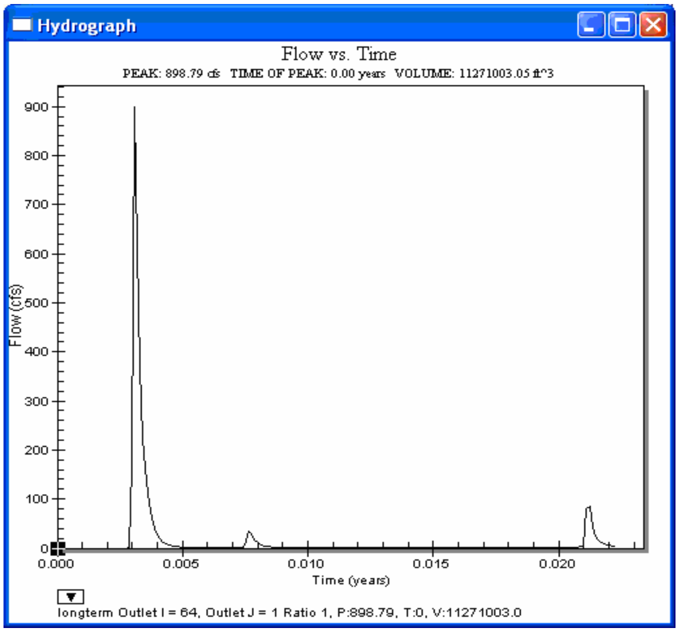
v. 9.0

WMS 9.0 Tutorial

GSSHA – Applications – Long Term Simulations in GSSHA

Set up and run a long-term simulation in GSSHA



Objectives

Learn how to set up a long term (weeks or months-long) simulation that includes several rainfall events along with an evapotranspiration model. In this tutorial, you learn how to set up a precipitation file and a hydrometeorological (HMET) file, both of which are required for long-term simulations.

Prerequisite Tutorials

- GSSHA – Modeling Basics – Developing a GSSHA Model Using the Hydrologic Modeling Wizard in WMS

Required Components

- Data
- Drainage
- Map
- Hydrology
- 2D Grid
- GSSHA

Time

- 30-45 minutes

1 Contents

2 Introduction

In this tutorial you will see how to set up and run a long-term simulation in GSSHA. You will begin with an existing project file. Long-term simulations typically involve running several rainfall events along with the evapotranspiration model for weeks to months. There are two key parts to running a long-term simulation. The first is to set up the precipitation file for multiple events, and the second is to set up the evapotranspiration model with its hydrometeorological (hmet for short) data.

3 Open an Existing GSSHA Project

Open a WMS project file for the Judy's Branch watershed. This model has been set up to simulate a single rainfall event. We will modify the project and perform a long term simulation.

1. In the ***2D Grid Module*** select ***GSSHA | Open Project File…***
2. Locate the ***GSSHA Distributed Hydrologic modeling*** folder in your tutorial files. If you have used default installation settings in WMS, the tutorial files will be located in ***\My documents\WMS 9.0\Tutorials\\.***
3. Browse and open the file ***\GSSHA Distributed Hydrologic modeling\LongTerm\Judys.prj***
4. Save the project with a different name ***\GSSHA Distributed Hydrologic modeling\Perwsonal\LongTerm\ longterm.prj***

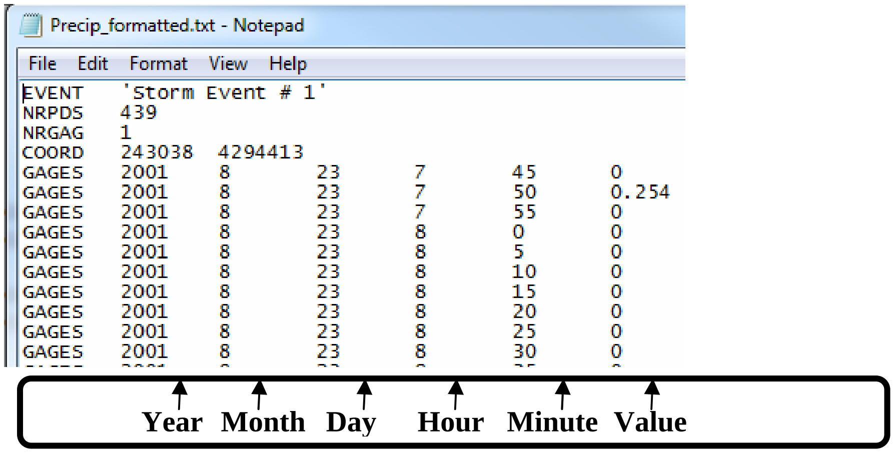
4 Format Data for Long-Term Simulation

A long-term event typically consists of multiple rainfall events, often with several rain gages. Multiple gage events can either be setup using WMS or using the *Time Series Data Editor* which is a convenient tool developed for managing such time series data.

Minimize the WMS window and from the *Start* menu of your computer, open the *Time Series Data Editor.*

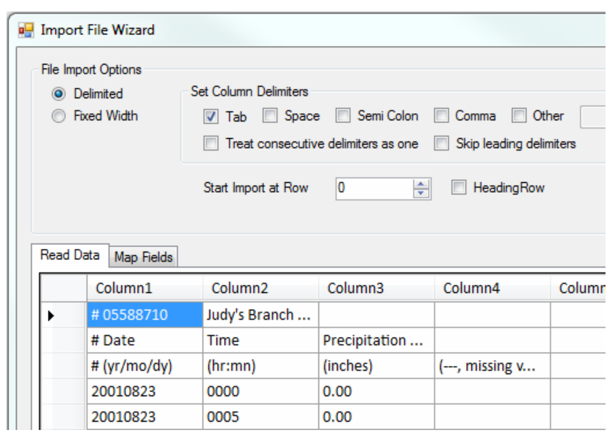
4.1 Format the Precipitation Data

Precipitation data preparation for GSSHA involves formatting as shown in the following figure and saving the formatted data as a gage file (*.gag).

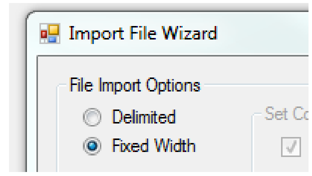


The raw data often does not come in this format and needs some processing before it can be used in a *.gag file. Follow these steps to get the raw data formatted:

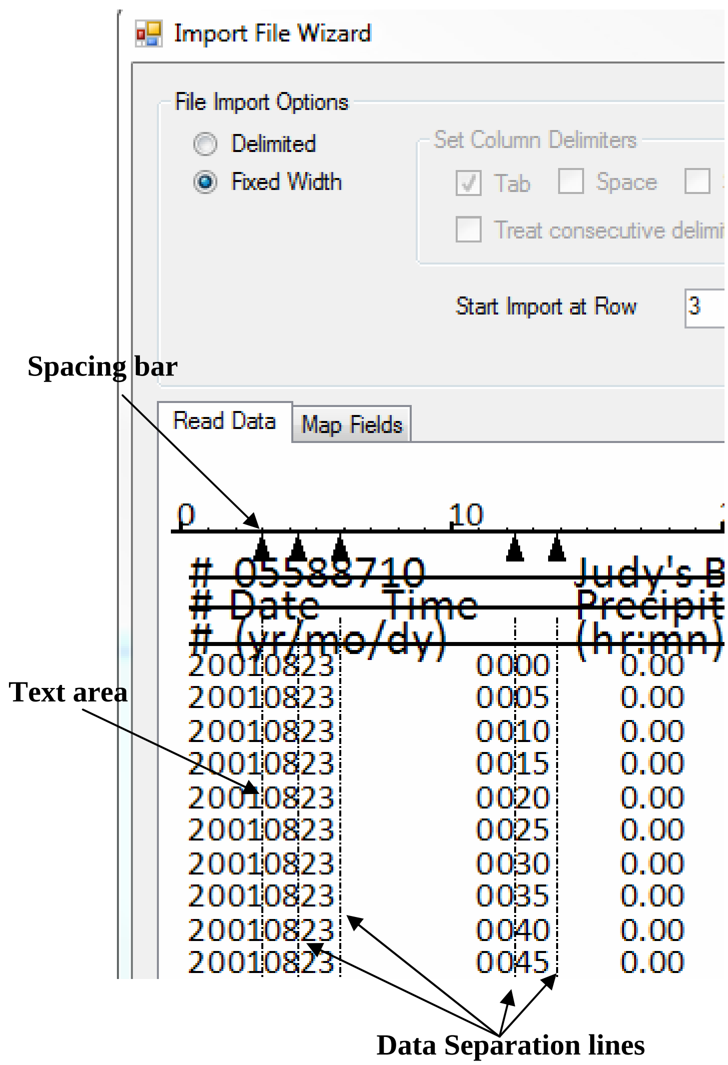
1. In the *Time Series Data Editor* window, select ***File|Open.***
2. Open the file ***\GSSHA Distributed Hydrologic modeling\RawData \JudysBranch\Long_Term_Simulation\ Precip_data\precip_raw.txt***.
3. This will open the data into the *Import File Wizard.*



4. Select *Fixed Width*

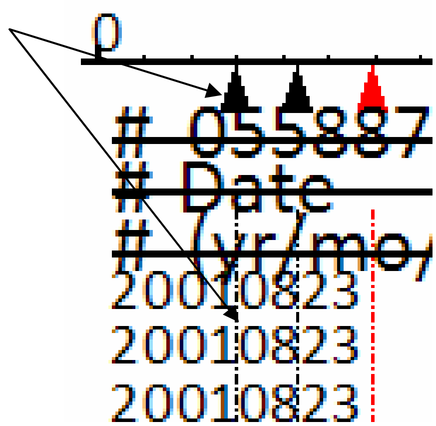


5. Make sure that you are in the *Read Data* tab.
6. Enter 3 for *Start Import at Row* field to clear out three lines of heading text that is in the data. This number represents the row number from which the actual precipitation data begins and means that nothing from the first three lines will be imported. Leave the *Heading Row* option unchecked.
7. Now separate the columns by inserting vertical lines that represent the location to separate columns. This can be done in either of the following two ways:
   - Click on the text area OR
   - Click on the spacing bar (Horizontal line with numbers 0, 10, 20 etc) at the top of data

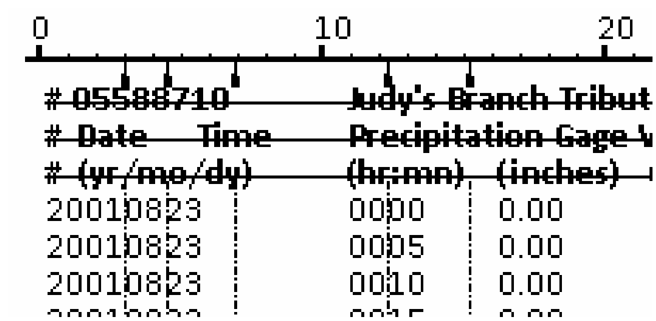


8. If you clicked at a wrong location, you can drag the line to the desired location. To do this click on the vertical line or the arrow head at the top of the line which will turn to red once selected. Then while holding the mouse down drag the line/arrow head and move to the desired location

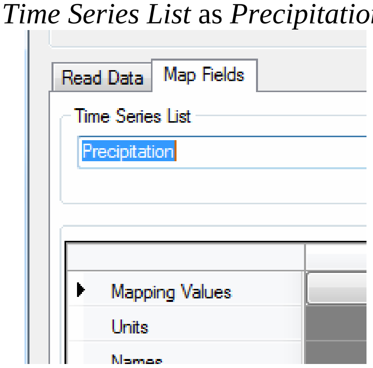
Click and drag the line or the arrow head to move the line



9. Make sure that you have inserted the column separators such that *Year*, *Month*, *Day*, *Hour*, *Minute* and *Value* are in separate columns, See the following figure.



10. Then click *Next* which will take you to the *Map Fields* tab.
11. Enter the name for *Time Series List* as *Precipitation.*

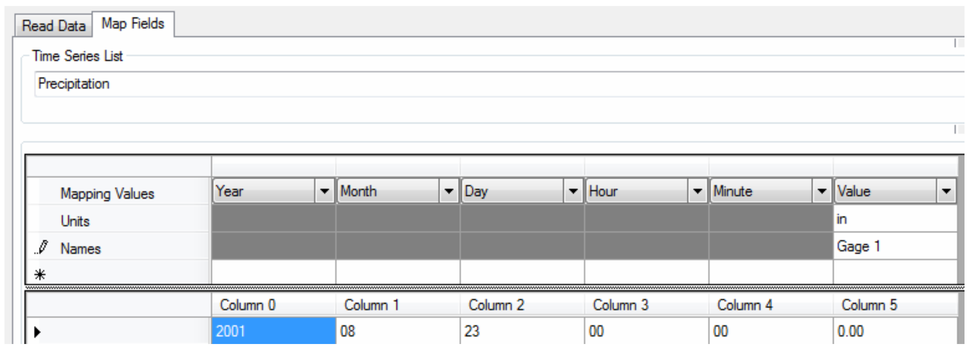


12. Make sure that the data is properly separated into the columns. If they are not separated properly, you can click *Back* button and modify it.
13. Now map each column as shown in the following table:

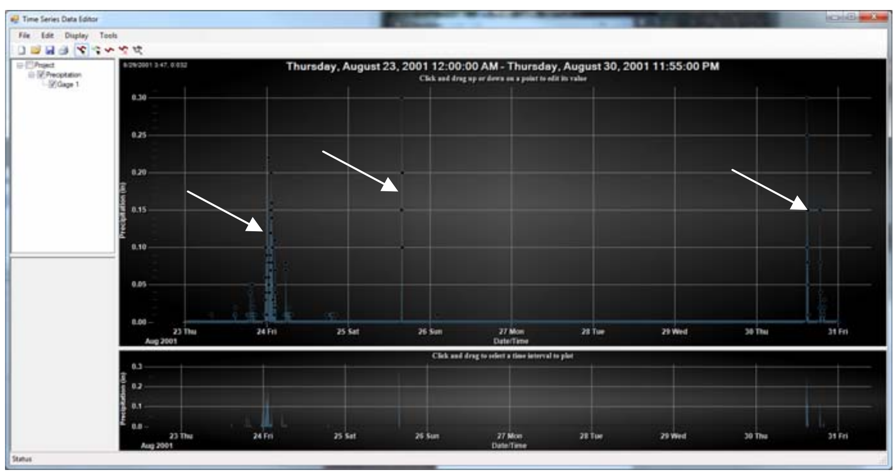
Column	Mapping Data

Column 0	Year
Column 1	Month
Column 2	Day
Column 3	Hour
Column 4	Minute
Column 5	Value

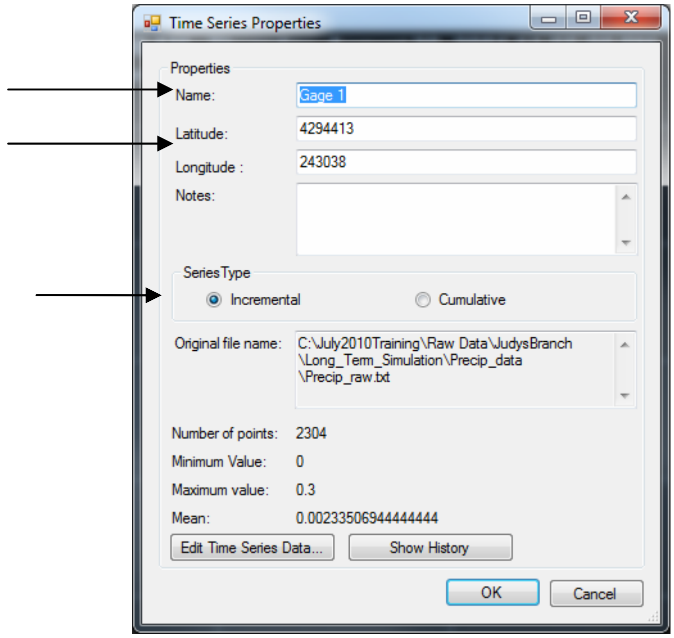
14. For the *Value* (Column 5), enter *In* to define the unit and *Gage 1* for the name. See the following figure and compare your mapping:



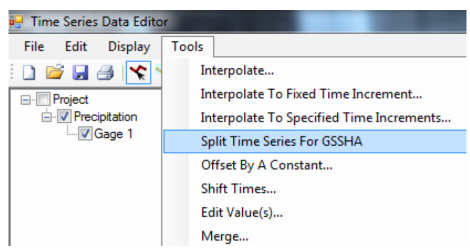
15. Click OK to close the *Import File Wizard.*
16. You can now see the data plotted in the form of a time series and listed as Time Series on the project explorer. The storms are pointed by the arrow heads in the following figure.



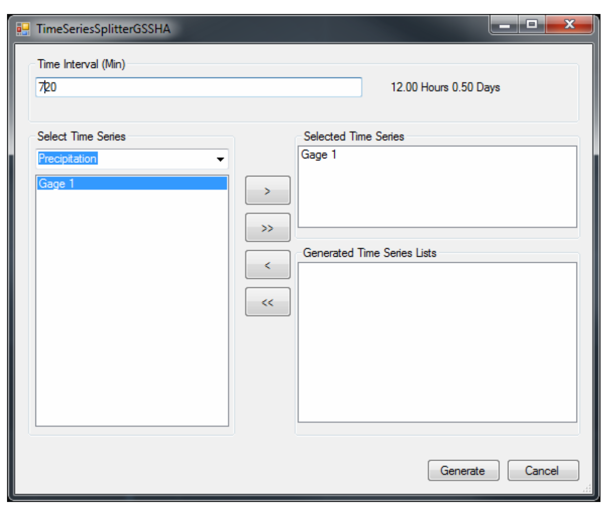
17. The data you just imported is a record of precipitation over about a week's time. Out of this data, we will exclude the times when there was no rainfall for a considerable duration. In other words, we will need to isolate the storms into separate events.
18. On the project explorer, click on *Gage 1* and select ***Edit|Properties.*** Enter the coordinates for gage location as Latitude = 4294413 and Longitude = 243038.
19. You can see a brief statistics of the data such as Min, Max, Mean etc
20. Make sure *Incremental* is selected and click OK.



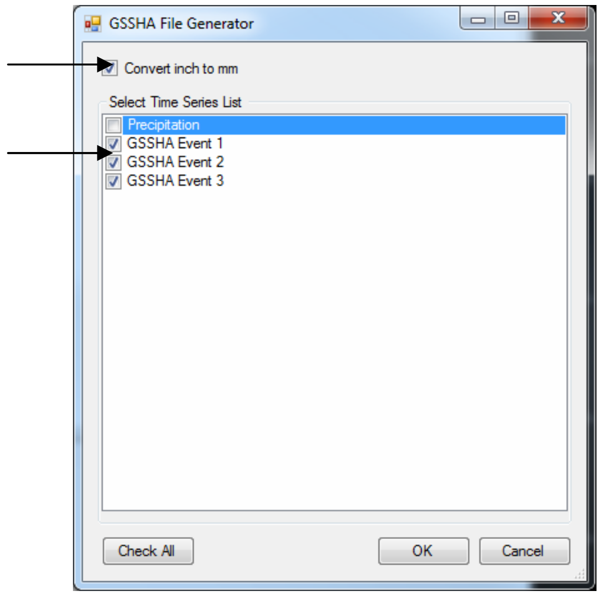
21. Select ***Tools|Split Time Series for GSSHA.***



22. Enter 720 minutes (12 hrs) for the time interval, which is the duration of no rainfall used as a criterion to separate the storms into individual events. In other words, if there is no rainfall for 12 hours after a storm we assume that the storm has ended.
23. Highlight *Gage 1* and click  button to select the data and click *Generate.*



24. This will populate a list of different events on the project explorer. All these events are individual storms each at least 12 hours apart. Now, we are ready to export the data as a gage file to be used in GSSHA.
25. Select ***File|Save As.*** Save the data as ***\GSSHA Distributed Hydrologic modeling\Personal\LongTerm\ precipitation.gag.***
26. Click the *Save* button. This will open *GSSHA File Generator* dialog.
27. Toggle *Convert inch to mm* at the very top of the dialog which will convert the precipitation data to mm since GSSHA requires the precipitation data to be input as mm.
28. Toggle the check boxes adjacent to the three storms named *GSSHA Event 1, GSSHA Event 2 and GSSHA Event 3*



29. Click OK.

This data is now formatted properly and ready to use in GSSHA. Do not close the *Time Series Data Editor* yet. We will use it one more time in the following section to format the hydrometeorological data.

In *Time Series Data Editor*, select ***File|New.*** Select No when prompted to save.

4.2 Format the Hydrometeorological Data

Hydrometeorological data are used in GSSHA to determine how the soil moisture is affected by atmospheric conditions. The hydrometeorological data is used to drive the evapotranspiration model which is particularly important during the time between events when it is not raining. In the following steps we will create a file that contains all the hydrometeorological data for the same period as the precipitation data.

1. The HMET data we will be using here is extracted from a spreadsheet ***\GSSHA Distributed Hydrologic modeling\RawData\JudysBranch\Long_Term_Simulation\Hmet_data\ Hmet_raw.xls***.
2. Open this file in Excel.

GSSHA needs the following hydrometeorological information from this data:

Date	in "YYYYMMDD" format, Example: "20010823" is August 23, 2001
Hour	in "????z" format, Example: "0100z" is 1:00 AM zulu time, the z stands for zulu, and is needed
Barometeric Pressure	in decimal value with inches as the unit, Example: "29.92"
Relative humidity	in percent value, Example: "54"
Sky Cover	in 8ths of the sky that is covered, Example: "0" means no clouds, "4" is halfway covered, and "8" is completely overcast
Wind Speed	in knots, with direction and unit label, Example: "21006KT" is wind from 210 degrees at 6 knots
Temperature	in degrees Celsius, Example: "32" is 32 degrees Celsius
Direct Radiation	W h m^{-2}
Global Radiation	W h m^{-2}

The Barometric pressure, relative humidity, Sky cover and Wind speed are in the first sheet (named KBLV_Scott) whereas the two radiation parameters are in the second sheet (Scott_radiation_2001).

3. Since the two sets of data in the two sheets have a different time scale (although they are for the same length of time), we will have to import these data individually to the *Time Series Data Editor.*

Note: If your data has the same start/finish time and same temporal resolution (Same time steps), then you can import all the data at once.

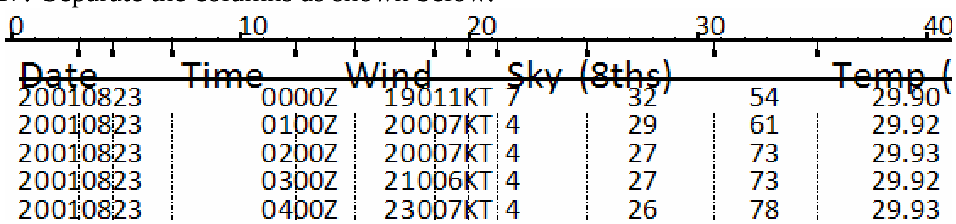
4. In Excel, create a copy of this data by saving the workbook as ***\GSSHA Distributed Hydrologic modeling\Personal\LongTerm\Hmet_Raw.xls.***
5. Switch to the first sheet which is named ***KBLV_Scott***. Delete all other column except the ones shown in the following figure (Right click at the column header and select delete)

	A	B	C	D	E	F	G
1	Date	Time	Wind	Sky (8ths)	Temp (C)	RH%	Altimeter (Inches)
2	20010823	0000Z	19011KT	7	32	54	29.90
3	20010823	0100Z	20007KT	4	29	61	29.92
4	20010823	0200Z	20007KT	4	27	73	29.93
5	20010823	0300Z	21006KT	4	27	73	29.92
6	20010823	0400Z	23007KT	4	26	78	29.93
7	20010823	0500Z	22004KT	4	26	78	29.94

6. Select ***File|Save as*** and save this Sheet as a **TEXT** file in ***\GSSHA Distributed Hydrologic modeling\Personal\LongTerm\Input1.txt.***
7. Click *OK* and Click *Yes*
8. Similarly switch to second tab in the spreadsheet (***Scott_radiation_2001***) and delete all other columns except the ones shown in the following figure.

	A	B	C	D	E	F
1	year	mo	day	hr (Z)	direct rad	total global rad
2	2001	8	23	00	0	41.99586496
3	2001	8	23	01	0	0
4	2001	8	23	02	0	0
5	2001	8	23	03	0	0
6	2001	8	23	04	0	0

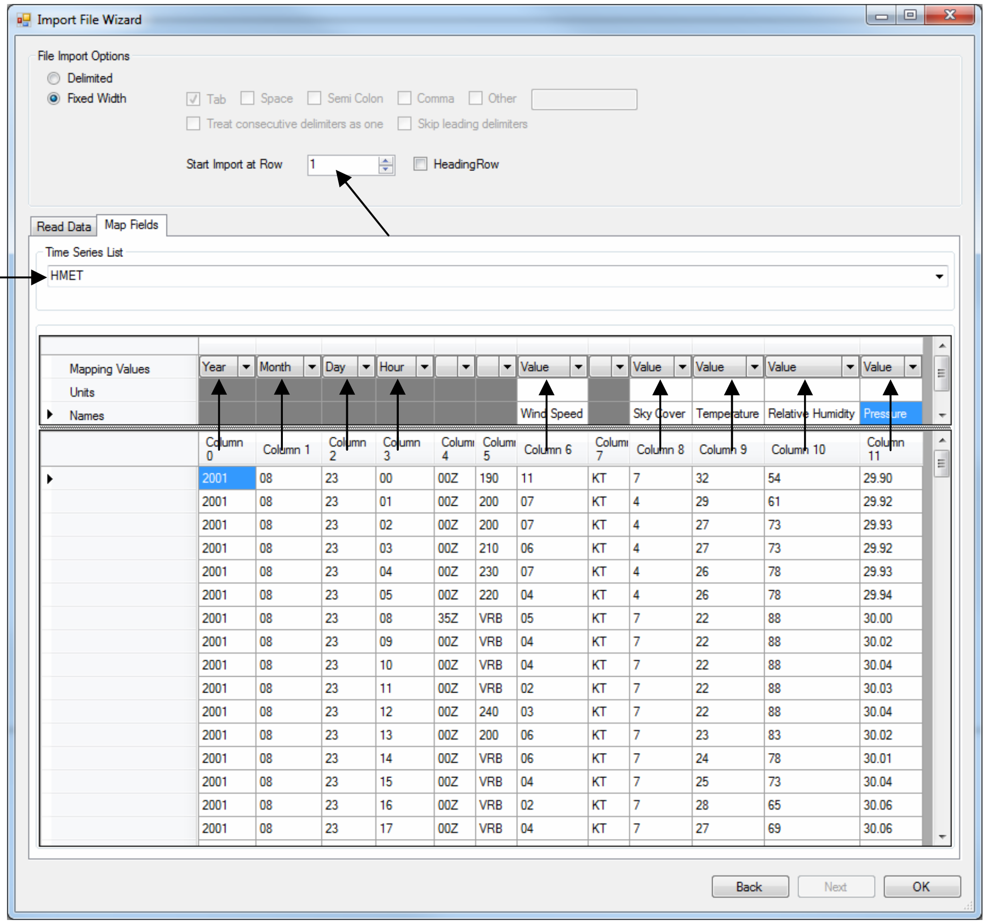
9. Select ***File|Save as*** and save this Sheet as a **TEXT** file in ***\GSSHA Distributed Hydrologic modeling\Personal\LongTerm\Input2.txt.***
10. Click OK and click Yes.
11. Close Excel and select No when prompted to save changes.
12. Go to the *Time Series Data Editor*.
13. Select ***File|Open*** and open file ***\GSSHA Distributed Hydrologic modeling\Personal\LongTerm\Input1.txt.***
14. This will bring the *File Import Wizard.*
15. Select *Fixed Width.*
16. Specify *Start Import at Row* to be 1.
17. Separate the columns as shown below.



Note: The *Date* column should be separated into Year, Month and Day. Initial two digits in the *Time* column represent hours. The fourth and fifth digits on the *Wind* column represent wind velocity, column *Sky(8ths)* is sky cover, column *Temp* is temperature, column *RH%* is % Relative humidity and column *Altimeter(Inches)* is barometric pressure.

18. Click *Next*
19. Enter *HMET* for *Time Series* List name.
20. Map the fields as shown in the following figure and enter the names.

Column	**Mapping Data**	**Field Names**
Column 0	Year	
Column 1	Month	
Column 2	Day	
Column 3	Hour	
Column 6	Value	Wind Speed
Column 8	Value	Sky Cover
Column 9	Value	Temperature
Column 10	Value	Relative Humidity
Column 11	Value	Pressure

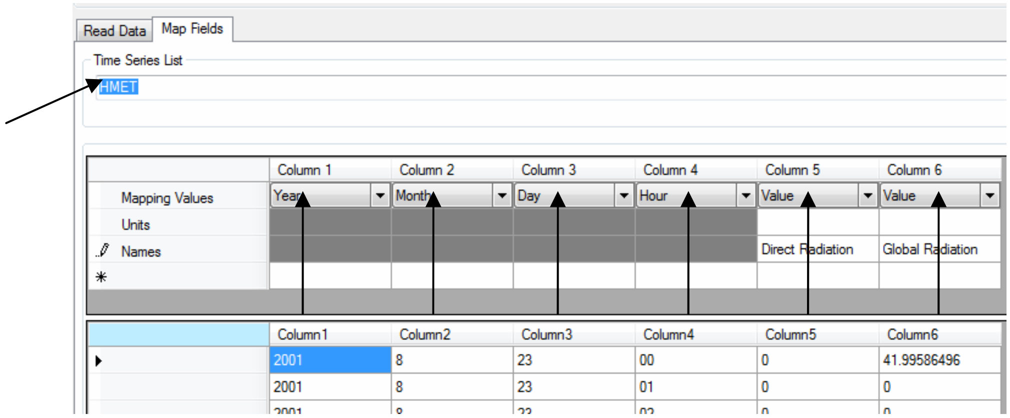


21. Click OK which will bring the data into the *Time Series Data Editor.* You can now see the data plotted as well as listed in the project explorer.

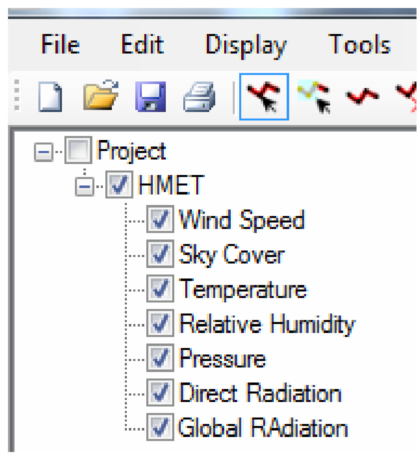
Similarly, let us import *Input2.txt* which has radiation data.

22. Select ***File|Open.*** Open File located at ***\GSSHA Distributed Hydrologic modeling\Personal\LongTerm\ Input2.txt.***
23. All the fields are already split. So you do not have to separate any column.
24. Enter 1 in the *Start Import at Row* field.
25. Click *Next*
26. In the *Time Series Field* Select ***HMET*** from the drop down menu.
27. Map the columns as follows:

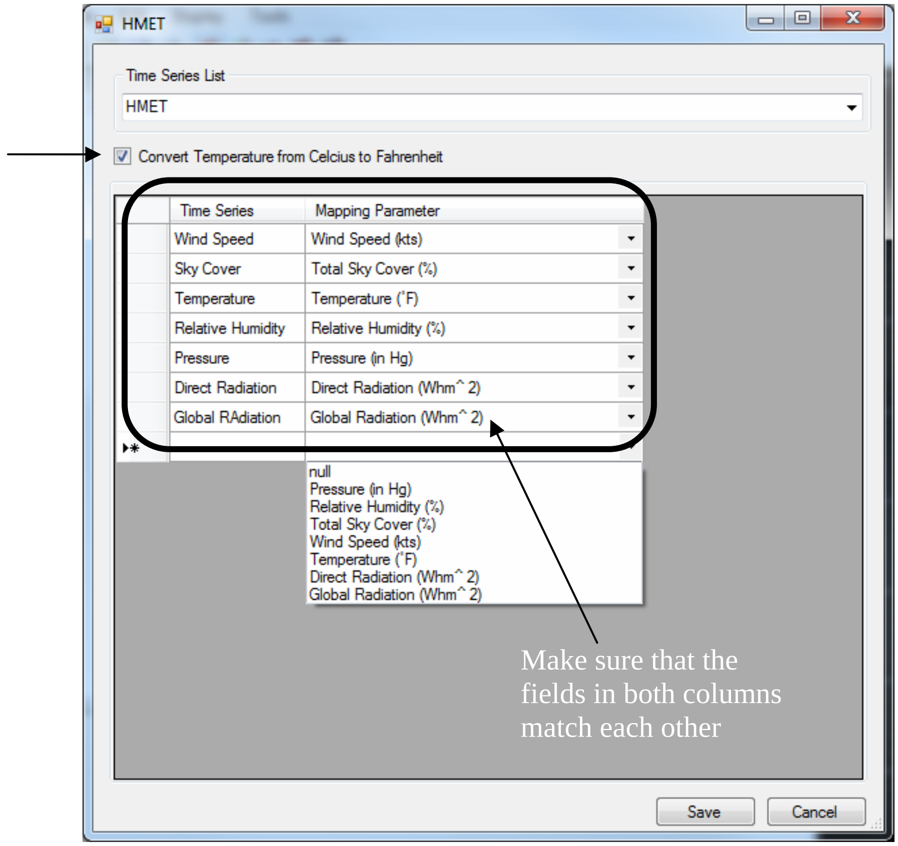
Column	Mapping Data	Field Name
Column 1	Year	
Column 2	Month	
Column 3	Day	
Column 4	Hour	
Column 5	Value	Direct Radiation
Column 6	Value	Global Radiation



28. Select OK
29. Now, you should have seen that the data from second input file has been added to the same time series. Check the project explorer.



30. The data is now ready to export as GSSHA HMET data. Select ***File|Save As.***
31. Browse ***\GSSHA Distributed Hydrologic modeling\Personal\LongTerm*** and enter ***hmet*** as the name of the file.
32. In the *Save as Type field,* select ***HMET (*.hmt)*** and click *Save.*
33. In the *HMET* dialog, toggle ON the option to *Convert Temperature from Celsius to Fahrenheit.*
    NOTE: The temperature data we imported was in Celsius (you do not need to convert if the data is already in Fahrenheit).
34. Select the mapping parameters (eg select *Temperature* time series and choose *Temperature* etc) from the drop down box to match with the *Time Series* names. See following figure

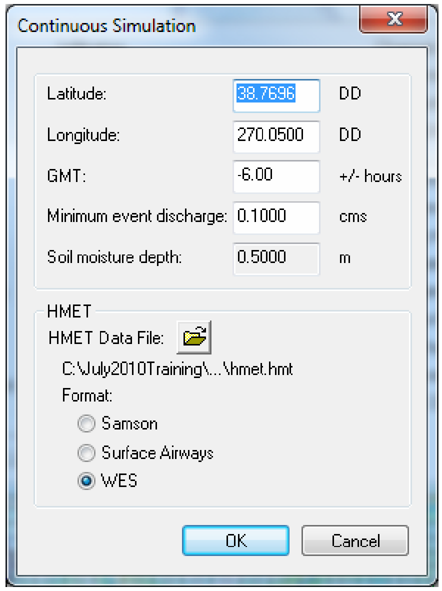


35. Click *Save.*
36. You may now close the *Time Series Data Editor.*

5 Setting up Long-Term Simulation

Now we will go back to WMS and set up the Long-term modeling data. First we need to set up the Job control options to turn on long-term mode.

1. Select **GSSHA| Job Control…**
2. In the "Evapotranspiration" section of the window toggle on "Penman Method".
3. Enter 0.5 for *Soil Moisture depth*
4. Check the box next to "Long term simulation" in the GSSHA Job Control Parameters window.
5. Click the *Edit parameter...* button and enter a value of 38.7696 for "Latitude".
6. Enter a value of 270.05 for "Longitude".
7. For "GMT" enter a value of –6.00.
8. Enter 0.10 for "Minimum event discharge".
9. Make the "Soil moisture depth" equal to 0.5.
10. Click on the folder icon to next to "HMET Data File" to browse for the Hmet text file you created with the *time Series Data Editor*. Navigate to the file and select it. ***\GSSHA Distributed Hydrologic modeling \LongTerm\hmet.hmt.***
11. Under "Format", toggle on WES.



12. Select *OK*.
13. In the Overland Flow Computation method combo box make sure *ADE* is selected.
14. Select *OK*.

5.1 Set up the Evapotranspiration Parameters

1. Select **GSSHA | Map Tables…**
2. Click on the *Evapotranspiration* tab.
3. In the drop down box next to *Using index map* select Land use, then click the *Generate IDs* button.
4. Enter the values required for evapotranspiration using the following table:

Land use ID	**11**	**14**	**16**	**21**	**41**
Land Surface Albedo	0.15	0.22	0.22	0.22	0.2
Vegetation height (m)	0.08	0.1	0.5	1	17
Vegetation Radiation Coeff	0.7	0.5	0.35	0.2	0.15
Canopy stomatal resistance (s\m)	20	20	50	86	100

5. Click *Done*.

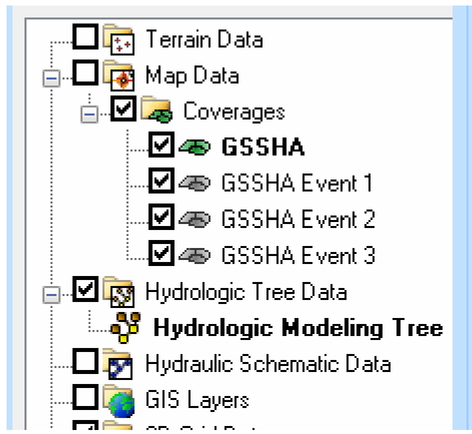
5.2 Importing the Gage File

Next we need to set up our precipitation file.

1. Select **GSSHA | Precipitation…**
2. Select *Gage* from the drop-down menu.
3. Click the *Import Gage File…* button.
4. Browse to the precipitation file ***\GSSHA Distributed Hydrologic modeling \Personal\LongTerm\ precipitation.gag***, select it, and hit OK.

Since we only have one gage, the rainfall data is spread out uniformly over the watershed. If we had more than one gage we would pick either Theissen Polygons or Inverse Distance weighted here in this dialog.

5. Select *OK*.
6. You should have seen that three coverages added in the project explorer representing three storms.



6 Change the Output Control

We are ready to run now, but first we will want to change some output options. We will not want to output the data sets so frequently.

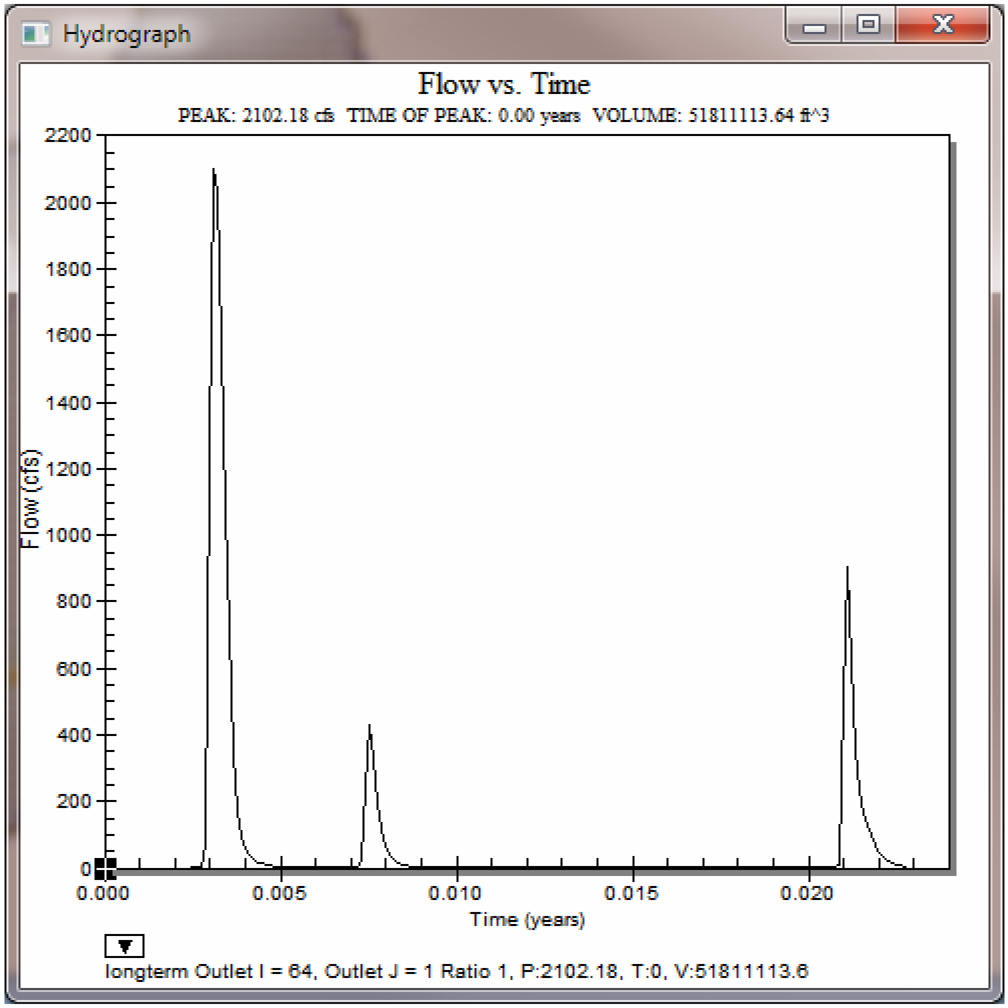
1. Select **GSSHA | Job Control...**
2. Click on the Output Control... button.
3. In the Write frequency section of the dialog, change the Write Frequency to 60 (minutes).
4. Select *OK*, *OK*.

7 Save and Run the model

1. Save the GSSHA project ***\GSSHA Distributed Hydrologic modeling \Personal\LongTerm\ longterm.prj***
2. Select ***GSSHA|Run GSSHA*** and click *OK*.

8 Results

Your results should look something like the figure below.


Hydrograph
Flow vs. Time
PEAK: 2102.18 cfs TIME OF PEAK: 0.00 years VOLUME: 51811113.64 ft^3
Flow (cfs)
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0.000
0.005
0.010
0.015
0.020
Time (years)
longterm Outlet I = 64, Outlet J = 1 Ratio 1, P:2102.18, T:0, V:51811113.6

