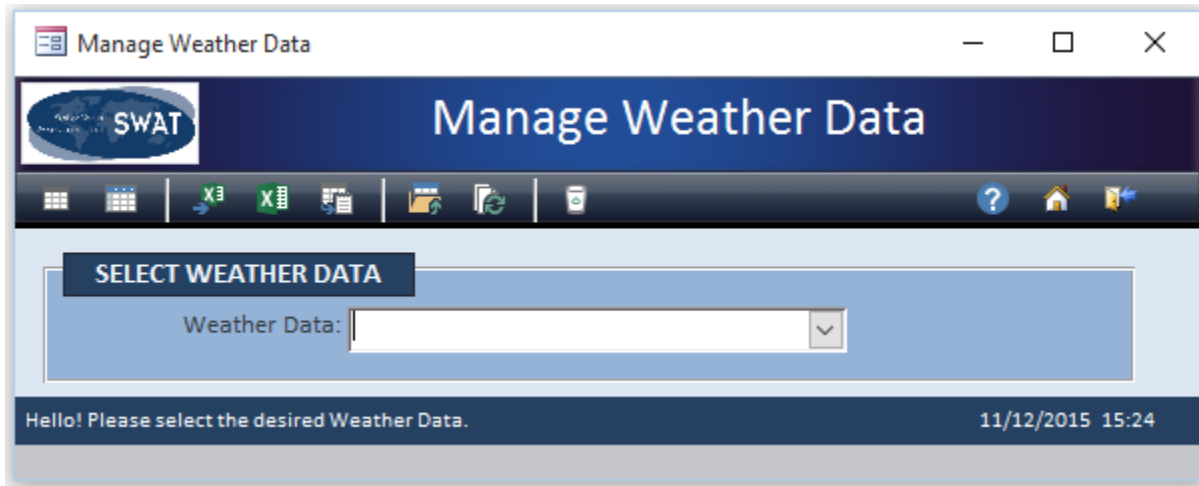

Figure 3 - The Manage Weather Database window.

Obs: Please remember that in order to maintain the data integrity, it is recommended to store the weather stations data **prior to** storing other related weather data.

The Manage Weather Database window header has eight buttons:

- The ▦ button displays the selected weather data (view/edit);
- The ▦ button displays the selected weather data by station (view only). When pressed, a new window will ask the user to inform the Station Name as a filter. If left blank, all stations will be shown.
- The ▦ button exports the selected weather data as **.xls** file;
- The ▦ button exports the selected weather data as **.xlsx** file;
- The ▦ button exports the selected weather data as **.csv** file;
- The ▦ button imports external weather data from a **.csv** or **.txt** file;
- The ▦ button updates the stored weather data from an external **.csv** or **.txt** file;
- The ▦ button deletes all the selected weather data stored in the database.

Obs: Please note that by pressing the button **"Import weather data"** only new information will be imported to the database. Previous stored unique combinations of Date and Station Code will **not** be updated. To do so, please use the update button (see The **Weather Variables Tables** for more details on how the weather data tables are defined).

iv.   The Write Data to ArcSWAT Input Files window

The Write Data to ArcSWAT Input Files window allows the user to export stored weather data as .txt files ready to be used as input for ArcSWAT projects. It looks like Figure 4.
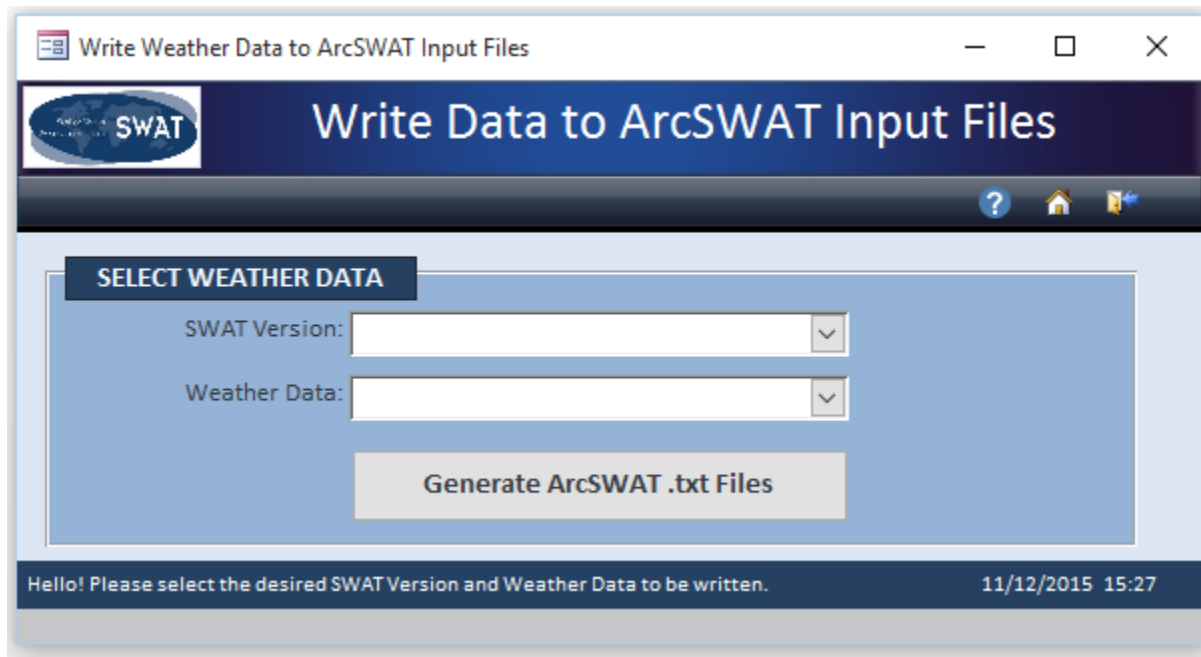
The Write Data to ArcSWAT Input Files window body has the following information:

- A field called **"SWAT Version"**, which must be filled before proceeding (i.e. 2009 or 2012).
- A field called **"Weather Data"**, which must be filled before proceeding.
- A button called **"Generate ArcSWAT .txt Files"**.

When the button **"Generate ArcSWAT .txt Files"** is pressed, it will access all the selected weather data and write it to .txt files which will be stored in a folder named after the selected weather data variable. If this folder already exists, a message will be shown to the user asking whether to proceed or not.

v.   The SWAT WGEN Statistics window

The SWAT WGEN Statistics window allows the user to calculate the WGEN statistics based on the stored weather data and export it as an output file. The output format of such calculations is compatible with the SWAT WGEN database format. It looks like Figure 5.
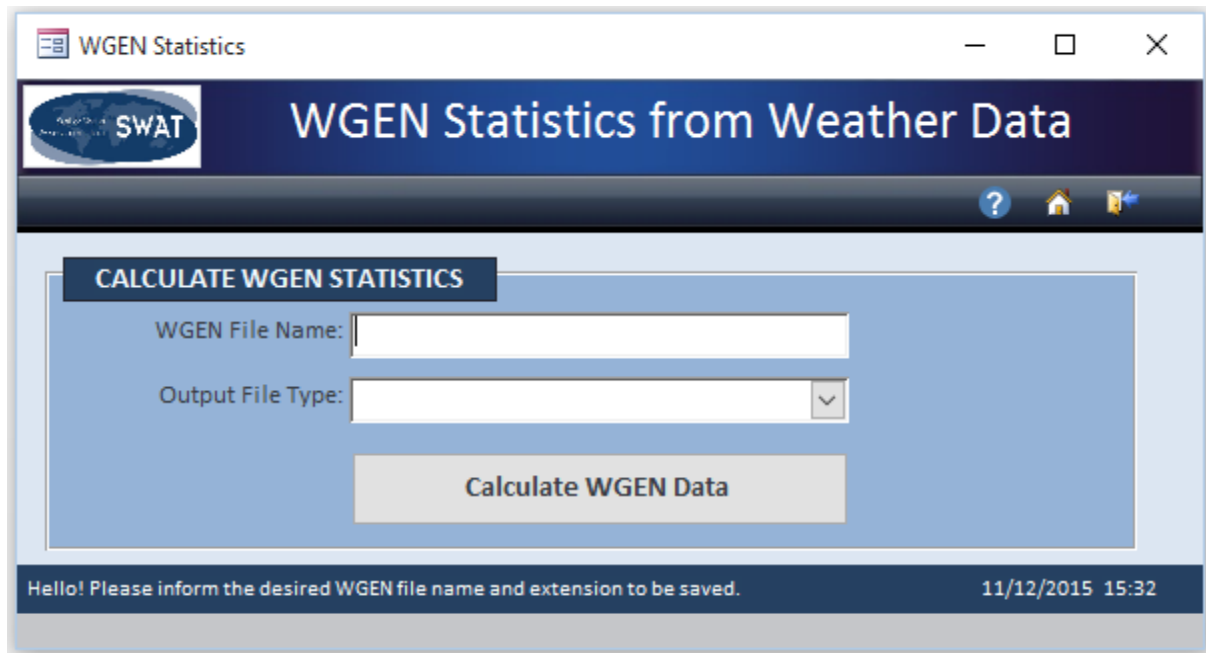
Figure 5 - The SWAT WGEN Statistics window.

The SWAT WGEN Statistics window body has the following information:

- A field called **"WGEN File Name"**, which stores the name of the output file to be created after the calculation of the WGEN statistics. If left blank, the name "WGEN" will be used.
- A field called **"Output File Type"**, which stores the extension of the output file to be created after the calculation of WGEN statistics. If left blank, the extension ".xls" will be used.
- A button called **"Calculate WGEN Data"**.

When the button **"Calculate WGEN Data"** is pressed, it will access all the selected weather data, calculate the WGEN statistics for the available stations at once and write them to the selected WGEN file name and extension. If the file already exists, a message will be shown to the user asking whether to proceed or not.

Some considerations regarding the WGEN statistics calculation:

1. The **RAIN_YRS** (number of years of maximum monthly half-hour rainfall) is currently not calculated by the application. A default value of RAIN_YRS = 10 is assumed for all weather stations;
2. The **RAINHHMX** (maximum half-hour hour rainfall in entire period of record for month) is estimated as being the average of 1/3 of the maximum recorded daily rainfall for that month.
3. The **DEWPT** (Average daily dew point temperature for each month) is actually the relative humidity (fraction). This is done as the SWAT model understands the DEWPT variable as the average daily dew point temperature for each month (°C) or the relative humidity (fraction) can be input. See the SWAT Input/Output Documentation for further details.

If any of the above mentioned considerations constrains your WGEN statistics, please consider updating these values yourself before uploading these data to your SWAT project.

vi.   The Help window

The Help windows brings the possibility of accessing some documents that may be helpful during the use of the Weather Database. It looks similar to Figure 6.

Figure 6 - The Help window.

The Help window brings access to the following documentation:

- The SWAT Weather Database Manual (i.e. this document);
- The 2012 SWAT Input/Output Documentation;
- The 2009 SWAT Theoretical Documentation, and;
- The 2012 ArcSWAT User's Guide.