Introduction to AGWA
The Automated Geospatial Watershed Assessment Tool

Calibrating hydrographs using multipliers

Introduction:	In this exercise you will attempt to calibrate KINEROS2 to match an observed hydrograph of a channel in an upper portion of the Río Suchiapa.
Goal:	To familiarize yourself with calibrating KINEROS2 in AGWA using multipliers and batch simulations to match an observed hydrograph.
Assignment:	Run the KINEROS2 model using batch simulations with a suite of multiplier files to match an observed hydrograph.

A Short Introduction to KINEROS2 Multipliers in AGWA

The following table contains a brief summary of how the KINEROS2 multipliers in AGWA affect the model results. Even though many of the multipliers have similar descriptions for the effects, the magnitude of the impacts can vary greatly. This point is reflected by the intensity of the color associated with each multiplier in the table, where more sensitive parameters have more intense/darker colors.

If you do have observed hydrograph data and are attempting to calibrate KINEROS2 using the parameter multipliers we recommend the following procedures:

1. Change the “channel hydraulic conductivity (KS)” and “overland hydraulic conductivity” multiplier by the same amount unless you feel infiltration in the channels is substantially different than in upland/hillslope areas (e.g. for perennial channel flow the channel KS multiplier will be nearly zero) until you come close to matching the observed runoff volume with the simulated runoff volume. Increasing the KS multiplier will decrease runoff volume.
2. Change the “Channel Manning’s roughness (n)” and “Overland Manning’s roughness (n)” by the same amount unless you feel the channel and overland flow roughness are substantially different to attempt to match the simulated peak runoff rate (Qp) to the observed Qp. Increasing the roughness multiplier will typically reduce Qp and cause the time to peak runoff to be later.

Channel width	Increasing channel width causes channel flow to widen and slow. This results in increased channel infiltration, decreased peak flows, decreased total outflow, decreased erosion and sediment yield from lower flows, and slows drainage times.
Channel depth	Has no effect unless channel overbank is defined outside of AGWA.
Channel hydraulic conductivity (KS)	Increasing channel KS results in increased channel infiltration, decreased peak flows, decreased total outflow, decreased erosion and sediment yield from lower flows, and has no significant impact on timing.

Channel mean capillary drive (G)	Increasing channel G results in increased channel infiltration, decreased peak flows, decreased total outflow, decreased erosion and sediment yield from lower flows, and has no significant impact on timing.
Channel Manning's roughness (n)	Increasing channel roughness causes channel flow to slow. This results in increased channel infiltration, decreased peak flows, decreased total outflow, decreased erosion and sediment yield from lower flows, and slows drainage times.
Upland/hillslope interception	Increasing upland/hillslope interception causes less rainfall to reach the ground. This results in less opportunity for upland/hillslope infiltration, decreased upland/hillslope outflow, and decreased upland/hillslope erosion and sediment yield. This propagates through to the channels, resulting in similar trends.
Upland/hillslope percent cover	Increasing upland/hillslope cover causes a lower rainfall intensity until the interception depth is reached. This results in less opportunity for upland/hillslope infiltration, decreased upland/hillslope outflow, and decreased upland/hillslope erosion and sediment yield. This propagates through to the channels, resulting in similar trends.
Upland/hillslope Manning's roughness (n)	Increasing upland/hillslope roughness causes upland/hillslope runoff to slow. This results in increased upland/hillslope infiltration, decreased peak flows, decreased total outflow, decreased erosion and sediment yield from lower flows, and slows drainage times. This propagates through to the channels, resulting in similar trends.
Upland/hillslope hydraulic conductivity (KS)	Increasing upland/hillslope KS results in increased upland/hillslope infiltration, decreased peak flows, decreased total outflow, decreased erosion and sediment yield from lower flows.
Upland/hillslope pave	Has no effect on hydrology. Increasing upland/hillslope pave results in decreased erosion and sediment yield on the uplands/hillslopes.
Upland/hillslope splash	Has no effect on hydrology. Increasing upland/hillslope splash results in increased erosion and sediment yield on the uplands/hillslopes.
Upland/hillslope mean capillary drive (G)	Increasing upland/hillslope G results in increased upland/hillslope infiltration, decreased peak flows, decreased total outflow, and decreased erosion and sediment yield from lower flows.
Upland/hillslope coefficient of variation for KS (CV)	Increasing upland/hillslope CV results in decreased upland/hillslope infiltration, increased peak flows, increased total outflow, and increased erosion and sediment yield from higher flows.

Getting Started

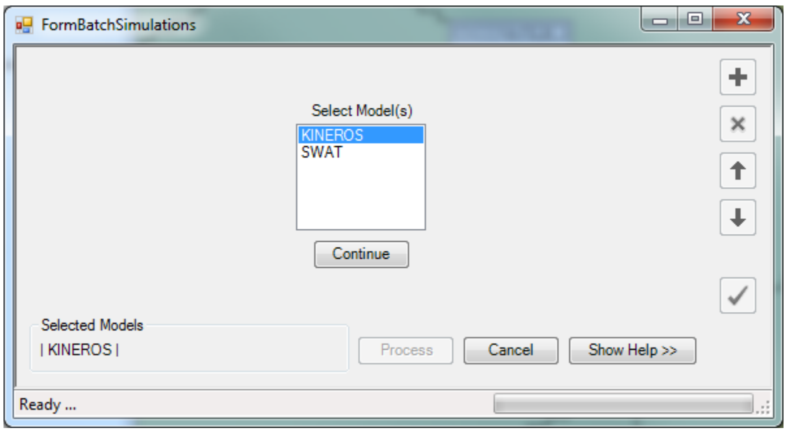
Open the existing **tutorial_Suchiapa** map document. We will be building off of the work done previously by running a suite of simulations with different multiplier files.

Part 1: Running KINEROS2 in Batch Mode with Multiplier Files

In this exercise, you will use the existing **d1k2** discretization and **p4** parameterization to create several simulations with different multiplier files. Using Batch Simulations allows you to quickly create many simulations with different configurations. This is useful when calibrating a model because it allows you to quickly assess the effectiveness of different parameters on meeting your objective.

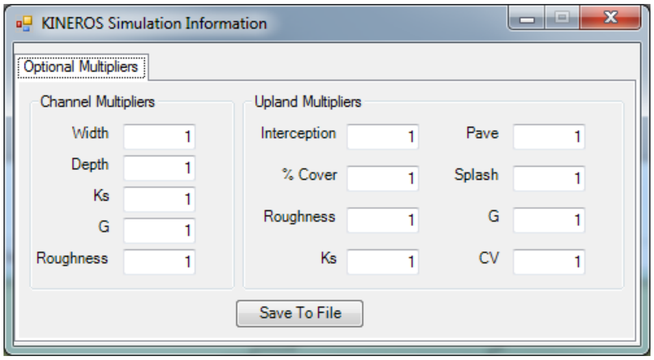
Step 1: Introducing batch simulations

1. Write the KINEROS2 input files and run a single simulation using batch simulations by selecting ***AGWA2 Tools>Simulation Options>Batch Simulations***.



   1.1. ***Select Model(s)*** box: **KINEROS**
   1.2. Click ***Continue***. The batch simulations table opens.
   1.3. In Row 1:
      1.3.1. ***Discretization***: Double-click and select **d1k2**
      1.3.2. ***Simulation name***: **default**
      1.3.3. ***Parameterization***: **p4**
      1.3.4. ***Precipitation File***: **E:\AGWA\workspace\tutorials\tutorial_Suchiapa\d1\d1k2\precip\1a1h.pre**
      1.3.5. ***KINEROS Multiplier File***: **(Create new)**. The KINEROS Simulation Information form opens.

1.3.5.1. Leave the multipliers set to **1**.

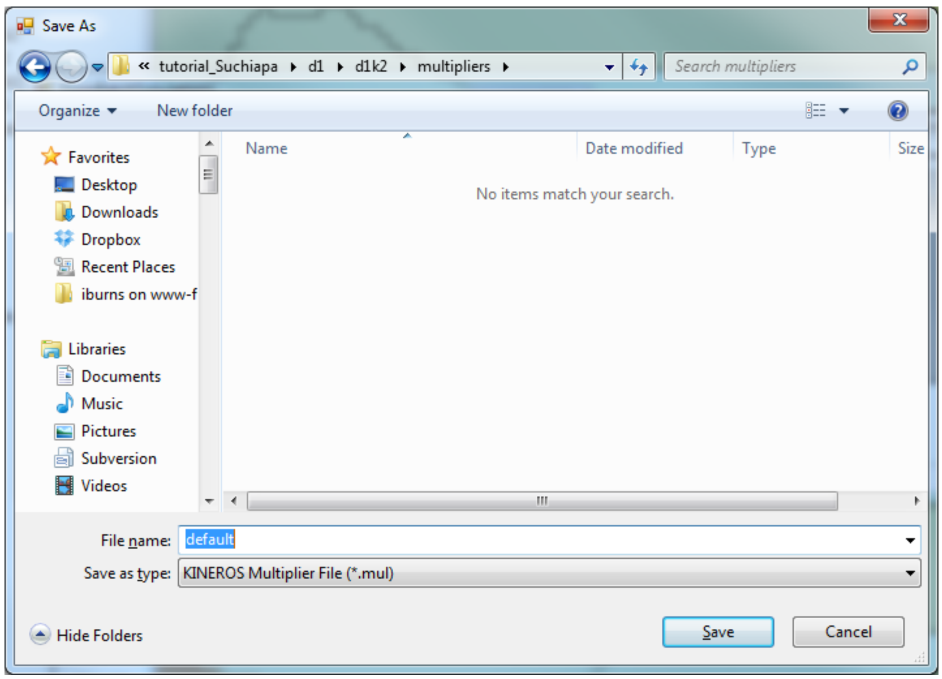


1.3.5.2. Click ***Save To File***.

1.3.5.2.1. Save to the default location the form opens to.

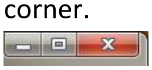
1.3.5.2.2. ***File Name***: **default**

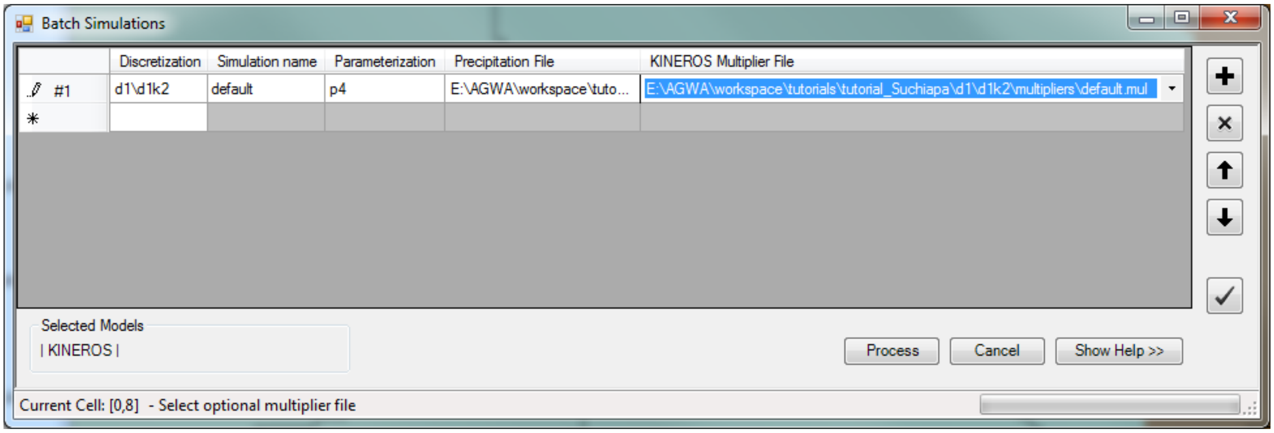
1.3.5.2.3. Click ***Save***. You are returned to the Batch Simulations form.

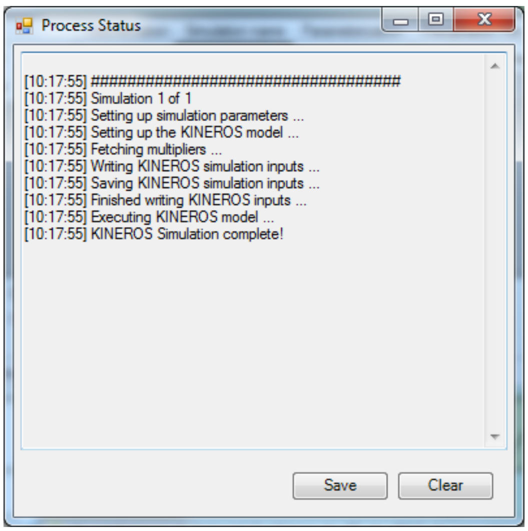


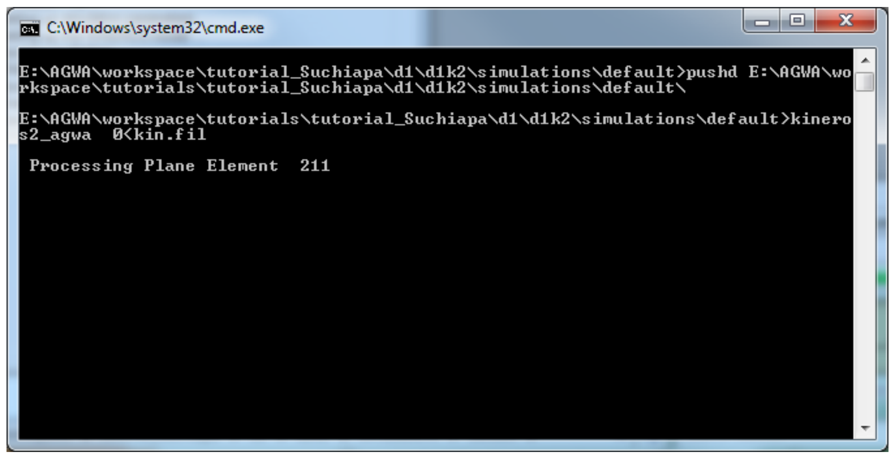
1.4. Click ***Process***.

1.5. When the simulations are complete, close the Process Status form by clicking the X in the corner.





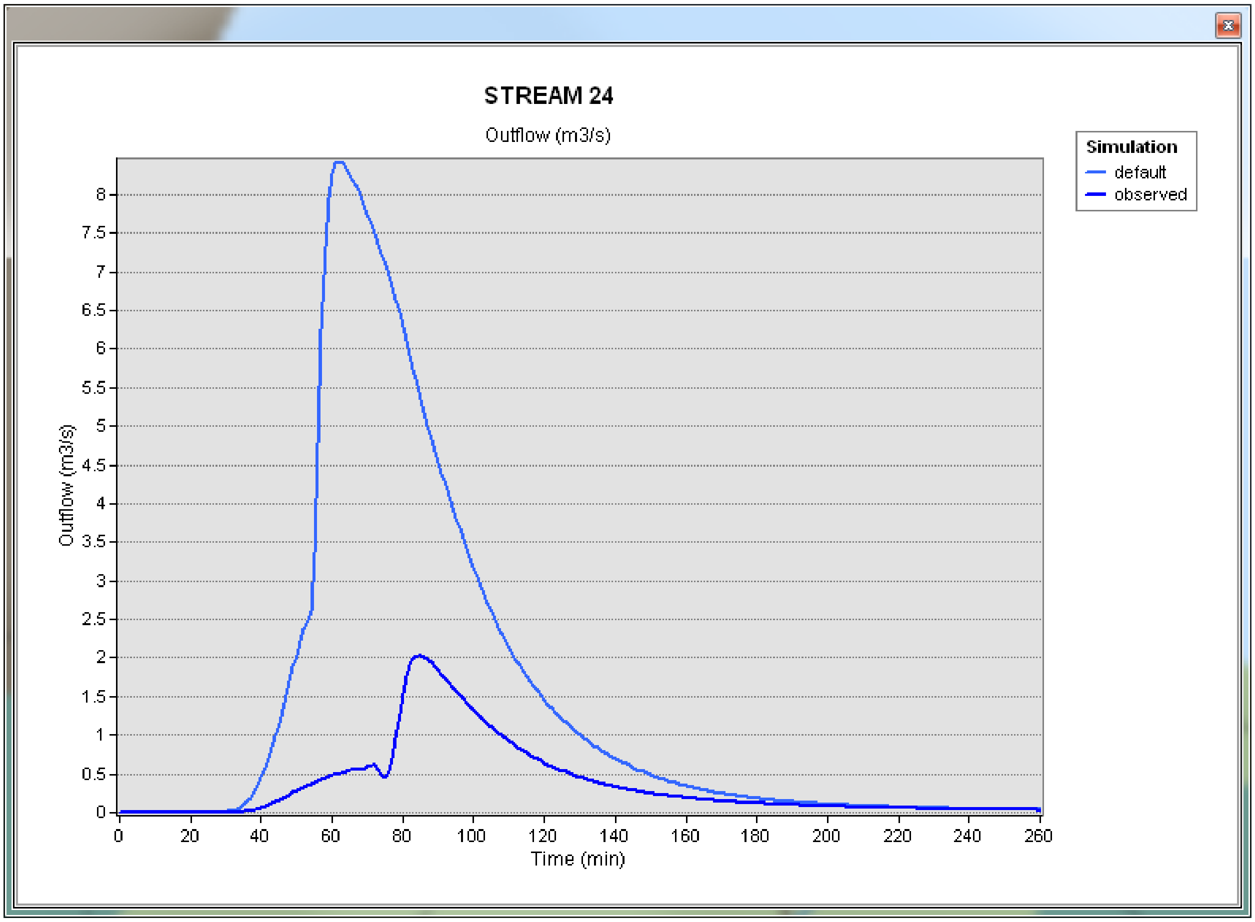




Step 2: Using batch simulations with several multiplier files

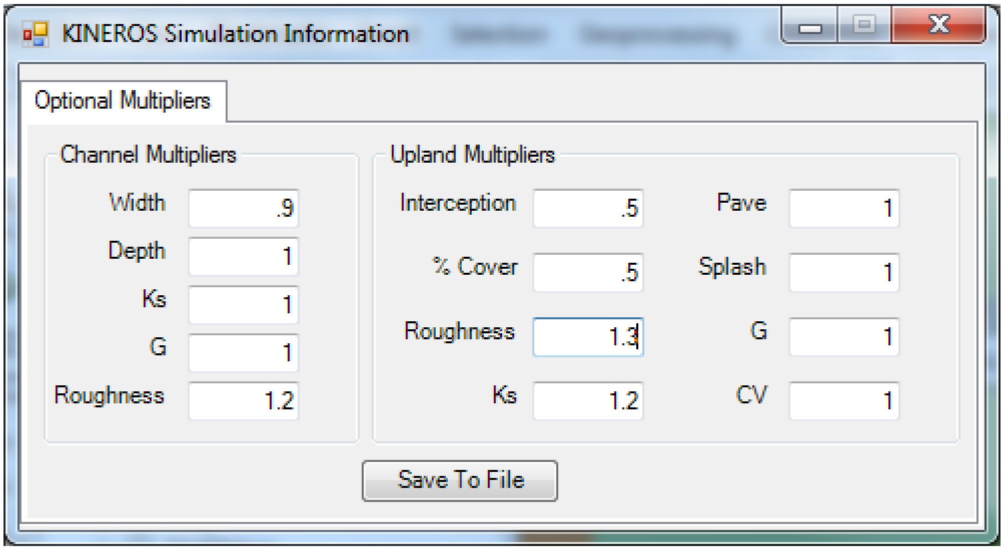
Step 1 introduced you to the batch simulation process with the default simulation. In Step 2, you will use the batch simulation process again, but this time create several multiplier files as you go. Each simulation will use a different multiplier file, but will otherwise be identical. The result will allow you to quickly view hydrographs for multiple multiplier configurations to assess the best parameters to modify to match the observed hydrograph.

The hydrograph below shows the ***default*** simulation and the ***observed*** hydrograph. Use the multiplier table above as a guide to set your multipliers. The following multipliers should be used: channel width, channel roughness, upland interception, upland % cover, upland roughness, and upland Ks.



2. Write the KINEROS2 input files and run several simulations in batch mode by selecting ***AGWA2 Tools>Simulation Options>Batch Simulations***.
   2.1. ***Select Model(s)*** box: **KINEROS**
   2.2. Click ***Continue***. The batch simulations table opens.
   2.3. In Row 1:
      2.3.1. ***Discretization***: **d1k2**
      2.3.2. ***Simulation name***: **scenario1**
      2.3.3. ***Parameterization***: **p4**
      2.3.4. ***Precipitation File***:
      E:\AGWA\workspace\tutorials\tutorial_Suchiapa\d1\d1k2\precip\1a1h.pre
   2.4. ***KINEROS Multiplier File***: **(Create new)**. The KINEROS Simulation Information form opens.

2.4.1. Set the multipliers like the screenshot.



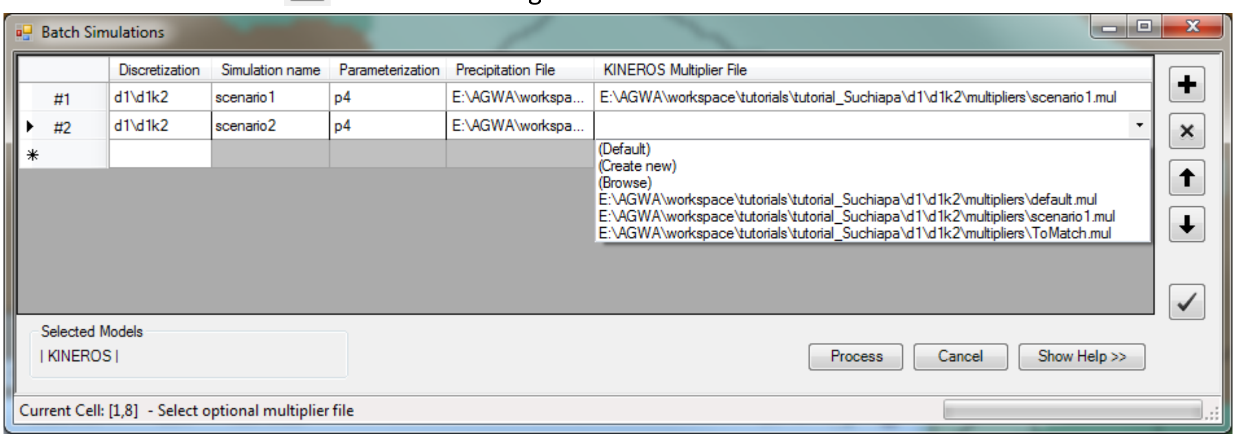
2.4.2. Click ***Save To File***.

2.4.2.1. ***File Name***: **scenario1**

2.4.2.2. Click ***Save***. You are returned to the Batch Simulations form.

2.5. Add another row to create a simulation with a different multiplier file.

2.5.1. Click the + button on the right side of the form to add a new row.



2.5.1. ***Discretization***: **d1k2**

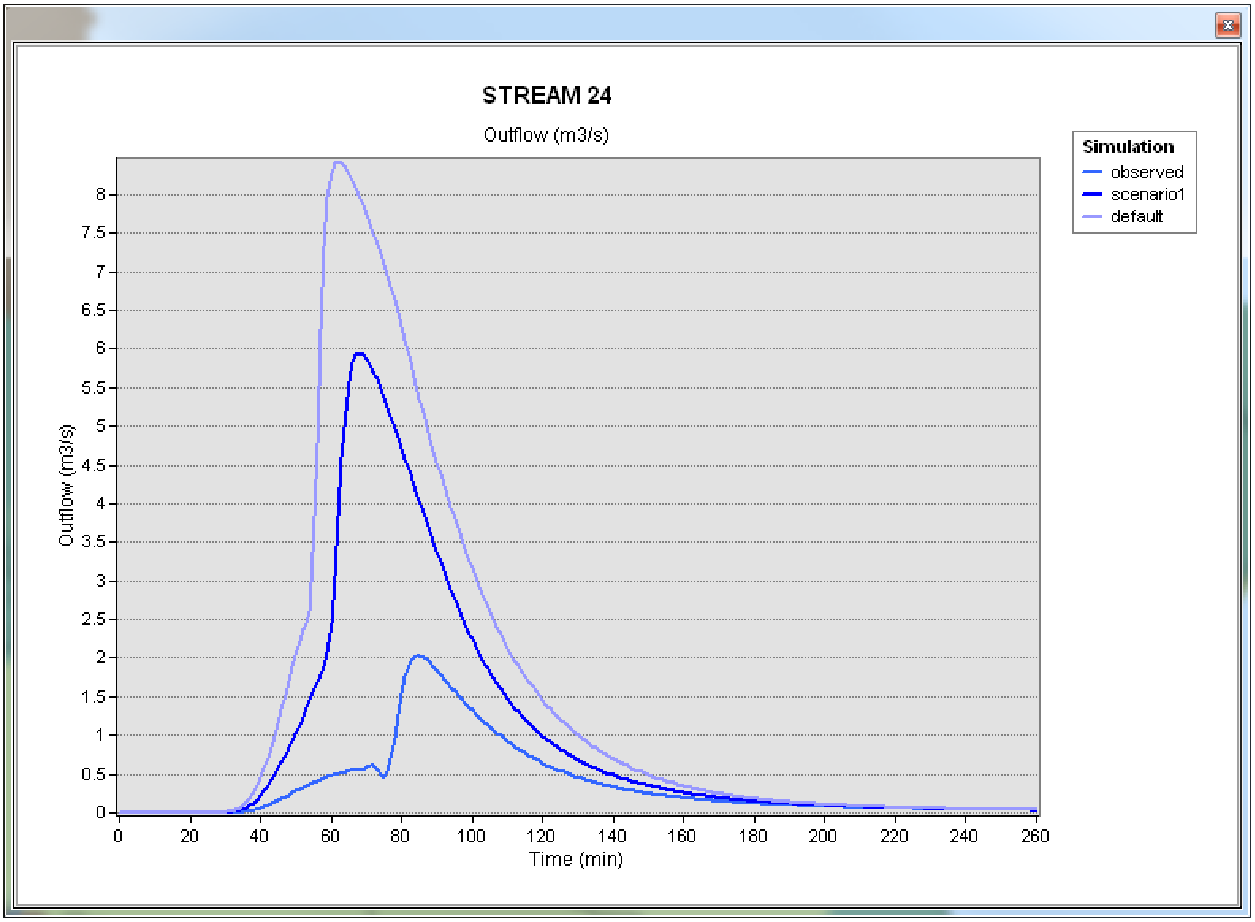
2.5.2. ***Simulation name***: **scenario2**

2.5.3. ***Parameterization***: **p4**

2.5.4. ***Precipitation File***:
E:\AGWA\workspace\tutorials\tutorial_Suchiapa\d1\d1k2\precip\1a1h.pre

2.5.5. ***KINEROS Multiplier File***: **(Create new)**. The KINEROS Simulation Information form opens.

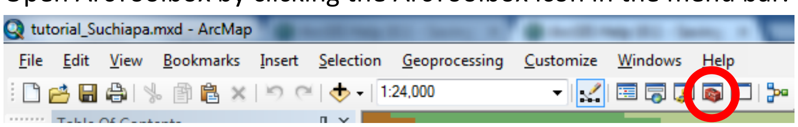
2.5.5.1. Adjust the multipliers to try and match the ***observed*** hydrograph. The figure below shows the ***default*** simulation, ***observed*** hydrograph, and the ***scenario1*** simulation created in ***2.4.1***. As you can see, ***scenario1*** is better than ***default***, but it can be improved.



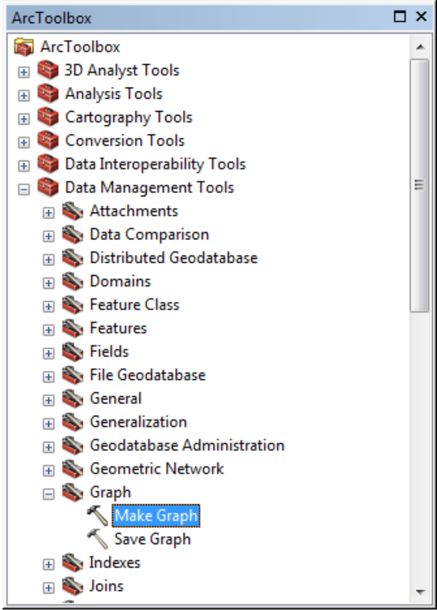
2.6. Add more rows and create new multiplier files to test various configurations. Once you have several simulations, click ***Process***. Proceed to ***Step 3*** to evaluate how your simulations compare to the observed hydrograph.

Step 3: Evaluating the simulations by comparing to the observed hydrograph.

2.1. Open ArcToolbox by clicking the ArcToolbox icon in the menu bar.

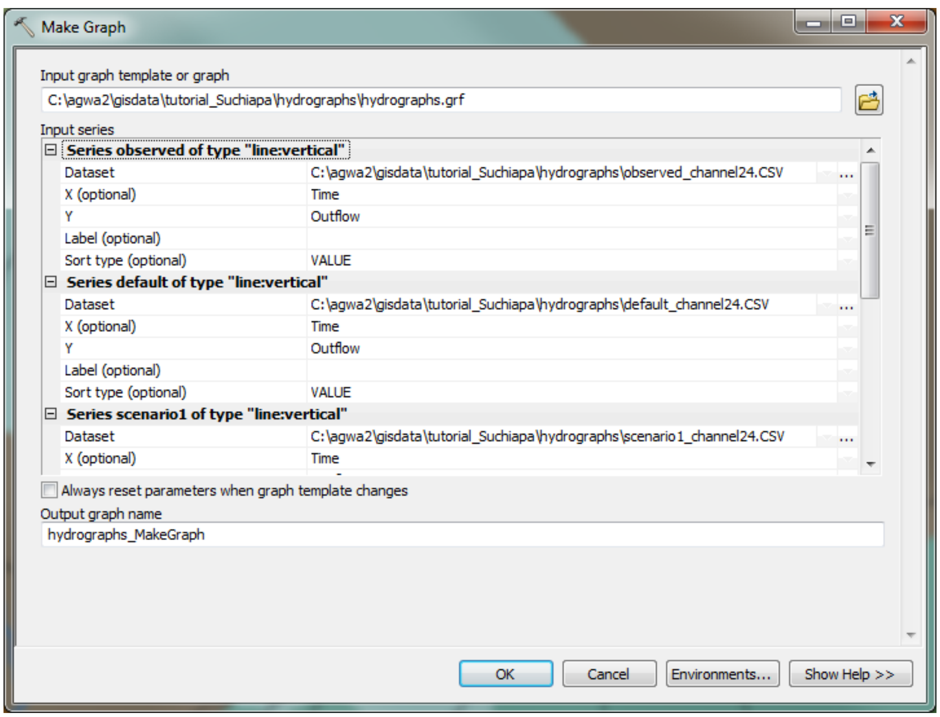


2.2. Load the observed hydrograph into ArcMap by double clicking ***Data Management Tools>Graph>Make Graph*** in ArcToolbox.



2.2.1. ***Input graph template or graph***:

C:\agwa2\gisdata\tutorial_Suchiapa\hydrographs\hydrographs.grf



2.2.1.1. ***Series observed of type "line:vertical"***:

2.2.1.1.1. ***Dataset***:

C:\agwa2\gisdata\tutorial_Suchiapa\hydrographs\observed_channel24.CSV

2.2.1.2. ***Series default of type "line:vertical"***:

2.2.1.2.1. ***Dataset***:

C:\agwa2\gisdata\tutorial_Suchiapa\hydrographs\default_channel24.CSV

2.2.1.3. ***Series scenario1 of type "line:vertical"***:

2.2.1.3.1. ***Dataset***:

C:\agwa2\gisdata\tutorial_Suchiapa\hydrographs\scenario1_channel24.CSV

2.2.2. Click ***OK***.

2.3. Compare the hydrographs loaded above to the hydrographs for the simulations you created by selecting ***AGWA2 Tools>View Results>KINEROS Results>View Hydrograph***.

2.3.1. ***Watershed***: **d1k2**

2.3.2. ***Simulation***: select any of the simulations you have created.

2.3.3. Click the ***Select Feature*** tool and select ***Stream 24***.

2.3.4. Select **Outflow (m3/s)**.

2.4. Repeat for all of your simulations.

3. If you think you can improve your hydrograph, go back to ***Step 2*** and create more simulations with different multiplier configurations.