HEC-HMS Long Term Simulation
for the El Cajon Watershed

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Summary

The Mexican government is planning to install a system of dams along the Santiago River. The hydrological effects of these dams on the surrounding area within the watershed are as yet unknown. Computer models will be created to model the watershed in order to gain a better understanding of the possible effects created by the insertion of these dams. Specifically, the program HEC-HMS will be used for the long term simulation of the watershed. This long term simulation will be used to determine how much time will be required to fill the new dams. The students from ITESO have not had experience in running long term simulations using HEC-HMS, nor were they able to gather sufficient data to produce the simulation for them. As a result, we have created two tutorials to help them learn how to produce an accurate model of the Cuenca Cajon. The first tutorial is a step-by-step document that teaches how to produce a long term simulation. The second tutorial teaches how to use the optimization tools within the HEC-HMS program to create a more accurate model.

Since we were unable to obtain real conceptual hydrologic data for a long-term simulation, an additional analysis was performed using the Mod Clark method, a simpler model requiring fewer input parameters. Although the Mod Clark method makes assumptions uncharacteristic of our watershed, the output was helpful for a cursory analysis of a long-term storm event on the Cajon watershed.

Introduction

The project for the Cuenca Cajon changed throughout the semester. Initially, our counterparts in Mexico wanted us to produce a working long-term simulation that we could send to them. They would then be able to modify the parameters in the simulation in order to fine-tune the simulation to more accurately represent the watershed. After some efforts to obtain the necessary information for the HEC-HMS program, it became clear that the information gathering process would take much longer than initially anticipated. Because of the relatively short time period that our team had to produce an accurate running model for ITESO, we decided that the most productive things to do would be to produce a tutorial for the students at ITESO to be able to follow once they are able to obtain the required information and a running model using simplified inputs. We decided to adhere to the following Chinese proverb: "Give a man a fish; you have fed him for today. Teach a man to fish; and you have fed him for a lifetime."

Materials and Methods

Before a long term simulation could be created, the watershed needed to be delineated and prepared for the long term simulation in WMS. In order to delineate the watershed, we first downloaded Digital Elevation Models (DEM) from the internet. Our counterparts from Mexico sent us a website where these DEMs could be obtained. After downloading and opening these DEMs in WMS, we ran TOPAZ and then the outlet where the dam was to be built was inserted. Once these steps were accomplished, the watershed Cuenca Cajon was delineated. After our first delineation of the watershed, we noticed that our delineation differed from an image that our counterparts had sent us previously. Upon asking them about the discrepancy, we found that a dam already existed in the watershed that we hadn’t included in our delineation. After making that correction, we were ready to insert parameters for the watershed in WMS to prepare it for the HEC-HMS long term simulation. Because we lacked the necessary information from Mexico, we decided to, at least initially, use parameters from the long term simulation tutorial that we were using to create our model. These parameters were used to estimate values such as canopy storage, soil storage, groundwater storage, etc. Once these parameters were inserted, we were ready to open the watershed in the HEC-HMS program.

Once the watershed was opened in HEC-HMS, more parameters were inserted for the simulation, including precipitation, evapotranspiration, among others. While entering these parameters, we found that the tutorial we were using was for a different version of HEC-HMS than we were using for our simulation. Because of this issue, we met with Dr. Nelson and Chris Smemoe to figure out how the newer version of HEC-HMS worked. After a few meetings, we were able to successfully enter all the necessary information and obtain a working long term model of the watershed. We then repeated the process several times to verify that our procedure was correct (and not just lucky). We then were able to put together a tutorial in English, and a PowerPoint version of the tutorial in Spanish.

After meeting with our counterparts in Mexico, we determined that it would be beneficial to optimize the parameters within the model. Fortunately, HEC-HMS has optimization capabilities built into the program. However, no one knew how to use these tools, so we decided to learn how to use the optimization tools and then produce a second tutorial. We met with Chris Smemoe, who taught us the intricacies of the optimization tools of HEC-HMS. We then completed some sample optimization runs, and wrote the second tutorial.

The simplified model we used to create the running long-term simulation was the HEC-HMS Mod Clark method. With the Mod Clark method, we used the SCS Curve Number method to calculate losses. The model used a 25 by 25 grid which we used with real soil type and land use shapefiles to create a Curve Number grid. Since the soil type and land use files were obtained from Mexico, a new Curve Number table was prepared relating Spanish soil type and land use descriptions to common conventions used in the United States.

Once we finished the SMA tutorial, we created a MOD Clark model using actual data for our watershed. To begin, we overlaid our watershed with a 25 x 25 grid. In order to obtain a distributed curve number grid, however, the land use and soil type data needed to be converted from Mexican standards to United States conventions. This was done by creating a custom curve number table and mapping a separate curve number to each grid cell. After using default values for the initial abstraction (0.2) and potential retention scale factor (1.0) we computed the lag time using the SCS method. The next task was entering precipitation data into WMS.

Precipitation data was obtained from two different websites. The MSN News and Weather website (2007) provided average precipitation data for Tepic, Mexico, the location of the closest gaging station to our watershed. To compare with the average precipitation data, we also gathered real daily precipitation data for July-August 2006 from the Weather Underground website (2007). We first entered the average precipitation values at daily intervals for a two-month period into WMS. The time-step intervals in the job control naturally followed the intervals of the rainfall data. We also divided the average daily precipitation values into 6-hour increments and changed the job control accordingly. With the actual precipitation from the Tepic station, we entered the data in 6-hour increments, once with a linear temporal distribution and once with a simplified typeII-24 hour temporal distribution. Again, the job control was changed accordingly. Four separate HMS files were saved to be used as input for HEC-HMS. Each HMS file was opened in HEC-HMS and run separately with their respective time intervals.

Results

Figure 1 shows the delineated watershed created in WMS. Figure 2 shows a screenshot of the delineated watershed in HEC-HMS. Figure 3 and Figure 4 are screenshots of data pertaining to a long term simulation run in HEC-HMS. Figure 3 shows the hyetograph of the projected precipitation. Figure 4 shows the direct runoff according to the HEC-HMS simulation. Figure 5 shows a screenshot of the results of an optimization trial. All figures are displayed in the appendix of this report.

Four graphs were generated with the MOD Clark method. Figures 6 and 7 show the output hydrographs for the models using average precipitation values. Figure 6 shows the results for the daily intervals and has a peak flow of approximately 3,500 cfs. Figure 7 shows the results for the 6-hour intervals and also has a peak flow of approximately 3,500 cfs. Figures 8 and 9 show the output hydrographs for the models using actual precipitation values. Figure 8 shows the results for the 6-hour linear distribution and has a peak flow of approximately 15,000 cfs. Figure 9 shows the results for the 6-hour simplified typeII-24 hour distribution and has a peak flow of approximately 16,500 cfs.

Discussion

A discussion of the results from the long term simulations and optimizations produced by HEC-HMS SMA method would be pointless because the information used to produce those results is erroneous. However, the tutorials created from those trial runs will provide a useful tool for the students in ITESO to produce more accurate long term simulations of the watershed once correct information can be obtained.

The MOD Clark method is only as accurate as the input data. The average precipitation data contained data points for each day of the simulation and was unrepresentative true precipitation behavior over the course of two months. If a continuous two month storm were to occur, the models using average precipitation values would be accurate. However, this is not realistic. For this reason, we also created models using actual precipitation data containing multiple storm events during our two-month simulation period.

The MOD Clark method used with SCS Curve Number calculations is best suited for single storm events. This is because the SCS Curve Number method uses initial abstraction in consideration of losses. This means that for long-term simulations, the initial abstraction is only considered during the first storm event. Once the initial abstraction is satisfied, it is satisfied for the entire simulation period, even if dry periods occur during the simulation. Although the models created using actual precipitation data contained more representative input, initial abstraction assumptions over exaggerate the peak flows. If the initial abstraction was considered at the beginning of each storm throughout the simulation, the peak flows shown in Figures 8 and 9 would likely be lower. Even though each of the MOD Clark models has its weakness, it provides a ballpark estimate of peak flows for the watershed.

Collaboration

As we began the project early on in the semester, we struggled because we didn't have a clear understanding of the purpose of our project. We were still communicating back and forth about what was feasible and what wasn't according to the information that was obtainable. As it became more apparent that some of the required information would be long in coming, we were able to decide what was reasonable for us to accomplish in the given time period. Our counterparts in Mexico were very diligent in responding to our questions and excited about what we were able to bring to Mexico. This was helpful in expediting the decision process regarding the scope of the project. It would have been helpful for us to have a meeting with our international group at the beginning of the project by allowing us to talk face to face about what was expected of each side of the project.

Once we were actually in Mexico and had the chance to work with our counterparts, because of our frequent communication, we were able to work quickly and effectively. The students from ITESO were able to follow the tutorial that we had created and adapted to the new software quickly. Because of that, we felt that our efforts in this project were effective. Also, throughout the week we were able to get to know the students from ITESO and establish friendships that will last beyond the project itself. Friendship is an important component to a successful collaborative experience.

Conclusion

In spite of the initial vagueness of the project at the beginning of the semester, we were able to give the students from ITESO something that will aid them in producing long term models for watersheds. After creating several successful simulations of our own, we were able to use that experience to produce tutorials for our counterparts in Mexico. These tutorials will prove invaluable in the continued progression of this and other long term projects.

In addition to helpful tutorials, we are now also able to provide the ITESO students with a working Mod Clark simulation with results which will allow them to compare output with the SMA model. Although the MOD Clark method using SCS Curve Number assumptions is less accurate than a SMA model for long-term simulations, the output generated is a useful measuring stick for future runoff calculations for the El Cajon watershed.

References

MSN News and Weather 2007, *Weather Averages: Tepic, MEX*. Available at: http://weather.uk.msn.com/daily_averages.aspx?wealocations=wc:MXNT0065&weai=7.

Weather Underground 2007, *History for Tepic, Mexico*. Available at: http://www.wunderground.com/history/airport/MMEP/2006/7/1/DailyHistory.html?req_city=NA&req_state=NA&req_statename=NA

APPENDIX

(all other files and data concerning this project can be found in the “Team Cuenca Cajon” folder in the “cemexico” groups folder for the 2007 study abroad class and on a CD-ROM)

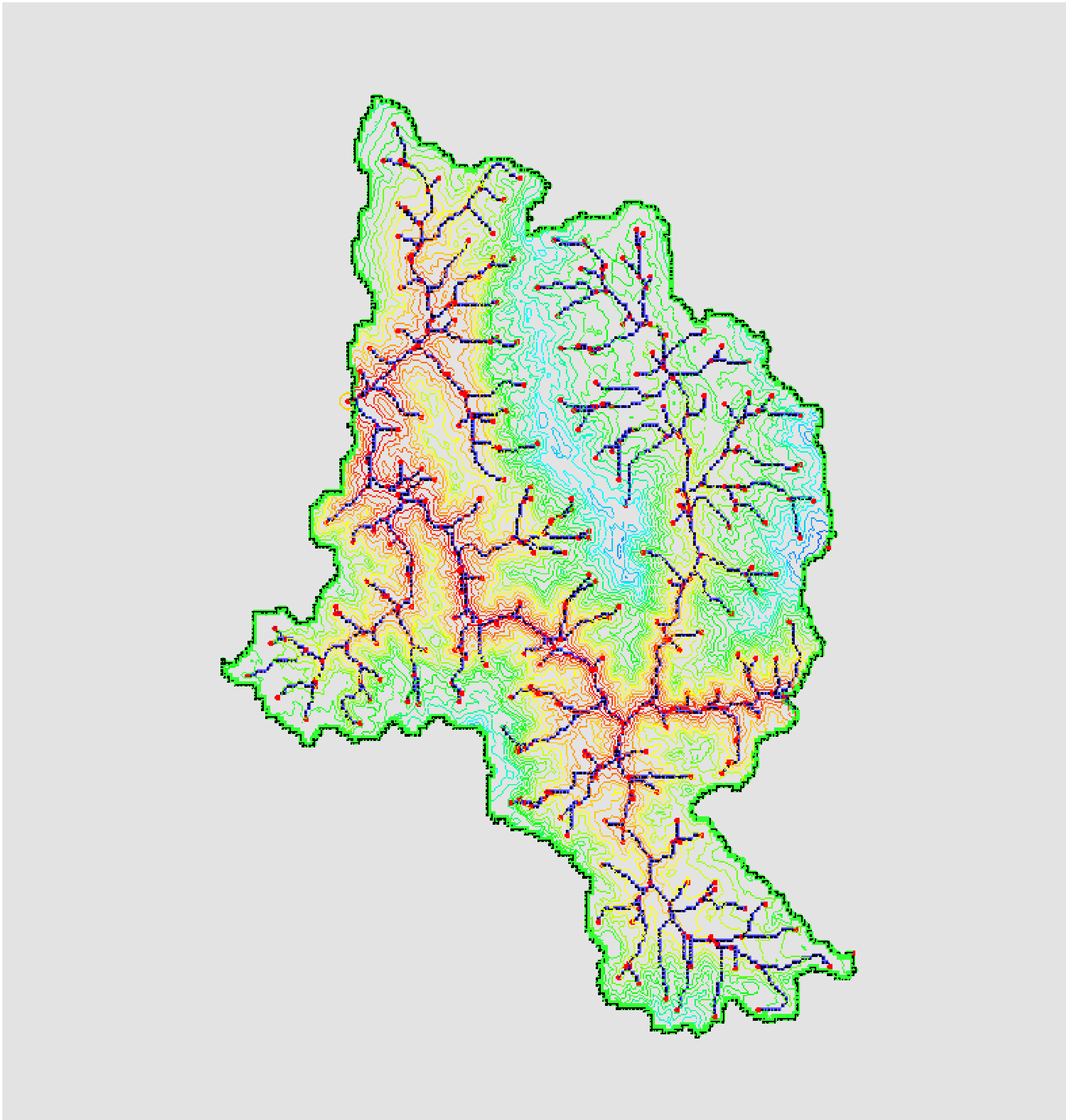

Figure 1. Delineated watershed created in WMS.

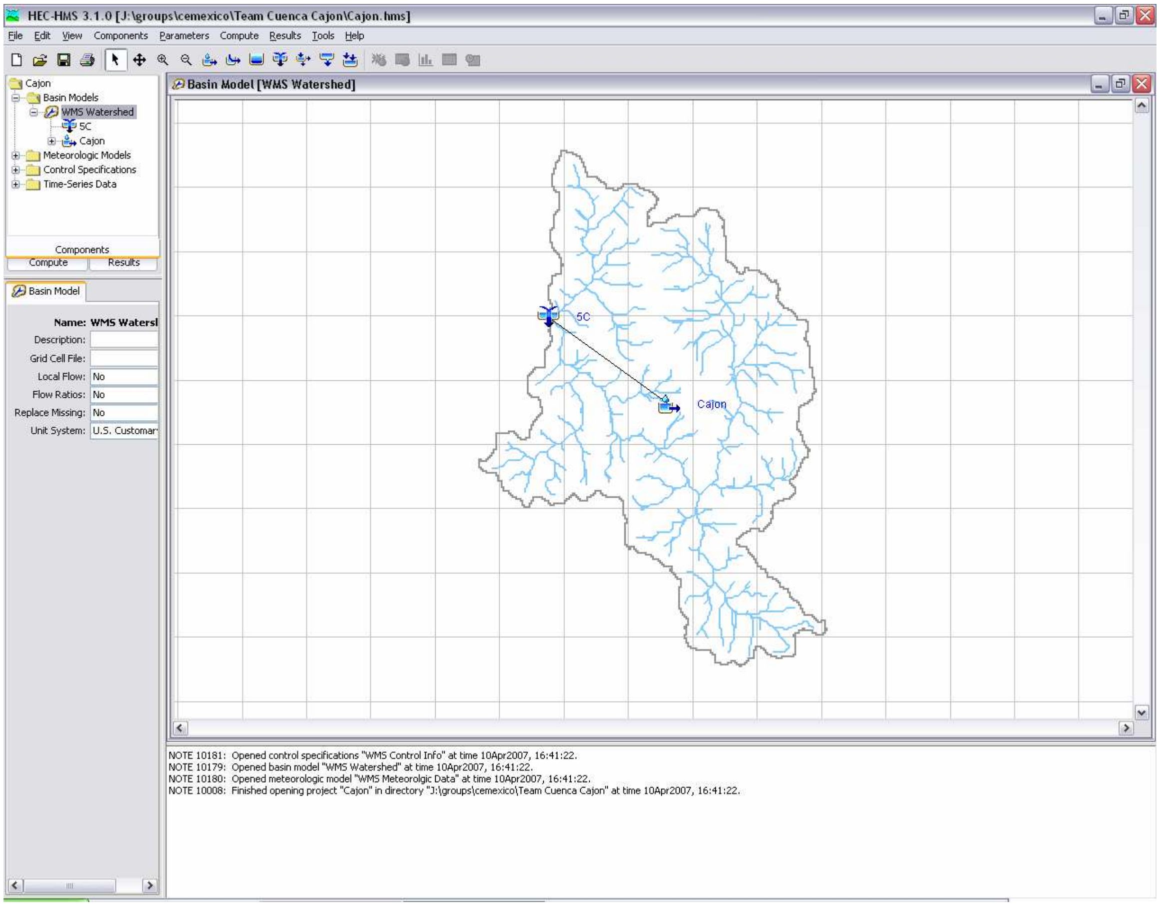

Figure 2. Screenshot from HEC-HMS of delineated watershed.

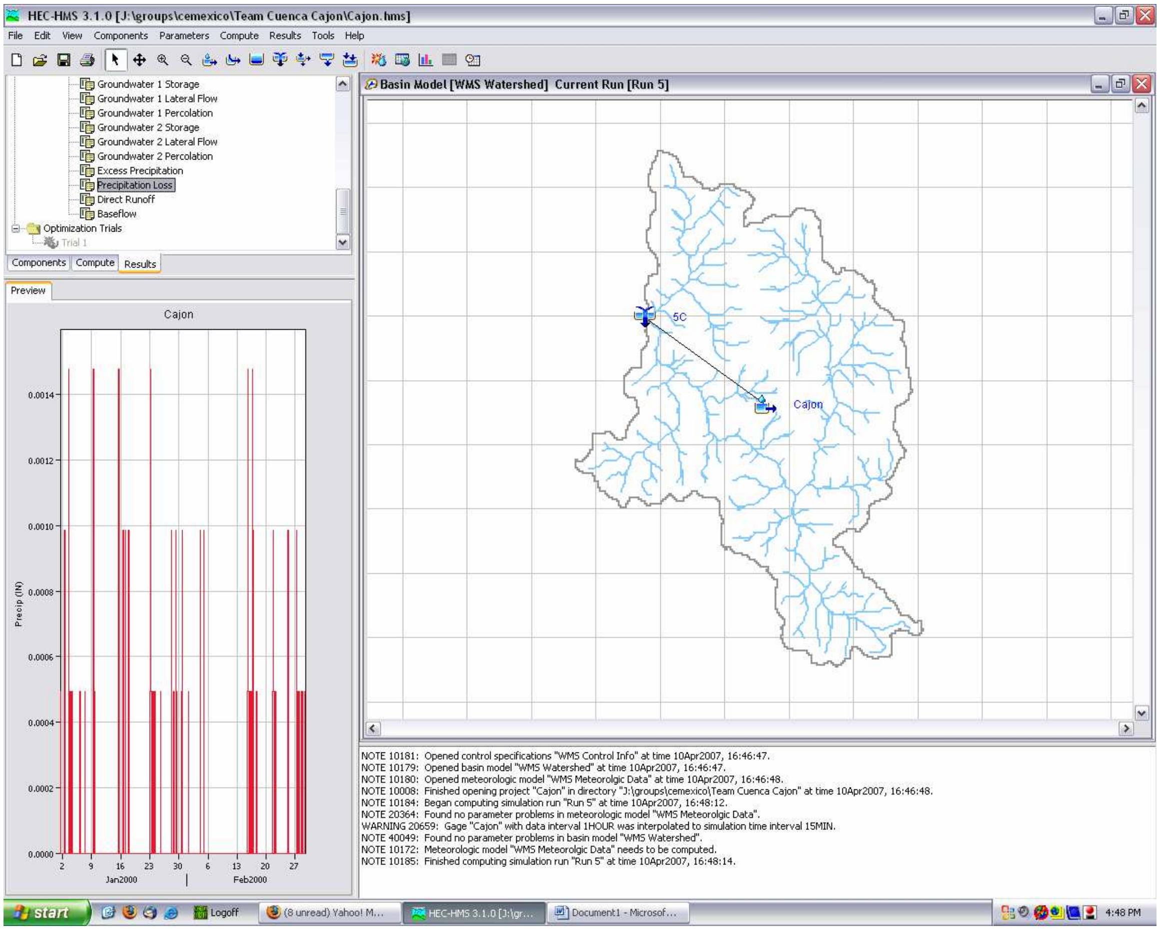

Figure 3. Screenshot of precipitation data in HEC-HMS.

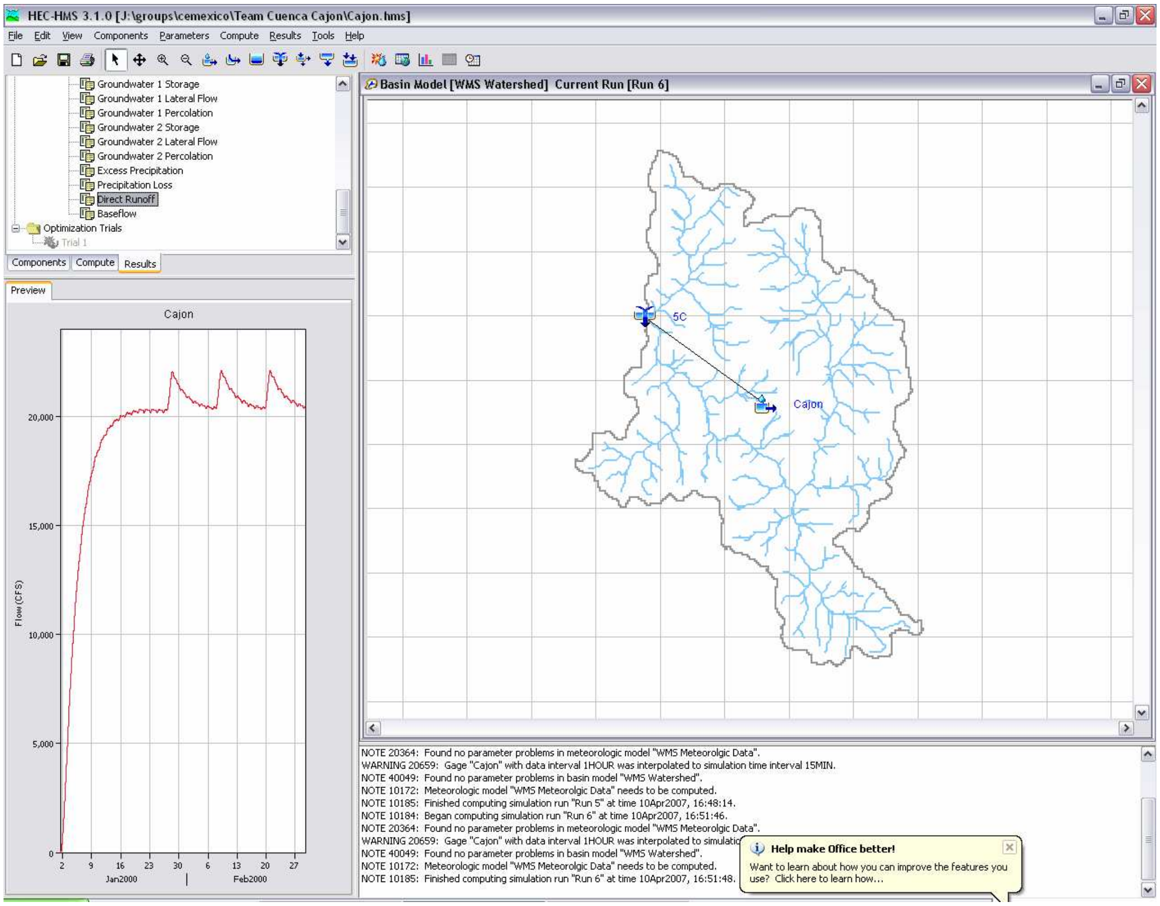

Figure 4. Screenshot of runoff results from long term simulation in HEC-HMS.

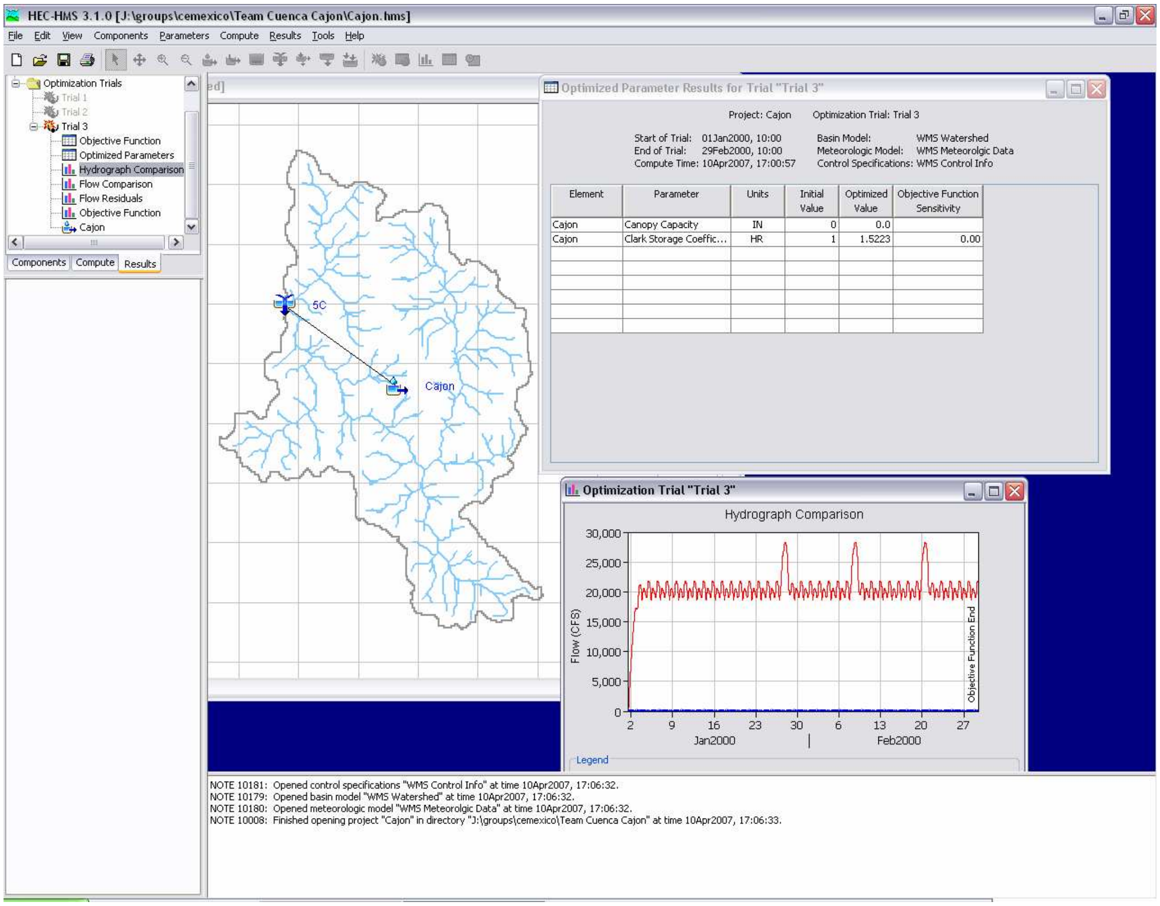

Figure 5. Screenshot of results from optimization run in HEC-HMS.

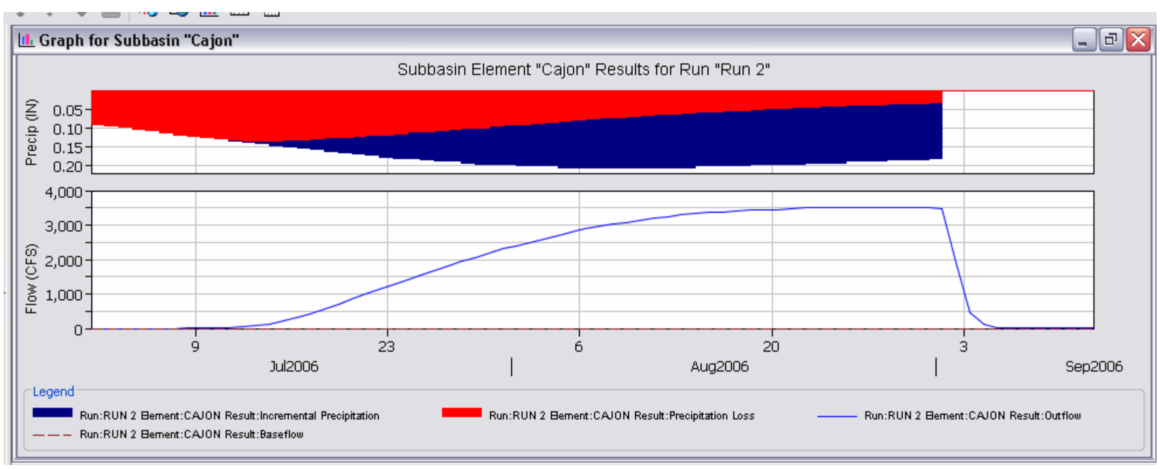

Figure 6. Output hydrograph for daily increments of average precipitation data.

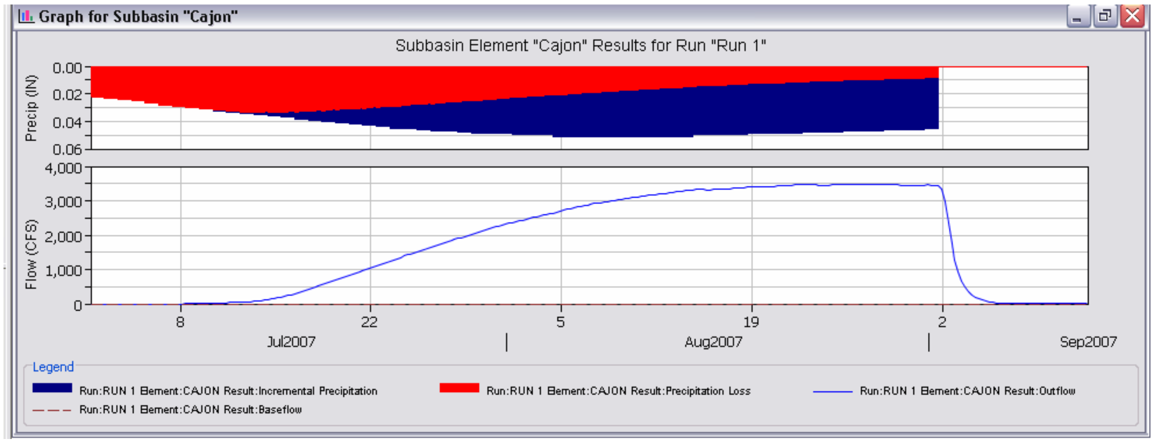

Figure 7. Output hydrograph for 6-hour increments of average precipitation data.

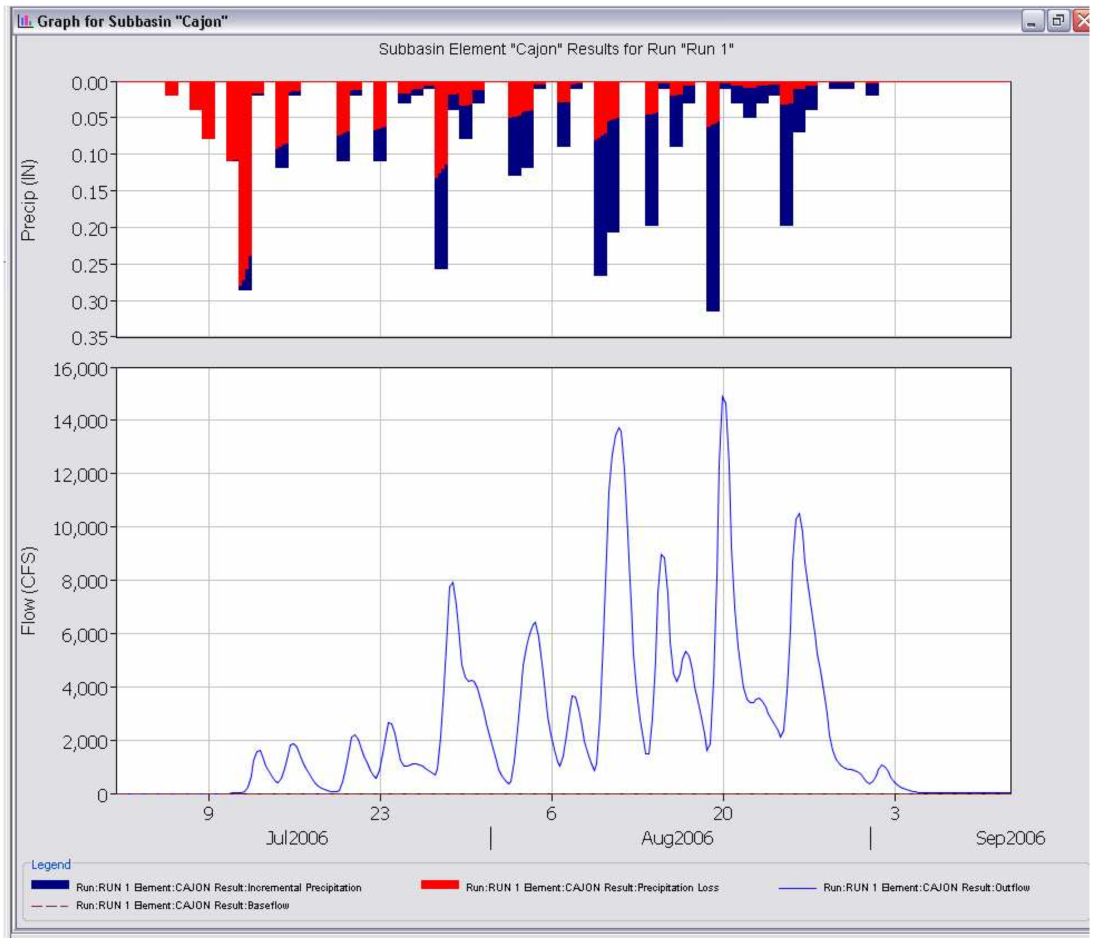

Figure 8. Output hydrograph for linear distribution of actual precipitation data.

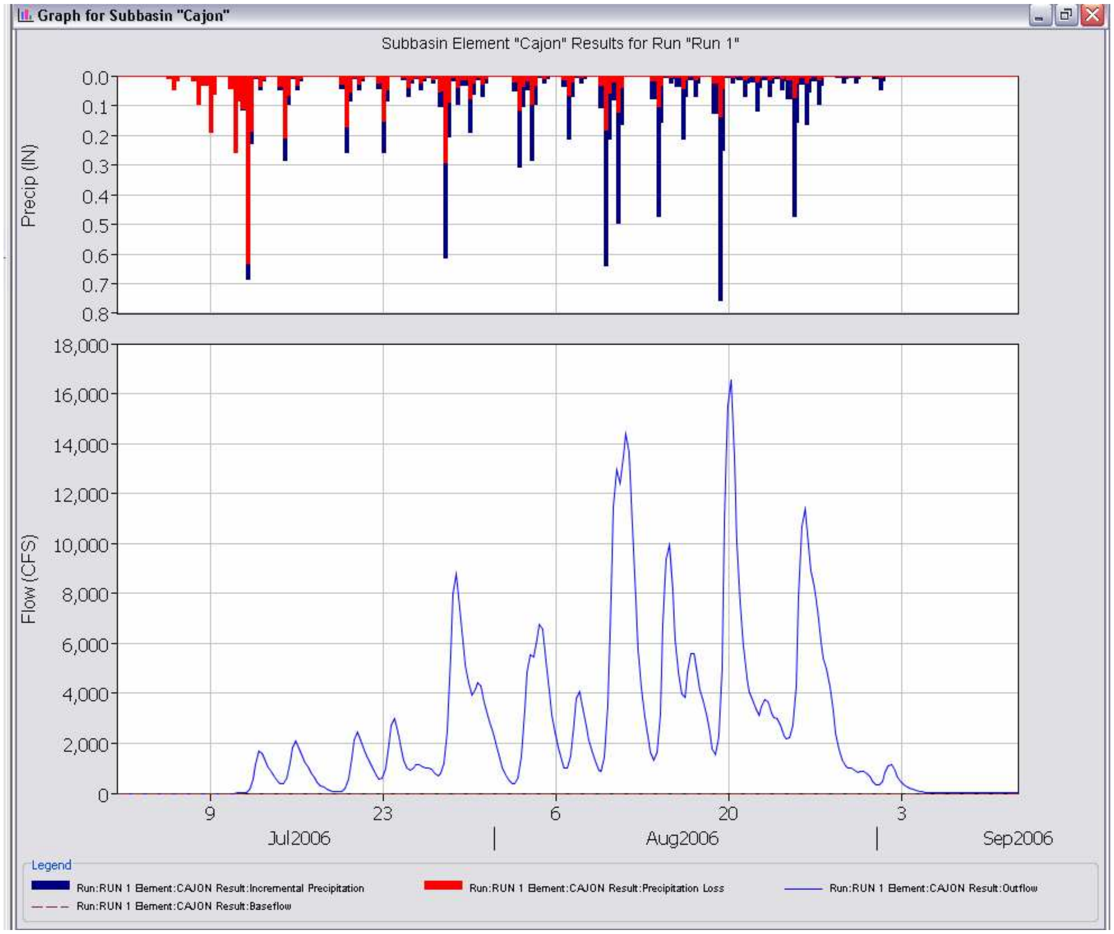

Figure 9. Output hydrograph for simplified typeII-24 hour distribution of actual precipitation data.

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THE FOLLOWING IS A STEP BY STEP TUTORIAL TO CREATE A WATERSHED IN WMS AND PREPARE IT FOR USE IN HMS:

1.1 Useful Button Icons in WMS

 -- Drainage Module

 -- Hydrological Module

 -- Create Outlet Point

 -- Zoom

 -- View Previous

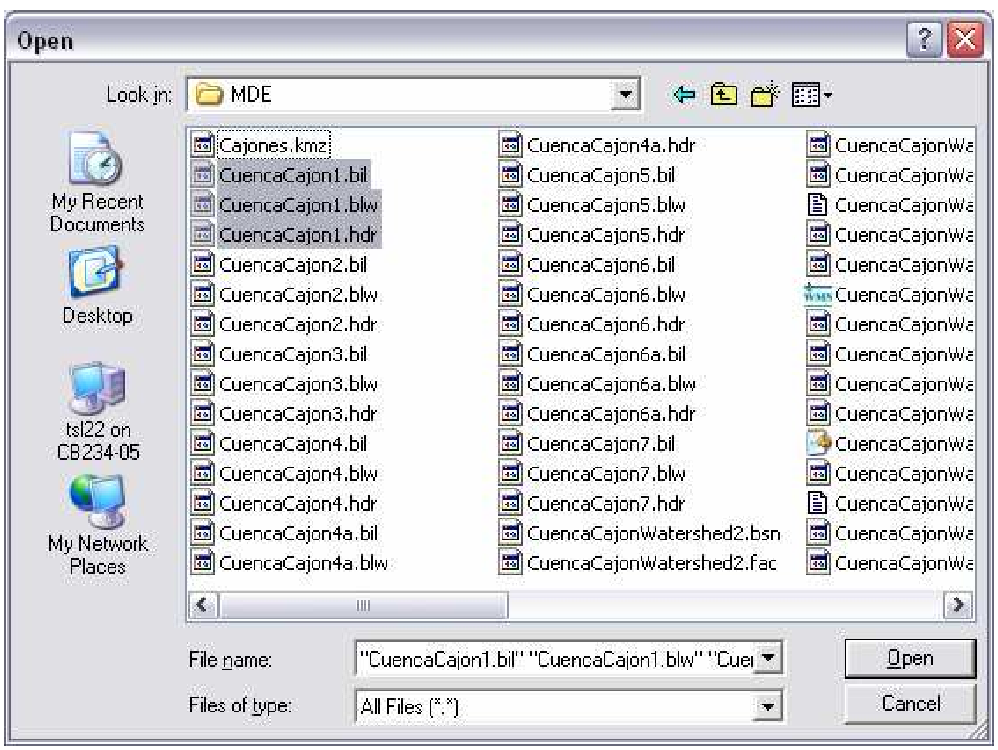
 -- Frame

 -- Select feature point/node

1.2 Reading the DEM/Delineating the Watershed

1. Download the appropriate Digital Elevations Models (DEMs) from the internet.

   Note: When you download a DEM from online, three files will be downloaded: a file type ".bil", ".blw", and ".hdr". It is important that these three file have the same name. WMS has a hard time recognizing the given names so it will be useful rename each file.



2. Open the DEMs into WMS. To do this:

   2.1. Click ***File → Open***

   2.2. Open the DEM with file type ".hdr"
   NOTE: If you have one than one DEM to open, click the Add button in the *Importing NED BIL File* dialog box.

   2.3. Click OK.

   2.4. When asked if you want to convert coordinates, click YES.

   2.5. In the *Coordinate Conversion* dialog, select the following parameters on the left (*Convert From…*) side: Change the Horizontal system to Geographic NAD 83

   2.6. Change vertical units to **meters.**

   2.7. Click the *Edit project coordinate system* toggle box. Select the following parameters on the right (Convert To…) side:

   2.8. Change the Horizontal system to **UTM NAD 83.**

   2.9. Change the Horizontal units to **meters.**

   2.10. Make sure you have the correct **UTM** Zone.

   2.11. Change the vertical units to **meters**.

   2.12. Click OK.

3. Compute TOPAZ Flow data. To do this:

   3.1. Make sure the drainage coverage is active in the project manager.

   3.2. Change to the Drainage Module.

   3.3. Click ***DEM → Compute TOPAZ Flow Data…***

   3.4. Click OK on the *TOPAZ Run Options* dialog.

   3.5. Change Basin Area and Distances to desired units

   3.6. Click OK on *Units* dialog.

   3.7. Click close when TOPAZ is finished (this may take a few minutes)

4. Define Outlet: To do this:

   4.1. Click the create outlet point button.

   4.2. Click on the DEM where you want the outlet (the outlet needs to be on a stream created by TOPAZ)

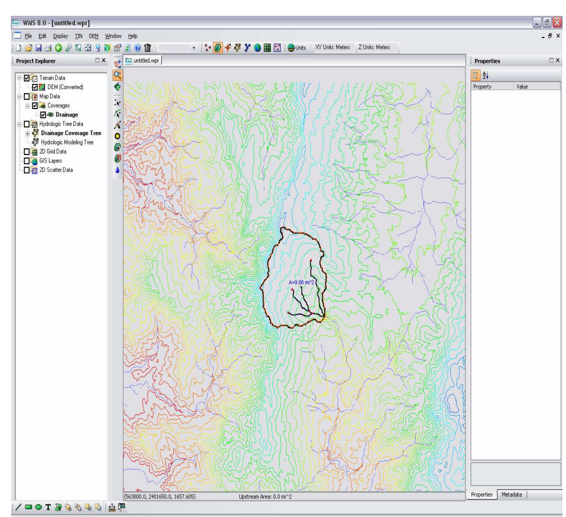
5. Delineate Basin: To do this:

   5.1. Click **DEM → Delineate Basins Wizard**

   5.2. Click OK

   5.3. Change Basin Area and Distances to desired units

   5.4. Click OK



You have now successfully delineated a watershed and are ready to prepare it for use in HMS.

THE FOLLOWING IS A TUTORIAL FOR PREPARING THE WATERSHED FOR ANALYSIS IN HMS AND FOR RUNNING THE ANALYSIS IN HMS:

1.3 Single Basin Analysis

The first simulation will be defined for a single basin. You will need to enter the global, or Job Control parameters as well as basin and meteorological data.

1. Setting up the Job Control:

   Most of the parameters required for a HEC-HMS model are defined for basins, outlets, and reaches. However, there are some “global” parameters that control the overall simulation and are not specific to any basin or reach in the model. These parameters are defined in the WMS interface using the Job Control dialog.

   1.1. Switch to the *Hydrologic Modeling* module 

   1.2. HEC-1 should be the default model, so change the default model to HEC-HMS by selecting it from the drop down list of models found in the Edit Window

   1.3. Select ***HEC-HMS | Job Control***

   1.4. Enter A desired name in the Name: field

   1.5. In the Description: field you can enter your name

   By default the simulation is set to run for 24 hours starting from today’s date at 15 minute intervals. You can choose the duration and intervals for which the simulation runs.

   1.6. Select the appropriate hours

   1.7. Change the Time interval to the desired interval

   1.8. Select the Basin Options tab

   1.9. Enter A desired name in the Name: field (same name chosen in the previous tab)

   1.10. Set the Basin Model Units to the desired units

   Setting the computation units DOES NOT cause any units conversion to take place. You are simply telling HEC-1 what units your input parameters are in and expect results of computation to be in the desired units. If you specify Metric then you must ensure that input units are metric (sq. kilometers, mm for rain, meters/kilometers for length) and results will be in metric (cms).

   1.11. Select the **Meteorological Options** tab

   1.12. Enter A desired name in the Name: field (same name chosen in the previous tab)

   1.13. Toggle on “Include evapotranspiration method in meteorological model”

   1.14. Select *OK*

1.4 Setting up the Basin Data Parameters

In the first simulation you will treat the entire watershed as a single basin.

1. Select the *Select Basin* tool 
2. Double-click on the brown basin icon labeled 1B. Double-clicking on a basin or outlet icon always brings up the parameter editor dialog for the current model (in this case HEC-HMS)
3. Notice that the area has been calculated.
4. Change the name to match the name you gave the basin earlier
5. Enter a desired description in the description box.

   Displaying and Showing options allows you to see only those variables for which you wish to enter data. For example in this case toggling on the *Loss Rate Method* allows you to pick which method you want to. You then toggle the display for the different parameters associated with a given methodology from the show column.

   The HMS-Properties window is versatile in that it allows you to see properties for all of selected basins, junctions, reaches, reservoirs, etc.
6. Toggle on the Display of the *Loss Rate Method* option
7. Toggle the *SMA* from the Show column in the Display options window
8. SMA parameters are defined using SMA units in WMS. To create a new SMA unit, select the “Define” button under “Define SMA Unit”.
9. In the Land Use Mapping dialog, turn OFF “SCS CN’s” and turn ON “SMA Unit” in the *Display parameters* section.
10. Select “Add landuse ID to list”.
11. Enter the correct values for each parameter below, for the SMA unit you have added:

    SMA Unit Name:
    SMA Canopy Storage Capacity:
    SMA Surface Storage Capacity:
    SMA Surface Soil Infiltration Max Rate:
    SMA Soil Profile Storage Capacity:
    SMA Soil Profile Tension Zone Capacity:
    SMA Soil Profile Percolation Max Rate:
    SMA Groundwater 1 Storage Capacity:
    SMA Groundwater 1 Percolation Max Rate:
    SMA Groundwater 1 Storage Coefficient:
    SMA Groundwater 2 Storage Capacity:
    SMA Groundwater 2 Percolation Max Rate:
    SMA Groundwater 2 Storage Coefficient:
12. Select the *Apply* button.

13. Enter the correct values for each parameter below for the SMA method:

    SMA Unit:
    % Impervious:
    % of Canopy Capacity:
    % of Surface Capacity:
    % of Soil Capacity:
    % of Groundwater 1 Capacity:
    % of Groundwater 2 Capacity:

14. In the *Display options* section of the HMS Properties dialog, turn on the *Transform* box on and then turn the *Clark* box on. Turn on the *Base Flow* box and turn on *Linear Reservoir*.

15. In the *Properties* portion of the *HMS Properties* dialog set the *Transform Method* to *Clark*. Set the *Baseflow Method* to *Linear Reservoir*.

16. Enter the correct values for each parameter below into the *HMS Properties* dialog:

    Time of Concentration:
    Storage Coefficient:
    Groundwater 1 Storage Coefficient:
    Groundwater 1 Number of Reservoirs:
    Groundwater 2 Storage Coefficient:
    Groundwater 2 Number of Reservoirs:

17. Select *OK* on the *HMS Properties* dialog.

You now have all of the basin parameters to run a long-term analysis. You will need to go to the HEC-HMS program to finish entering meteorologic data and to run and calibrate your HMS simulation.

1.5 Exporting Simulation to HEC-HMS

To run your HMS project, you will need to export the data you have defined in WMS to HMS. This section will guide you through the process of doing this.

1. Select ***HEC-HMS | Save HMS File…***
2. Enter a desired name for the name for the HMS file, note the directory you are saving the file to, and select Save.
3. Start up the HEC-HMS program. Perform the following commands in HEC-HMS
4. Select ***File | Open…***
5. Browse to the directory containing the HMS project you saved from WMS.
6. Open the HMS project you saved from WMS

1.6 Entering Precipitation data into HEC-HMS

To run a long-term hydrologic analysis in HEC-HEM, precipitation data needs to be inputted. This section will guide you through the process of doing this.

1. Click Components → Time-Series Data Manager
2. Click ***New…***
3. Give a name and a description to the new gage.
4. Click ***Create***
5. Close the Time-Series Data Manager dialogue box
6. Expand the Time-Series Data tree
7. Expand the Precipitation Gages tree
8. Expand the gage tree
9. Click the corresponding file under your gage
10. Under the Time Series Gage tab input the correct time interval
11. Under the Time tab, input the correct time duration
12. Under the Table tab, input the correct precipitation data

1.7 Entering Evapotranspiration data into HEC-HMS

To run a long-term hydrologic analysis in HEC-HEM, evapotranspiration data needs to be inputted. This section will guide you through the process of doing this.

1. Expand the **Meteorological Models** tree
2. Click on your watershed name
3. Under the *Meteorological Model* tab choose **Monthly Average** in the Evapotranspiration drop down menu.
4. Expand the tree that has your watershed name under the **Meteorological Models** tree.
5. Click on *Monthly Average*
6. Under the Evapotranspiration tab, input the correct **evapotranspiration rates** and **pan coefficients**.

1.8 Running the HEC-HMS Simulation

Now that you have exported your model and defined your meteorologic model, you can run the HEC-HMS simulation. To do this, perform the following steps:

1. Expand the **Basin Models** tree and click on your basin name. This will allow you to view your watershed.
2. Click **Compute → Create Simulation Run**
3. Click Next>
4. Click Next>
5. Click Next>
6. Click Finish
7. Click **Compute → Select Run** and then select the correct run
8. Click **Compute → Compute Run**
9. Click Close with computing reaches 100%

1.9 Viewing Results in HEC-HMS

This section will show you how to view results in HEC-HMS

1. Click on the **Results** tab
2. Expand the **Simulation Runs** tree
3. Choose the Run you want to see
4. Click on the name of your watershed
5. Now choose the results you want to view.

You have now successfully run a long term simulation in HEC-HMS and viewed the results.

☺

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NOTE: To optimize in HEC-HMS, discharge data will be needed.

1.10 Setting up a Discharge Gage

STEP 1: Open HEC-HMS 3.1.0

STEP 2: Open the HEC-HMS file saved from WMS

STEP 3: Click **Components → Time-Series Data Manager**

STEP 4: Choose *Discharge Gages* under the **Data Type** drop down menu

STEP 5: Click **New**…

STEP 6: Give the new gage a name

STEP 7: Click **Create**

STEP 8: Close the Time-Series Data Manager dialogue box

STEP 9: Expand the *Time-Series* Data tree

STEP 10: Expand the *Discharge Gages* Data tree

STEP 11: Expand the Gage 2 Data tree

STEP 12: Choose the gage listed under Gage 2

STEP 13: Under the *Time Window* tab, enter the correct starting and ending dates and time. NOTE: The starting dates and times must match the dates and time entered for the simulation

STEP 14: Under the *Table* tab, enter the correct discharge data with units of m^3/s

STEP 15: Expand the *Basin Models* tree (if it wasn't already)

STEP 16: Expand the *WMS Watershed* tree (if it wasn't already)

STEP 17: Select your basin

STEP 18: Under the *Options* tab, select your discharge gage under the *Observed flow* drop down menu

STEP 19: Click **Compute → Create Simulation Run**

STEP 20: Click Next > three times

STEP 21: Click Finish

STEP 22: Under the *Compute* tab, right click on the Run you just created and click Compute

STEP 23: At this point, you can check the result of the computed run by looking under the *Results* tab

1.11 Optimization

STEP 1: Click **Compute → Create Optimization Trial**
STEP 2: Click Next
STEP 3: Choose the correct run and click Next
STEP 4: Click Finish
STEP 5: Under the *Compute* tab, expand the *Optimization Trials* tree
STEP 6: Expand the Trial tree
STEP 7: Right click on the trial you just created and click *Add Parameter* (repeat this step until you have as many parameters as needed)
STEP 8: Click on Parameter 1
STEP 9: Under the Parameter 1 tab, choose your basin under the element drop down menu.
STEP 10: Under the Parameter 1 tab, choose the parameter you want to optimize under the Parameter drop down menu
STEP 11: Under the Parameter 1 tab, choose "No" under the *Locked* drop down menu, and choose appropriate values for the *Initial Value*, *Minimum*, and *Maximum*
STEP 12: Repeat Steps 8-11 for all the parameters added
STEP 13: Right click on the trial and click Compute

1.12 Results

STEP 1: Click the *Results* tab
STEP 2: Expand the *Optimization Trials* tree
STEP 3: Expand the *Trial 1* tree
STEP 4: Click on *Optimized Parameters* to view the new and optimized values

Emails to and from our Counterparts in Mexico:

On 2/6/07, **Adam Birdsall** <adam_birdsall@yahoo.com> wrote:

Hola,

We understand that the Cuenca Cajon needs to be modeled. We were wondering what flows you wanted us to find/calculate for the model, where the exit point for the watershed is located, and what some rough boundaries for the watershed are.

We only have a basic understanding of the project (only a paragraph), and we'd like to know more about it.

Tenemos algunos preguntas para ustedes concerniente al proyecto de la Cuenca Cajon. Primero, quisieramos saber si ustedes sepan cuales de los flujos se necesita calcular para el modelo de la cuenca. Segundo, necesitamos los coordenadas geograficas de la desembocadura de la cuenca. Tambien, quisieramos obtener algunos limites de la cuenca para modelarla.

Solo tenemos una idea basica del proyecto (un parafo no mas) y nos gustaria averiguar mas lo que se quiere cumplir con este proyecto. Gracias por la ayuda.

Adam Birdsall
Thomas Lloyd
Kyle Sanford

On 2/6/07, ***Hugo De Alba <hugo.dealba@gmail.com>*** wrote:

Hello Adam, Thomas and Kyle

Mañana recibirán un documento explicativo hecho por los estudiantes
con información básica y ubicación geográfica del embalse El
Cajón.

Estamos preparando la información necesaria para alimentar WMS.
Estamos conviertiendo los usos y tipo de suelo que utiliza INEGI
(Instituto nacional de estadística, geografía e informática) al USGS
land use an land cover codes. También les enviaremos los códigos de
las cartas de INEGI y dónde pueden descargar los modelos digitales de
elevación cada 30 metros.

En cuanto a sus dudas sobre el caudal, se utilizarán los datos de una

estación hidrométrica ubicada en la Yesca, todavía necesitamos
procesar los datos, pero en cuanto estén listos se los enviaremos.

Saludos,

Hugo

Tomorrow you should recieve a document made by the studentes explaining the basic information of El Cajon lake and also its geographic location.

We are preparing necessary information to use WMS, we are converting INEGI's land use an land cover codes into the USGS codes. Also we will send you an url where you can download INEGI's 30 meter DEMs.

Regarding your questions about the flow, we will use data from the hydrolmetric station located in La Yesca, but we are still processing the data, so as soon as we have it ready we'll send it to you.

Best regards,

Hugo

On 2/16/07, **Adam Birdsall** <adam_birdsall@yahoo.com> wrote:

Hugo:

Hemos recibido informacion para empezar nuestro modelo. Pero hay una diferencia entre lo que hemos modelado y la foto que ustedes nos han enviado. Queremos averiguar si es una diferencia valida o si la foto que nos enviaron es incorrecto. La difererncia que vemos esta en la parte del sur-este que se falto en la foto suya. Hay una estructra alla? No sabemos... Hemos incluido una foto de nuestro modelo de la cuanca que muestra el area de la cual tenemos la pregunta.

Tambien queremos averiguar cuando nos van a enviar los datos de precipitacion (la cantidad de la lluvia y la frequencia que llueva), la locacion exacta de la desembocadura de la cuenca (coordinados geograficos), la locacion de estructuras por el rio, el uso de la tierra adentro de la cuenca, el tipo de suelo en la cuenca, y datos de infiltracion y evaporacion. Esta informacion es lo que se requiere para criar un modelo de la cuenca a largo plazo. Gracias por su ayuda.

We have received quite a bit of information from you that has allowed us to begin modeling the watershed. However, we have noticed a distinct difference between the picture of teh watershed that you sent us and the resulting watershed delineated in our model. We were wondering if this was a legitimate difference, or if the picture you sent us was wrong. Is there a structure (like a dam or something) that we don't know about along the river? We have attached a picture of our watershed model which shows the area in question.

Also, we still need to get some more information from you. We need to know the precipitation data for the watershed (such as daily and hourly amounts as well as the frequency of the events). We also would like to know the exact location of the outlet of the watershed (geographic coordinates), the land use, soil type, infiltration rate, and evaporation rate. This information is what is required for a long-term model of the watershed. Thanks for your help in obtaining this information.

Adam Birdsall
Thomas Lloyd
Kyle Sanford

On 2/16/07, ***Hugo De Alba <hugo.dealba@gmail.com>*** wrote:

Hello Adam, first of all, yes there will be another dam in that spot that you mentioned, it will be called La Yesca. I don't have here the exact geographic coordenates for the outlet of the watershed here, but i will tell to students to send it to you as soon as possible and La Yesca's too.

We're trying to get the precipitation data, but is taking much longer than we expected, but i think we will get them soon, if not we can work provisionally with INEGI's hyetographs, but i don't like them because they are in 1:1,000,000 scale.

Students made two shapefiles of USGS Land use codes and soil type, these will serve you well in the model. I sent them to you through yousendit.com

Best regards,

Hugo

On 3/9/07, **Adam Birdsall** <adam_birdsall@yahoo.com > wrote:
Hugo y los demas,

Hemos cumplido con un modelo a largo plazo, pero el modelo contiene datos incorrectos. Entonces, podemos empezar a modelar la cuenca Cajon cuando ustedes nos envian la informacion que ya hemos pedido. Para recordarles, necesitamos datos del promedio de evaporacion para cada mes que quieren modelar; datos diarios de precipitacion (o cualquier frequencia que quisieran modelar); capacidades de la tierra, pabellon, agua subterranea; tambien el flujo bajo del rio y tarifas de filtracion. Sabemos que esta informacion puede ser dificil a obtener, pero si ustedes pudieran por lo menos adivinar numeros para estos parametros, nos ayudaria mucho.

Tambien, nuestro profesor quiere que presentemos algo. Hay cosas que ustedes quieren que presentemos que les ayudaria mas? Dinos si hay. Gracias!

We have successfully completed a long term model of the Cajon watershed, but the model contains incorrect information. We can start modeling the watershed once you send us the information that we have requested. To remind you, we need monthly averages for evaporation; daily values for precipitation (or whatever other frequency that you want to model); capacities of soil, canopy, and groundwater; also the base flow of the river and percolation and fitlration rates. We know that this information can be difficult to obtain, but if you could at least have a general idea of these values, that would help us a lot.

Also, our professor wants us to give a presentation something for you in Mexico. Are there things that you would like us to present that would be helpful for you? Let us know if there are. Thanks!

Adam Birdsall

On 3/9/07, ***Hugo De Alba* <*hugo.dealba@gmail.com*>** wrote:
Adam,

First of all, i'm sorry we haven't got the precipitation data yet, but i got Tepic's daily mean values for precipitation which is the nearest mayor city to El Cajón, I guess because of the lack of data we can use them. I also got the monthly evaporation values, but is a graph, i could´nt get a table, i hope that's fine.

I don't know what you mean with capacities of the soil, the shapefile that i sent you didn't work? is it for getting the infiltration rate? I send you some text, i hope that will be useful.
Neither, i don't know what you mean for canopy (pabellón)

Regarding the presentation, if it's possible we'd like to see the procedure you made to get the model in order for us to learn how to make one of our one.

If you have another question please don't hesitate to ask.

We look forward to see you guys in Guadalajara!

Hugo

Antes que nada, siento mucho no tener los datos de precipitación todavía, pero conseguí los datos promedio de precipitación diaria de Tepic que es la ciudad importante más cercana a El Cajón, supongo que a por falta de los datos de la zona se podrán utilizar éstos. También conseguí los valores mensuales de evaporación, aunque solo pude conseguir una gráfica, espero que sirva.

No entendí a que te refieres con capacidades del suelo, no te sirvió el shapefile de suelo, ¿lo de capacidad de suelo es para obtener la tasa de inflitración? Te mando un texto que encontré, espero te sea útil. Tampoco entendí a que te refieres con pabellón.

Sobre la presentación, me gustaría si es posible ver el procediento que hicieron para obtener el modelo para nosotros poder aprender a hacer uno nosotros.

Si tienes más dudas por favor preguntame.

Esperamos verlos muy pronto aquí en Guadalajara,

Hugo

On 3/12/07, **Adam Birdsall** <adam_birdsall@yahoo.com> wrote:
Hugo,

The soil storage is how much water the soil can hold before becoming saturated. Its units are in inches. The canopy storage capacity is similar in that it is the amount of water that the vegetation (plants) can hold, also measured in inches. I hope this answers your questions.

La capacidad del suelo refiere a cuanto se puede sostener en el suelo sin llegar a ser lleno. Las unidades de esta capacidad son en pulgadas. La capacidad de pabellon es similar. Esa capacidad refiere a la cantidad de agua que la vegetacion puede sostener, tambien sus unidades son pulgadas. Ojala que esto contesta a sus preguntas.

Adam

On 3/12/07, ***Hugo De Alba <hugo.dealba@gmail.com>*** wrote:

Adam,

I get it, it's for the initial abstraction.

Soil capacities are in the document i've just sent you, in graphs so i hope they're useful.

But i'm looking for the canopy storage.

I send you the original shapefiles with land use and vegetation, and soil types, maybe you can get it with the type of vegetation.

Ya entendí, es para la abstracción inicial.

Las capacidades del suelo vienen en una gráfica en el documento que te acabo de mandar, espero te sean útiles.

Estoy buscando las de *canopy*
Te mando los shapefiles originales de uso de suelo y vegetación y el de tipo de suelos. Tal vez puedes encontrar la capacidad por el tipo de vegetación.

Saludos,

Hugo

On 3/27/07, ***Hugo De Alba* <*hugo.dealba@gmail.com*>** wrote:

Hello Jim, Joshua, Adam, Kyle and Thomas

Espero que hayan disfrutado su estancia en México, como se habrán dado cuenta, en mi país tenemos todavía mucho trabajo por hacer para erradicar la pobreza y cuidar el medio ambiente, aunque no lo crean, este trabajo en conjunto y su visita es un gran paso para mejorar esta situación.

Espero que se encuentren muy bien de regreso en Utah en compañía de sus familias y amigos, quiero decirles que tenerlos aquí en Guadalajara, fue una experiencia muy agradable, interesante y sobre todo muy enriquecerdora. Ha sido todo un placer trabajar con alumnos de Estados Unidos y creo que se ganó mucho más que un simple modelo hidrológico, espero que se repita cada año y poder formar una unión de fraternidad entre ITESO y BYU. Seguimos en contacto para terminar este proyecto y quedo a sus ódernes para cualquier cosa que se les ofrezca.

Si alguna vez regresan a Guadalajara no duden en contactarme, siempre serán bienvenidos en mi casa.

Un abrazo,

Hugo
