WEPP/SWAT Future Climate Input File Generator: Instructions Manual

A simplified process for obtaining future climate inputs for the WEPP or SWAT models.

Prepared by: Joseph Trotochaud
Purdue University, Department of Agricultural and Biological Engineering
USDA-ARS National Soil Erosion Laboratory
West Lafayette, IN.

Purdue University is an equal opportunity/equal access institution.

Table of Contents

NOTE FROM THE AUTHOR:

Thank you for your interest in my project!

The following document details the use and construction of a purpose-built excel workbook (referred to herein as the macrobook) which can be used in conjunction with the MarkSim DSSAT Weather File Generator to simplify the creation of future climate data files for the WEPP or SWAT models. The macrobook is the result of extensive coding and validation using the WEPP model which can be found in the published work (Trotochaud, 2014). This method is intended for those that are conducting general impact studies and do not wish to spend the vast amount of time and resources to work with direct GCM output data. This method uses data from the IPCC 4th Assessment Report**. If high-accuracy, downscaled, IPCC 5AR climate data is desired for calculating absolute changes in sediment loss, water balance, or crop growth, other methods should be used.**

This is a supplemental work intended for use by those who wish to obtain future climate data using the methods detailed in Trotochaud, 2014. The purpose of this document is to provide further insight into the construction of the macrobook which is not included in the published work. Also presented are step-by-step instructions for the use of the macrobook for creating future climate files, as well as further explanation of functions not described in the published work. To reduce redundancy, not all information from the published work is included in this document, such as validation results and general conclusions from example applications.

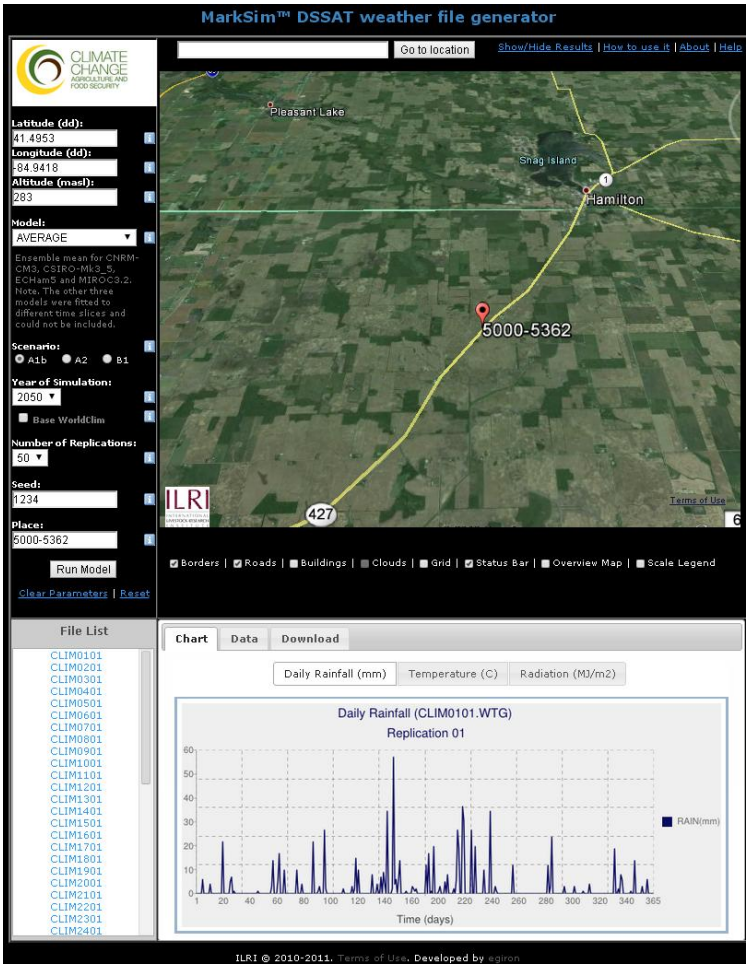
The macrobook is written in Microsoft Excel and uses VBA scripting to execute data manipulation tasks. Those with knowledge of VBA are welcome to modify the existing code in any way they see fit and may apply this method to other natural resource models. This is the first project I have ever completed using VBA, so forgive me if my methods seem crude or inefficient. Also, use these tools at your own risk. Although I am very confident in its functionality, I cannot guarantee that this document or the macrobook are free of errors.

I understand some people only care about one model or the other, so I have simplified the instructions by highlighting certain sections which pertain specifically to one model of the other. Sections highlighted in Green refer to statements or instructions specific to those interested in creating WEPP model inputs, while sections highlighted in Blue are for those interested in creating inputs for the SWAT model. Additionally, some sections of text may be **bold,** underlined, highlighted, or a combination thereof because I consider them particularly important. Remember these sections if nothing else.

Additional background on the project or the application of downscaled data in impact studies can be found in the published work.

RETRIEVING DATA AND FILE MANAGEMENT:

Before exploring the macrobook itself, you first need to acquire the downscaled future climate data from the MarkSim application. This can most easily be accomplished by accessing the online web application. If the web application does not work, the standalone version can also be used if you are willing to invest the time. The web application is shown below. It uses the familiar Google Earth application for choosing the location of interest, while the GCM, scenario, and time period selection is made through dropdown lists on the left-hand side. Once the parameters are chosen, selecting the **Run Model** button will downscale the selected data to you location and present graphical and tabular previews, as well as an option to download the data at the bottom of the screen. Additional documentation regarding the web application can be found by following the standalone link earlier in this section.



It is highly recommend that you choose to download data based on the AVERAGE model. Not only will this reduce the number of files you work with, but the IPCC recommends using an average of several models in any impact study (Wilby et. al., 2004).

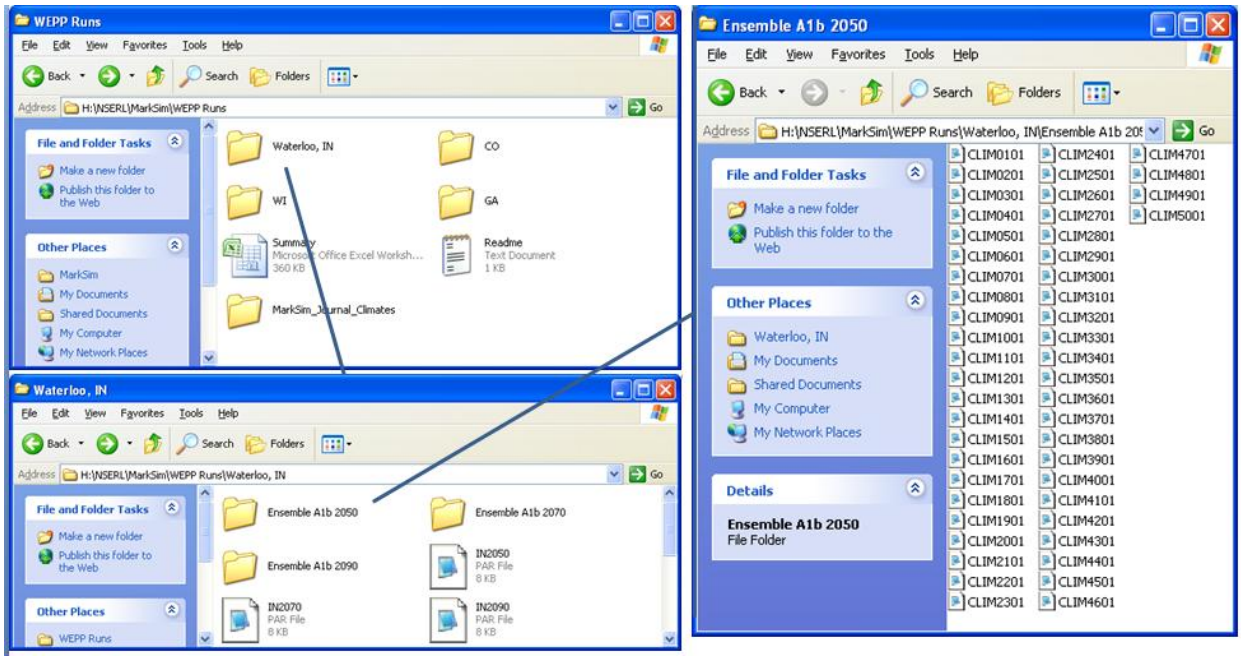
As you can see in the screen at right, multiple files are created based on the number of replications selected. Each file is a text file with daily time-series data on rainfall, temperature, and solar radiation for one year. The initial purpose of the macro sheet which was developed was only to organize the data so it could be fed into the .par file generator within the WEPP windows interface. It was later decided that the macrobook could instead be used to generate the .par file itself, thereby reducing the number of mouse-clicks by the user, as well as the allowing the incorporation of quality control and validation into the process. This resulted in redundant coding, but the results are the same as the WEPP .par generator while adding the advantage of diagnostic tools in the form of graphical comparisons of MarkSim output to historical .par files which come with the WEPP windows application. This function is explained in a later section. Further coding was done to create inputs for the SWAT model. As opposed to the WEPP climate files, the SWAT files are continuous daily data for several years. There are not diagnostic tools for creating SWAT files, since the nature of the

probabilistic MarkSim model would result in near-zero correlation with deterministic historical data. As such, only relative comparisons can be made with any certainty with this future data using the SWAT model.

As stated, MarkSim outputs each year as a separate text file with a .WTG extension. Some versions of excel do not recognize files with a .WTG extension, so the path name of each field has to have this .WTG extension replaced by .TXT. This is accomplished through the directory functions within Excel, but the files produced by MarkSim have to be organized in a certain manner as a consequence of the Macro coding. This is not difficult, but must be adhered to or else the macrobook will not work. The following rules MUST BE FOLLOWED when organizing your files.

- **All MarkSim output files must be in a single folder.**
- **Names given to these files by MarkSim cannot be altered.**
    - The names will be CLIM0101, CLIM0201, CLIM 0301, and so on. These eight characters cannot be modified in any way, nor can additional characters be added.
    - Changing CLIM0101 to CLIM0101a or A1b2050CLIM0101 will result in an end error in excel.
- **No other folders or files can be kept in the folder which holds the MarkSim output files.**
    - Doing so may result in the deletion of those files or folders. This is due to the fact that the macrobook makes a copy of all of the MarkSim files to change the .WTG tag to a .TXT tag. Once the new .TXT files are imported, they are deleted again to reduce redundancies.

If conducting an analysis which involves the use of multiple models, scenarios, and time periods, it can become difficult to remember naming of each folder, especially since the files contained within these folders have no identifying attributes to tell them apart. For this reason, I suggest a naming convention and folder hierarchy which worked for me. For each set of files downloaded by MarkSim, name the folder extracted-to based on the models, year, and location. For example, I was running simulations on a watershed neat Waterloo, IN using the ensemble means under the A1b scenario for the 2050, 2070, and 2090 periods. Here is what my folder looked like:



Another important point here is that the .par file created by the marcosheet will also need a folder designated, so a little thought into a folder hierarchy needs to be made ahead of time.

When you run the macrobook for WEPP outputs, you will be asked for the location of the historical CLIGEN .par file from the C:\WEPP\Data\climates directory. Instead of navigating all the way to that directory, I suggest copying the filing and putting it in the same folder as the MarkSim output folder. This makes it easier to locate the file when prompted, and also prevents potential corruption to the file in the event that something goes wrong with the macro. The macrobook needs the historical .par file because variables not modeled by MarkSim (such as wind) are assumed to be the same as the historical climate (Trotochaud, 2014). These variables are pulled directly from the original .par file for that location.

Now that you have the MarkSim output in a folder that you can easily find and the original .par file copied to the same parent directory as the MarkSim ouput, you are ready to run the macrobook.

NOTE REGARDING LATEST MARKSIM RELEASE:

During the course of this project, a new version of the MarkSim web application was released which works with data from the IPCC AR5 models. The user interface for the web application and the file format output by MarkSim are the same as for the AR4 models, so the methods detailed herein will still work with the AR5 data. The instructions are unchanged when using the WEPP/SWAT file generator for AR5 versus AR4 data.

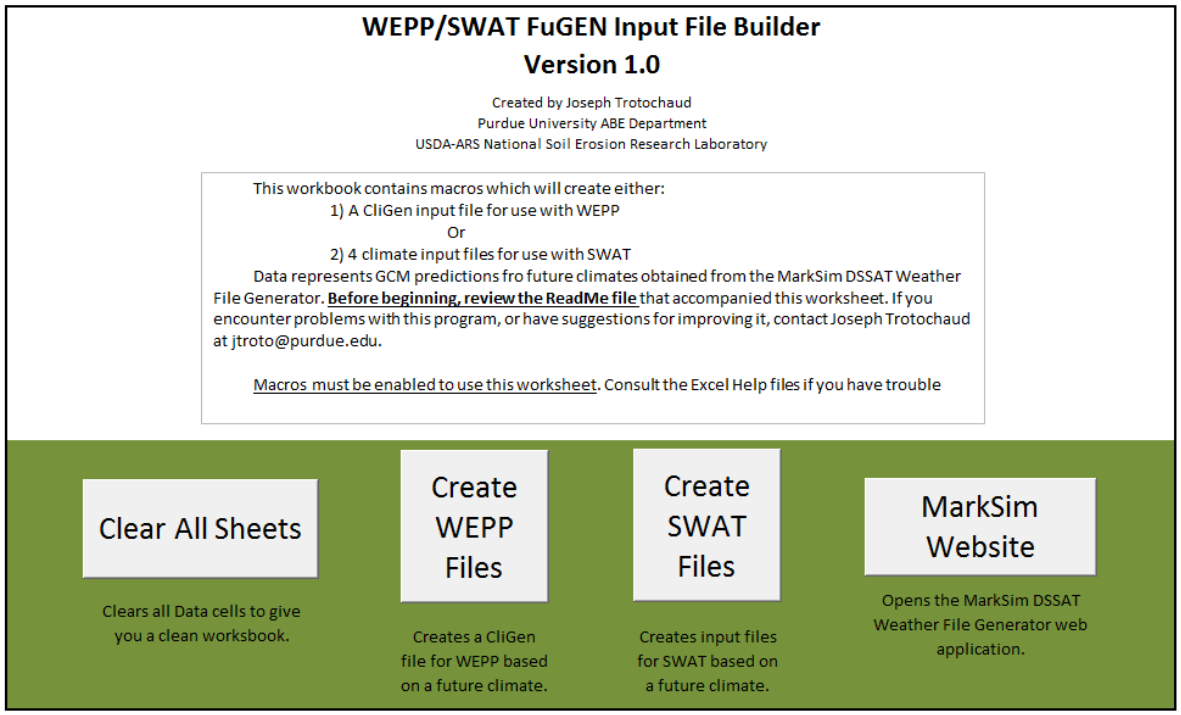
EXPLORING THE MACROBOOK:

If you are not interested in the inner workings, and are simply interested in obtaining future climate data, you can skip this section and go to INSTRUCTIONS FOR USE**.** The information in this section gives an overview of what the user sees when opening the macrobook, and details the inner workings of the Macros, as well as the reasoning behind their design and operation.

Excel Side

Open the macrobook and you will notice 9 tabs across the bottom of the page corresponding with a different sheet in excel. Each tab corresponds to a different stage in the process resulting in the creation of future climate files for both models.

The first sheet is the Welcome screen. This is the front-end of the macrobook and provides the casual user with all the tools needed to execute the macros. A brief description is given as well as the version and origin. There are three buttons across the bottom of the Welcome sheet. Command buttons have been placed into the macrobook to automate the process of importing and finalizing the MarkSim files. When you first open the macrobook, you will be presented with a welcome screen, shown below.



The Welcome tab contains four command buttons along the bottom of the screen.

Clear All Sheets	This button will clear any previously imported MarkSim data, as well as the paths you specify for folders and files. This button should be clicked before importing new data. Failure to do so will not result in significant slow-downs and possibly false reporting.
MarkSim Website	This button opens a hyperlinked URL which takes you to the Web Application where you download the MarkSim output.
Create WEPP Files	This button executes the macros for creating a .par file for use with CLIGEN inside of WEPP. Full instructions are included later in the manual.
Create SWAT Files	This button executes the macros for creating four SWAT input files for Precip, Tmax, Tmin, and SolRad. Full instructions are included later in the manual.

The next 4 sheets (Precip, TMax, TMin, SolRad) are used when the MarkSim output in imported to the macrobook. Each replication is placed in a separate column, while the rows correspond to days of the year. The default number of replications expressed across the top is 40, but the macros have been modified from their original fixed-replication capacity to enable the use of 1-99 different replications of data. These sheets are also used when conducting the statistical summaries. More about this process can be found in the Macro Side section later. For SWAT, these sheets are used to store the continuous daily data for individual parameters before exporting them as text files.

The Summary sheet is where the statistical summaries created by the macros are copied and displayed in tabular and graphical format for quality control and validation. Observing the graphical output allows the user to make sure that the macro executed properly, and also enables the user to determine how the MarkSim output differs from the historical .par file from the WEPP directory. This screen can also be used for validation; by downloading the 20th century model from MarkSim, a direct comparison can be made to the historical .par files which come with WEPP. Althought testing at multiple sites throughout the US showed that these fits were typically poor, it is possible that some locations will have lines that very closely fit, allowing absolute changes in runoff, erosion, etc. to be calculated with reasonable accuracy using WEPP.

The DP, Wind, ETC. sheet is used to combine the downscaled variables from MarkSim with the assumed historical variables from the historical .par file. Variables which MarkSim does not gerenate are assumed to be the same for the future period. This includes variables which require sub-daily data to create statistics for, such as wind patterns and time-to-peak distributions. A more complete discussion can be found in Trotochaud, 2014. Dew point temperature is also estimated using a delta-change method. Values for each month are formatted to the proper spacing, text style, and placement on this sheet in preparation of the creation of the new .par file.

The CLIGEN Format sheet is used to create the final CLIGEN .par file. To do this, the data from the DP, Wind, ETC. sheet is copied with each variable in a single row. The location data and a tag labeling this .par file as having been created are also inserted at this sheet. The macros then saves this sheet only based on a user-defined name to the parent directory. This is the sheet the user sees upon completion of the macros.

The Intermediate sheet is where individual files are imported before being copied to one of the four variable sheets. The paths for the MarkSim output folder as well as the historical .par file are also kept on and called from this sheet.

The Build sheet is used to aggregate data for the SWAT output files.

Macro Side

Macros are series of code written using the Microsoft Visual Basic for Applications (VBA) language. Macros allow the user to string together series of formatting and calculation commands which executed by hand would take long periods of time to complete. The VBA screen can be accessed in Excel by pressing **alt+F11**.

The process of creating a .par file is broken into two segments. The first segment involves the import, organization, statistical analysis, and graphical display of the MarkSim data. Each .txt file is read into the intermediate worksheet, where each data column corresponding to one of the four variables (Tmin, Tmax, Sol.Rad., or Precip.) is then copied to a corresponding sheet. The next .txt file is read into excel and placed in the next column on its respective sheet. If 10 .txt files are imported, this will result in the 4 variable sheets each having 10 columns in them.

The next series of macros, still considered within the first segment, conducts statistical summaries on each variable. These summaries include means and standard deviations on a monthly time-step for all variables, as well as a skew coefficient and two probability factors for precipitation. The VBA script which calculates the precipitation summaries is therefore very different and far more complex than for the other three variables. Once these summaries have been calculated, they are transferred to the Summary sheet, where they are converted to the proper units and displayed both graphically and in table form, concluding the first segment.

This first segment is observable when the user is running the macros. Writing the script differently could make it so that a single sheet is selected throughout the process, and none of the internal workings of the macros are visualized. However, debugging and testing was much more effective through visualization of the process.

The second segment is executed on the Summary sheet after the user has decided that no extreme outliers or statistical anomalies have contaminated the data. After clicking on the Continue with This Data command button, the statistical summaries for MarkSim are combined with the assumed historical data to create a complete .par file for use in WEPP. The finished .par file is then exported as a delimited .txt file with the .par file tag.

When creating inputs for the SWAT model, statistics do not need to be calculated and placed in a single file. Instead, each of the four variables required by SWAT are written into separate .txt files which hold several years of continuous daily data. As such, the SWAT code is much simpler. It aggregates the multiple output files from MarkSim in a similar manner as creating the .par file, but does not modify the data in any way. The raw output from MarkSim is just organized and written to .txt files using the macros. While this process does not take very long when done by hand, these macros do speed up the process of creating multiple replicates.

The entire macro process is automated, requiring only a few inputs from the user which are prompted at certain points in the process. The intention of this was to create a method with a very low learning curve with as few mouse-clicks as possible. The importing of each individual .txt file is the most time-consuming operation, and can take up to a minute to complete. Further decomposition of the macros is not included here, but the user is invited to inspect the code by opening the VBA editor. Be warned, though, that changing even a single character in the code may cause the macro to not work at all, as is the nature of VBA.

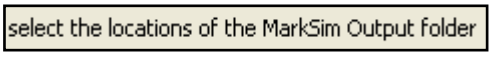
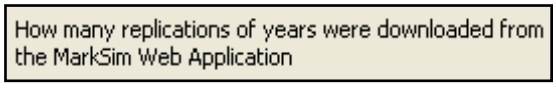
INSTRUCTIONS FOR USE:

Before Starting: Create a project folder where the input and output files will be stored using the methods recommended in the RETRIEVING DATA AND FILE MANAGEMENT section. Also, make sure that the printer's page orientation in Excel is set to **landscape**, otherwise some windows will be scaled oddly or tables will be cut off.

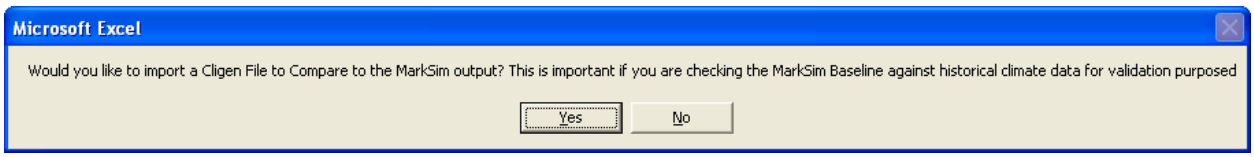
Creating Future Climate Data for the WEPP Model

The following instructions will aid the user in creating future climate inputs for the WEPP model based on the MarkSim DSSAT Weather Generator.

1. Copy the historical CLIGEN .par file from the WEPP\Data\climates subdirectory into the new folder
2. Download 50 repetitions of the future climate data from the MarkSim Website (see **Getting Data from the Web Application** if additional information is needed)
    a. **NOTE:** More replications may be downloaded and used, but testing at multiple sites throughout the US determined that 50 replications showed the best correlation to historical values (Trotochaud, 2014).
3. Extract the zipped MarkSim output files to a new folder within the Project Folder.
4. Open the excel workbook and select the sheet named "Welcome"
5. Press the **Clear All Sheets** button to make sure no residual data remains in the file.
6. Press the **Create WEPP Files** button and follow the on-screen prompts to create your new CLIGEN file.
    a. You will see the following prompts:

Prompt Dialogue	
	This is the unzipped folder from **Step 3**
	This is the .par file from **Step 1**.
	The number of replications cannot exceed the number generated by the MarkSim application. See **Step 2.**

    b. Once these prompts have been answered, you will see the statistical summaries being calculated for each variable. This process can take anywhere from 10 seconds to 3 minutes depending on the speed of your computer.
7. Once the statistical summaries have been calculated, the following prompt will appear:



    a. Selecting **Yes** will display the historical .par file summaries on the graphs alongside the MarkSim output. This is only necessary if comparing the historical WEPP climate to the

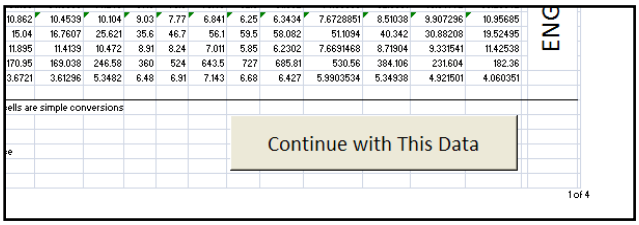
MarkSim 20th century output for validation purposes. See the next section ***Comparing MarkSim Historical Model Outputs*** for more details.

b. If you do not wish to display the historical data, select **No**.

8. The following prompt indicates the first segment of the program is complete:

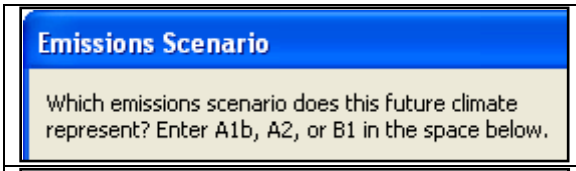
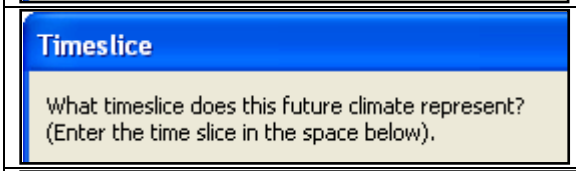
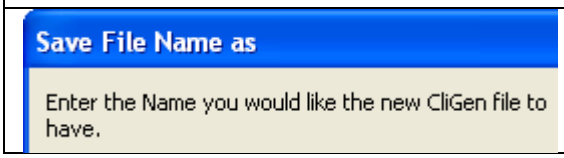
a. At this point, observe the tabular and graphical outputs for anything which seems odd. Extreme outliers affecting the data would result in spikes, particularly in the precipitation data.

9. If you are satisfied with the numbers, click on the **Continue with This Data** command button.

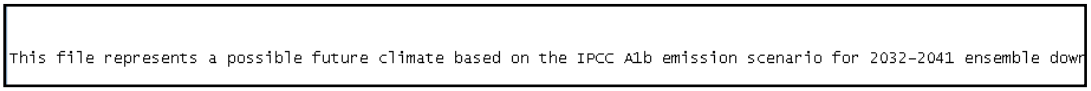


10. After a few simple prompts, you will now receive several prompts asking for details about the MarkSim data. These inputs are used to create a line of text at the bottom of the .par file which indicates where the file came from and what it represents.

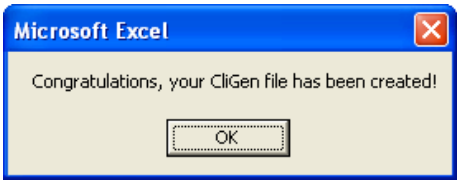
a. Each of these inputs is a text string, so syntax is not an issue.

	This indicated the SRES emission scenario from the IPCC 4AR selected in the MarkSim application.
	This indicated the year selected in the MarkSim application. Remember that this is a 10-year average, so you may identify 2050 as 2050 or 2046-2055.
	This is the **Folder** location the new .par file will be stores.
	This is the file name that will be given to the new .par file. This is also the name that will appear when loading the file in WEPP.

b. The result will appear as follows in the .par file created



11. If all no errors are encountered, the following message will display, indicating that the file with name and location specified in **Step 10** was created.



12. Repeat steps 1-11 using a new copy of the mcarobook for each desired future period as well as the MarkSim 20th century ouput.

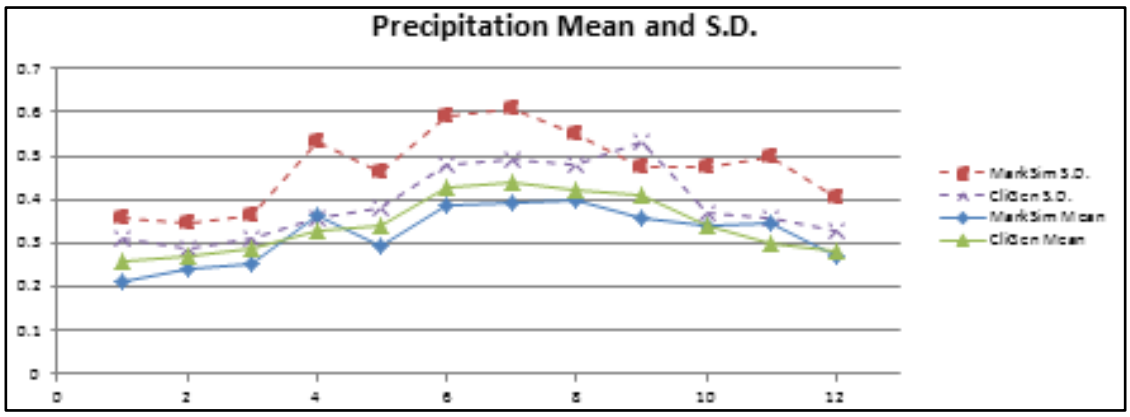
Now you are ready to use your future climate data in WEPP! You can either navigate to the new .par file from WEPP, or move it to the data folder in the C drive on your computer.

At this point, the excel file has actually been renamed and saved as a .txt format. If you wish to save this workbook for future use, you will need to **save as** and select **Macro-Enable Workbook** to retain the functionality of the Macros.

Comparing MarkSim Historical Model Outputs (WEPP Only)

As part of the validation process when developing the macrobook, comparisons were made between 20th century outputs from MarkSim and the historical .par files which came with the WEPP model. For more information on the results of this validation, refer to Trotochaud, 2014.

It was decided to leave these validation tools intact in the macrobook so that users could see if the MarkSim model reproduced historical weather patterns well enough for their particular location. While the validation in the published work was more thorough, the validation tools here just include line graphs shown on the Summary sheet which allow for visual inspection. An example of the precipitation graph is shown below:



In this case, the means match fairly well, while the standard deviations are not so good. In general, if the lines match up very closely, then absolute changes in WEPP or SWAT model outputs can be calculated by comparing future climates from MarkSim with historical data.

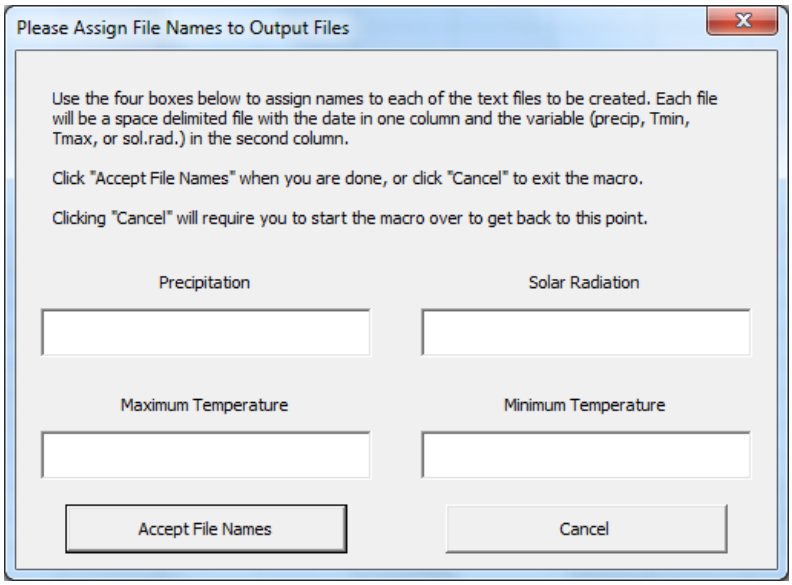
Creating Future Climate Data for the SWAT Model

The following instructions will aid the user in creating future climate inputs for the SWAT model based on the MarkSim DSSAT Weather Generator.

1. Download 10 repetitions of the future climate data from the MarkSim Website (detailed step-by step for this process can be found later in the document)
    a. **NOTE:** This process will only create a single 10-year slice of continuous data. If a longer period is desired, additional data will need to be downloaded and the process repeated. This is described in the ***SWAT Special Notes*** section found later
2. Extract the zipped MarkSim output files to a new folder within the Project Folder.
3. Open the excel workbook and select the sheet named "Welcome"
4. Press the **Clear All Sheets** button to make sure no residual data remains in the file.
5. Press the **Create SWAT Files** button and follow the on-screen prompts to create your new SWAT input files.
    a. You will see the following prompts:

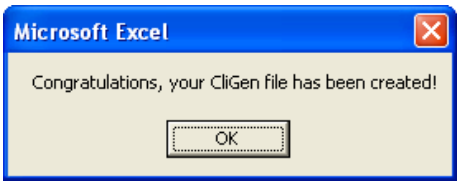
Prompt Dialogue	
Select the locations of the MarkSim Output folder.	This is the unzipped folder from **Step 2**
How many replications of years were downloaded from the MarkSim Web Application?	The number of replications cannot exceed the number generated by the MarkSim application. See **Step 1.**
What is the starting year for this data?	This depends on the number of years downloaded as well as the modeling year selected. See ***SWAT Special Notes*** if unsure of starting year.

    b. The following screen will then appear



c. After accepting the file names, you will then be prompted to select the location you would like the four new files to be saved.

6. If no problems are encountered you will receive the following message:



7. Repeat steps 1-6 using a new copy of the macrobook for each desired future period as well as the MarkSim 20th century output.

The input files can now be found in the specified folder.

SWAT Special Notes

This spreadsheet was designed specifically for WEPP, but it was determined that only minor modifications needed to be made to allow for its use with the SWAT model. The difference between the WEPP and SWAT models are that the WEPP model uses a stochastic weather generator to create single-year data based on monthly means, whereas the SWAT model uses continuous daily data. MarkSim produces continuous daily data in single year segments, which makes it nearly-ideal for use with SWAT. I say nearly-ideal because of the way in which MarkSim generates data.

This is all detailed in the MarkSim documentation, but a short example will cover the important parts. Let's say you need want data for the 2020-2100 time period. MarkSim generates data based around a single year, so if you select 2050 as the year of simulation, "*The data produced will simulate daily weather data representative of the average of 5 years to either side of the year selected (10 year slice)*"(MarkSim Web Application *How to use it* page) Meaning the files you receive for 2050 will represent potential future climates during the 2046-2055 time period. Therefore, by selected 10 replicates for 2050, you can create a 10-year continuous set of data ranging from 2046-2055.

The above example is how the macros in the worksheet were written, to use 10 year slices. The problem comes with longer periods of continuous simulation, since **stacking several 10-year slices may cause step-wise patterns to be observed over several decades in 10 year steps**. Put another way, the years on the edges of the slice would not be as robust as the years in the center of the slice. If we think about the 2050 example from the previous paragraph, years 2045 and 2046 may be significantly different since the 2045 data is based on 2040 and the 2046 data is based on 2050. This has not been tested, but logically this type of result can be expected. In order to eliminate this problem, you would have to download smaller numbers of replicates (say, 3-5 years), run the macros, and then manually stack the resulting input files. The most accurate method would be to download only one year at a time, but these two options would be very time consuming, which defeats the whole point of this work.

As a recommendation, the best policy may be to download decadal data centered on the fifth year and then present model results in terms of average annual results for each decade. This is a common practice in literature, and would avoid the potential for step-wise results.

A second issue is the replication of SWAT model results. WEPP uses a stochastic approach, so it generates several years of potential future climates and then takes an average. To do this in SWAT, you will need to download multiple sets of 10-year slices. This requires changing the seed number in the MarkSim Web Application so that you aren't downloading the exact same 10 year slices over and over again (see: **Getting Data from the Web Application**). This also means you will have to run the macros multiple times to get different replicates. The advantage of Excel is that once the macros have run, you can modify the data more specifically, so you can modify the data for your own means, and possibly find other ways to create multiple replicated by downloading and importing more than 10 replicates using the macros.

RECOMMENDED USAGE

Analysis of several sites throughout the US has shown that using the MarkSim model in the manner described here does not tend to reproduce historic weather patterns with enough certainty to calculate absolute changes in natural resource model outputs (Trotochaud, 2014). The historical CLIGEN files which come with WEPP cannot be used when comparing future data generated with this method.

In order to use this method for assessing future changes in natural systems due to climate change, the MarkSim 20th century data must be used as the baseline climate. The process for creating this baseline is no different from creating future climate inputs as described in the previous instructions section. The difference comes when downloading the data from the Web Application, which is detailed in the next section: **Getting Data from the Web Application**.

To conduct impact assessments using this method, the future climates must be compared to the MarkSim baseline in terms of percent change only. If comparisons are made to direct historical data, extreme and unrealistic changes in some model outputs may be observed. If changes are made in absolute terms (such as kg/ha soil loss or cfs streamflow) it must be noted that these changes will be in relation to the MarkSim baseline climate, and not the true historic observation. Stated absolute changes based on the baseline climate will be misleading due to amplification of actual changes. This is difficult to explain with an example, but just know that **COMPARISONS OF FUTURE CLIMATES MUST BE MADE IN RELATION TO THE MARKSIM 20TH CENTURY OUTPUT IN RELATIVE TERMS ONLY!!!** Failure to follow this rule will result in misleading, inflated, and generally false results.

A summary of the full process for creating future climate data using this method follows. This would make a useful checklist for first-time users.

1. Download MarkSim 20th century output from Web Application
2. Use MarkSim 20th century output to create the baseline climate using the macrobook
    - (Optional) Compare to historical .par file
3. Download MarkSim 21st century outputs for several time periods of your choosing
4. Use the macrobook to create future climates
5. Run WEPP or SWAT under baseline climate to obtain “historical” model output
6. Run WEPP or SWAT under future climates to obtain future model outputs
7. Compare various future periods to “historical” output in relative terms (% change)

GETTING DATA FROM THE WEB APPLICATION

It will be necessary to download several outputs from the MarkSim web application. Multiple future scenarios and time periods must be downloaded as well as the 20th century output. The following lists the setting to check when downloading each output.

- Latitude/Longitude/Altitude
  - Using the search bar at the top of the application or clicking on the map will fill in these boxes. I recommend filling in the altitude by clicking the map.
- Model
  - Select **AVERAGE**
- Scenario
  - For future climates: download one of each of the 3 scenarios.
  - The 20th century climate will be the same regardless of scenario selected
- Year of Replication
  - For future climates: download several different years of simulation (e.g. **2046** for 2041-2050, **2066** for 2061-2070, **2086** for 2081-2090)
  - 20th century climate: check **Base WorldClim**
- Number of Replications
  - WEPP: **50**
  - SWAT: **10**
    - **30** for the 20th century climate
- Seed:
  - This is how multiple replicated can be downloaded for use with the WEPP model. Setting to **0** will result in a random see.
- Place
  - Leave **Blank**

The year of simulation and scenario are the only setting that should be varied. If downloading three time periods for all three scenarios, you can expect 10 different zip files to be generated by the Web Application, as illustrated in the following table.

Scenario	Time Period			
	20th Cen.	2041-2050	2061-2070	2081-2090
A1b	X	X	X	X
A2		X	X	X
B1		X	X	X

This means you will have to change the setting on the Web Application and click **Run Model** 10 times. For SWAT, multiple replications of each future time period will be needed. The number of replications is up to the user, but if that number were 3, there would be 28 total zip files.

REFERENCES:

1. Wilby, R. L., Charles, S. P., Zorita, E., Timbal, B., Whetton, P., & Mearns, L. O. (2004). Guidelines for use of climate scenarios developed from statistical downscaling methods.
2. Trotochaud, J., Flanagan, D.C., Engel, B.A., (2014.) A Simple Technique for Obtaining Future Climate Data Inputs for Natural Resource Models. (Working)