Introduction to AGWA 3.0
The Automated Geospatial Watershed Assessment Tool

Assessing Alternative Futures Using ICLUS Data

Introduction	In this exercise you will use ICLUS (Integrated Climate and Land-Use Scenarios) data to investigate the manner in which land cover changes can affect runoff processes in the Cherry Creek watershed, Colorado.
Goal	To familiarize you with AGWA to analyze ICLUS land cover data for predictive hydrologic modeling for landscape assessment.
Assignment	Build land cover grids for 2020 and 2100 from the ICLUS A2 scenario in ArcMap for input into AGWA, and use it to run the SWAT model on the Cherry Creek watershed.

An Introduction to Alternative Futures Assessment with ICLUS Data

Changes in land-use and land cover are critical in the determination of water availability, quality, and demand. The consequences of human modification of the Earth's surface for extraction of natural resources, agricultural production, and urbanization may rival those that are anticipated via climate change (Vitousek 1994, Vörösmarty et al. 2000, Chapin et al. 2002, DeFries and Eshleman 2004, Brauman et al. 2007, Whitehead et al. 2009).

Scenario analysis provides the capability to explore pathways of change that completely diverge from baseline conditions and lead to plausible future states or events. Scenario analysis has been used extensively for a number of watershed issues related to environmental decision making (Kepner et al. 2012, March et al. 2012). Although a number of scenario frameworks are available to assist in evaluating policy or management options, most are designed to analyze alternative futures related to decision options, potential impacts and benefits, long-term risks, and management opportunities. They frequently are combined with process modelling and are intended to bridge the gap between science and decision making and are effective across a range of spatial and temporal scales (Liu et al. 2008a and 2008b, Mahmoud et al. 2009).

The Integrated Climate and Land-Use Scenarios (ICLUS; Bierwagen et al., 2010; EPA, 2009; EPA, 2010) project data was identified as an ideal dataset for projecting basin-wide development into the future because its national-scale housing-density (HD) scenarios are consistent with the Intergovernmental Panel on Climate Change (IPCC, 2001) Special Report on Emissions Scenarios (SRES; Nakicenovic and Swart, 2000) greenhouse gas emissions storylines. The ICLUS database produced 5 seamless, national-scale change scenarios for urban and residential development (Table 1).

By merging ICLUS projections from different years with National Land Cover Database (NLCD) data, it is possible to measure the change in land cover over time. These land cover grids can then be inputted into AGWA to assess change in watershed parameters over time.

Table 1: Summary of the types of changes of the different ICLUS scenarios.

Global Scenario		Demographic Model			Spatial Allocation Model	
		Fertility	Domestic migration	Net international migration	Household size	Urban form
A1	medium population growth; fast economic development; high global integration	low	high	high	smaller (-15%)	no change
B1	medium population growth; low domestic migration resulting in compact urban development	low	low	high	smaller (-15%)	slight compaction
A2	high population growth; greatest land conversion; high domestic migration resulting in new population centers	high	high	low	larger (+15%)	no change
B2	moderate economic development; medium population growth; medium international migration	medium	low	low	no change	slight compaction
Baseline (2000)	US Census medium scenario	medium	medium	medium	no change	no change

The Study Area

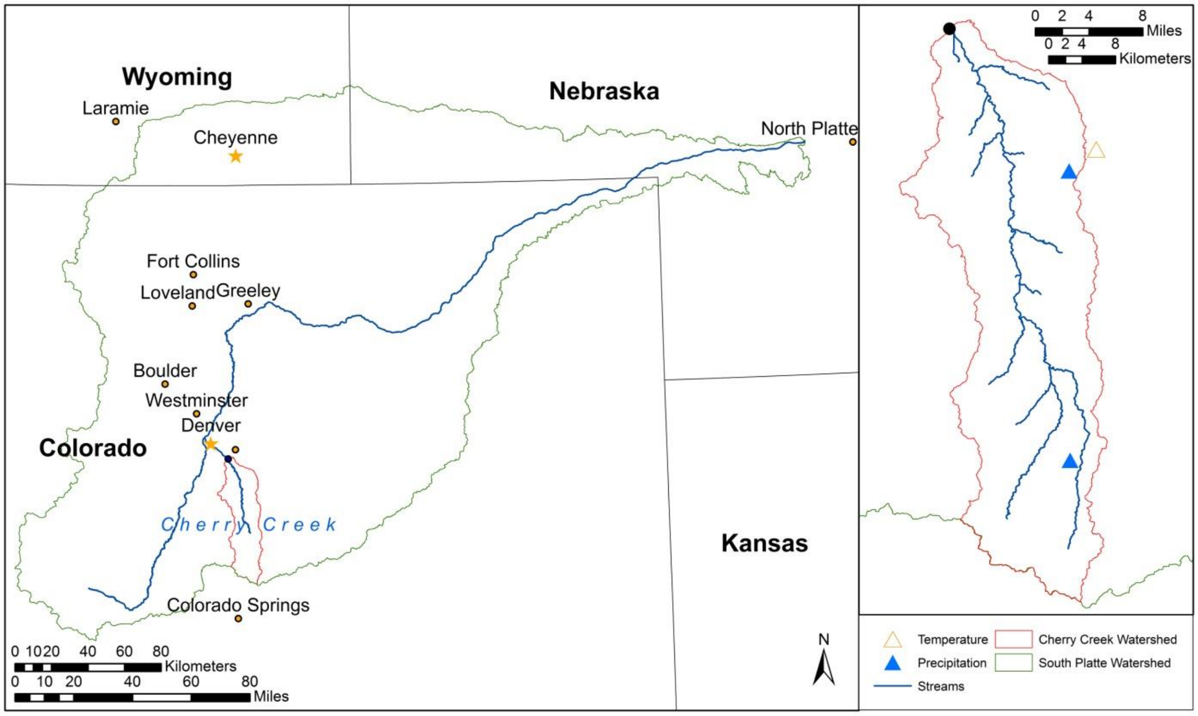
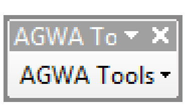


Figure 1. Location Map of the study area, the Cherry Creek Watershed within the South Platte River Basin.

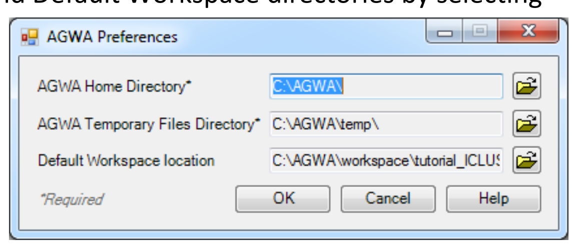
This exercise examines the effects of land cover change on the hydrology of the South Platte River Basin, which drains parts of Colorado, Wyoming and Nebraska. To ensure adequate time to finish the exercise, Part 2 of this exercise examines only hydrological effects in the Cherry Creek Watershed above the Cherry Creek Reservoir instead of the entire South Platte (Figure 1).

Getting Started

Start ArcMap with a new empty map. Save the empty map document as **tutorial_ICLUS_SouthPlatte** in the **C:\AGWA\tutorial_ICLUS_SouthPlatte** directory. If the ***AGWA Toolbar*** is not visible, turn it on by selecting ***Customize > Toolbars > AGWA Toolbar*** on the ArcMap Main Menu bar. Once the map document is opened and saved, set the Home, Temp, and Default Workspace directories by selecting ***AGWA Tools > Other Options > AGWA Preferences***



on the ***AGWA Toolbar***.



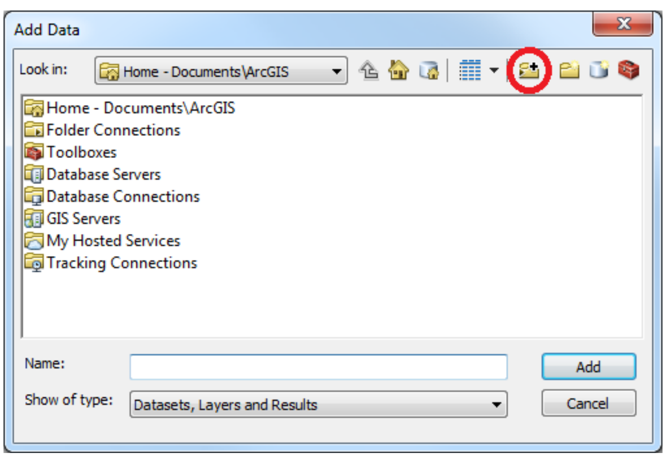
- Home: **C:\AGWA**
- Temp: **C:\AGWA\temp**

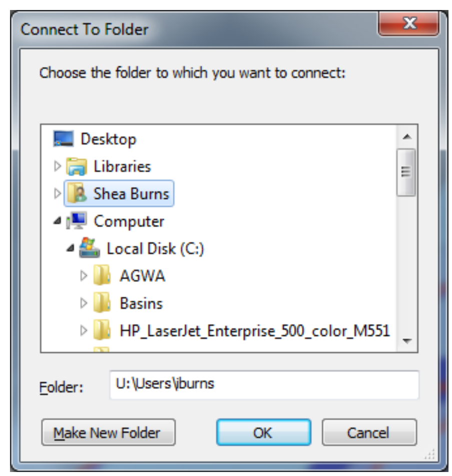
- Default Workspace: **C:\AGWA\workspace\tutorial_ICLUS_SouthPlatte**
  The default workspace location will need to be created by clicking on ***Make New Folder*** button in the window that opens.

> The Home directory contains all of the look-up tables, datafiles, models, and documentation required for AGWA to run. If this is set improperly or you are missing any files, you will be presented with a warning that lists the missing directories or files that AGWA requires.
>
> The Temp directory is where some temporary files created during various steps in AGWA will be placed. You may want to routinely delete files and directories in the Temp directory if you need to free up space or are interested in identifying the temporary files associated with your next AGWA use.
>
> The Default Workspace directory is where delineation geodatabases will be stored by default. This can be a helpful timesaver during the navigation process if you have a deeply nested directory structure where you store AGWA outputs.

GIS Data

Before adding data to the map, connections to drives and folders where your data are stored must be established if they have not been already. To establish folder connections if they don't already exist, click on the ***Add Data*** button below the menu bar at the top of the screen. In the Add Data form that opens, click the ***Connect To Folder*** button and select **Local Disk (C:)**.





Once the folder connection is established, navigate to the ***C:\AGWA\gisdata\tutorial_ICLUS_SouthPlatte*** folder and add the following datasets and layers:

- **..\cc_outlet.shp**
- **..\clipext**

- **..\facgfilldem1**
- **..\fdgfilldem10m**
- **..\filldem10m**
- **..\gsmsoilmu_a_co.shp**
- **..\nlcd2011cc**
- **..\pcp_gage.shp**

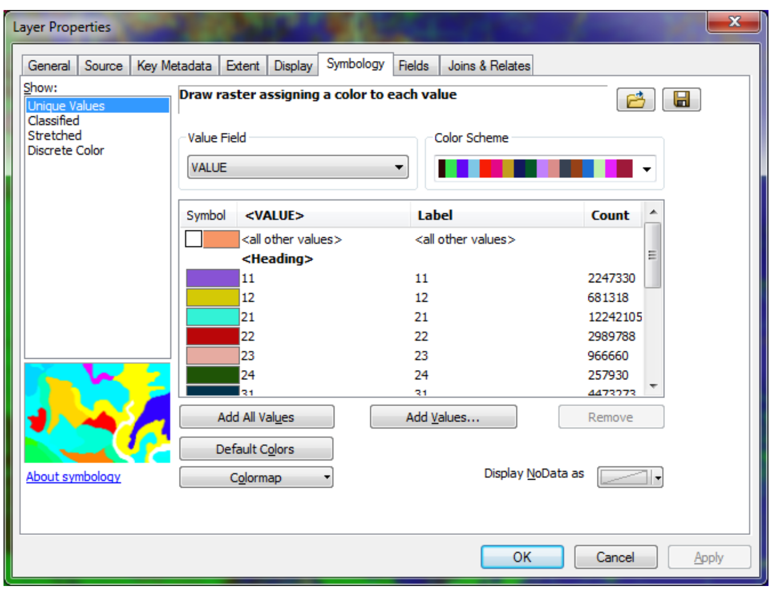
Then add the ICLUS Housing Density coverage from the ***C:\AGWA\gisdata\tutorial_ICLUS_SouthPlatte\ICLUSData*** folder:

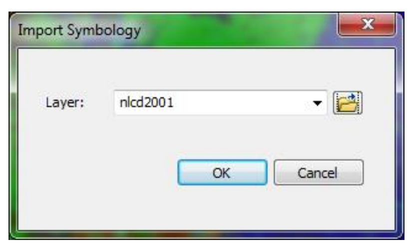
- **..\bhc2020a2**
- **..\bhc2100a2**

You will also need to add the following files from the ***C:\AGWA\datafiles*** folder:

- **..\lc_luts\mrlc2001_lut.dbf** – MRLC look-up table for 2001, 2006, and 2011 NLCD land cover
- **..\precip\tutorial_ICLUS_SouthPlatte\SWAT_pcp1990.csv**– unweighted precipitation data for gage in the study area
- **..\wgn\wgn_us83.shp** – weather generator stations for SWAT

To better visualize the different land cover types and associate the pixels with their classification, load a legend into the ***nlcd2011cc*** dataset. To do this, right click the layer name of the **nlcd2011cc** dataset in the ***Table of Contents*** and select ***Properties*** from the context menu that appears. Select the ***Symbology*** tab from the form that opens. In the ***Show*** box on the left side of the form, select ***Unique Values*** and click the button on the right. Click the file browser button, navigate to and select **C:\AGWA\datafiles\renderers\nlcd2001.lyr** and click on ***Add***, and click ***OK*** to apply the symbology and exit the ***Import Symbology*** form. Click on ***Apply*** in the ***Layer Properties*** form and then on ***OK*** to exit this form.





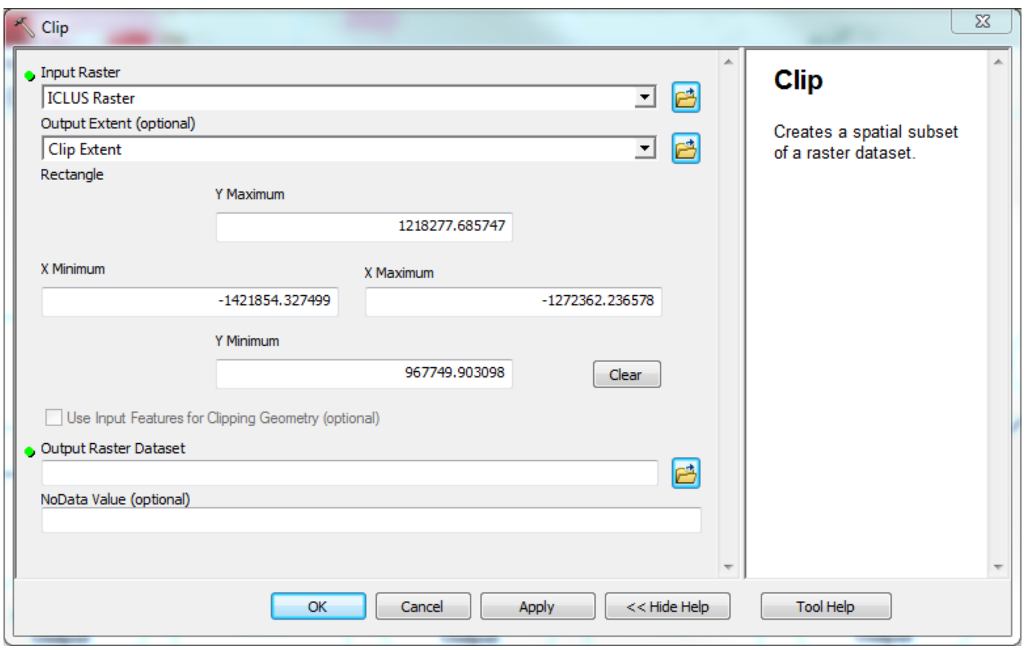
Part 1: Creating Land Cover Grids from ICLUS data

In Part 1, you will modify National Land Cover Database (NLCD) 2011 grids based on the ICLUS Scenario A2 data for decades 2020 and 2100 using the ***Land Cover*** model in the ***ICLUS*** toolbox in ArcMap.

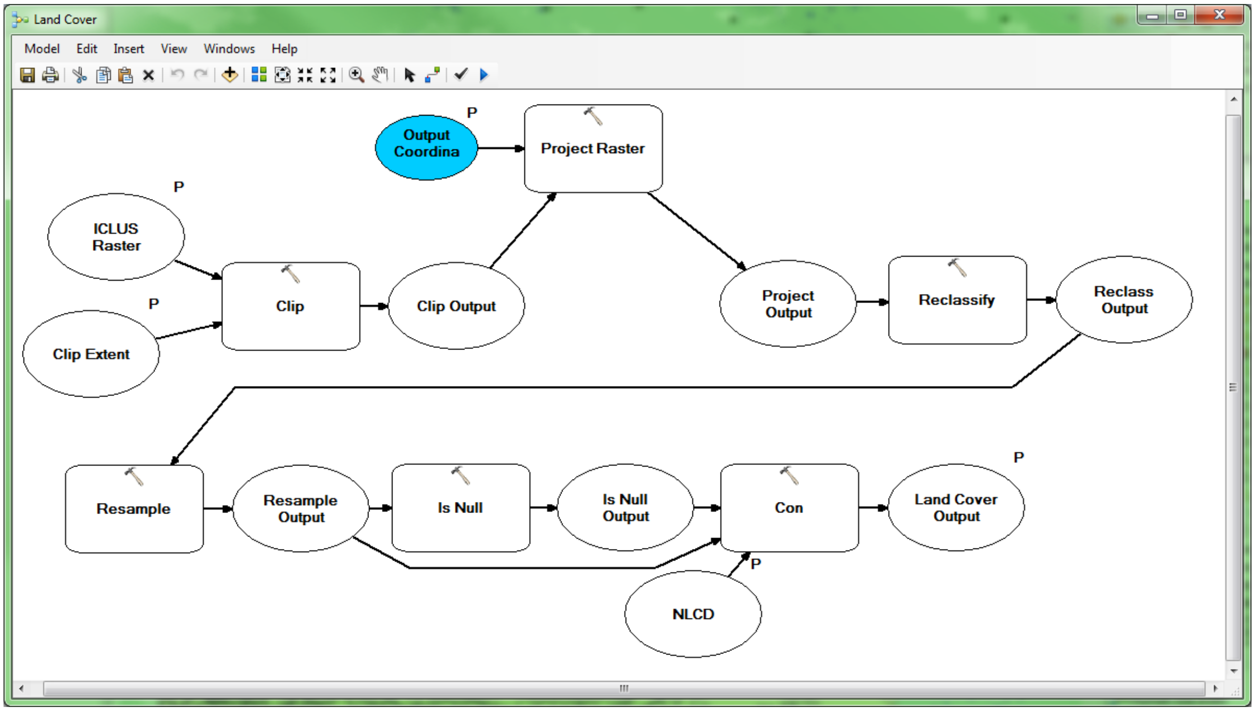
1. Navigate to the ***ICLUS*** toolbox and explore the ***Land Cover*** model.
   1.1. Open ***ArcCatalog*** by clicking the ***ArcCatalog*** button .
   1.2. Navigate to ***C:\AGWA\gisdata\tutorial_ICLUS_SouthPlatte*** to find and open the ***ICLUS_101.tbx*** toolbox.
   1.3. Right-click on the ***Land Cover*** model and choose ***Edit*** to explore the model in ***Model Builder***.

The Model Builder window shows the different data, processes, and tools in the model. Spend some time looking at the model to understand what is involved. The oval icons are data that are input by the user, pre-defined in the model, or derived during the model execution. The rectangular icons are tools from ArcToolbox.

   1.4. Double-click on the ***Clip*** tool.



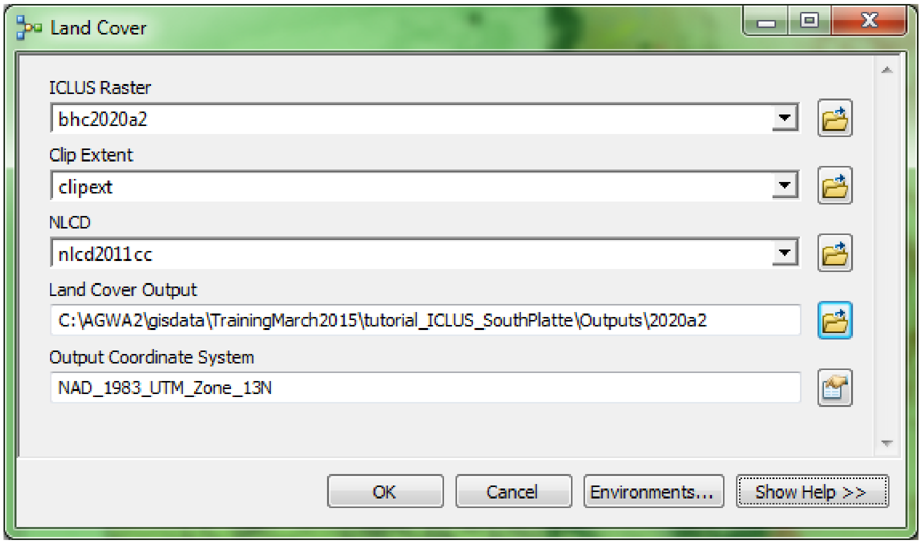
   1.5. You can see that the parameter ***ICLUS Raster*** is directed to the ***Input Raster*** (parameters are user-specified items labeled with a “P” to the upper right of the icon) and the parameter ***Clip Extent*** is directed to the ***Output Extent (optional)***. This is done because the ICLUS layers are national grids and when used as an input for a local or regional application like this exercise, it can substantially increase the processing time if not clipped to an area of interest first. The ***Output Raster Dataset*** is blank because it will be automatically created as an intermediate layer by the model. This output layer will then be fed into the next tool in the model, ***Project Raster***. This process continues until the final output layer, ***Land Cover Output*** is created.



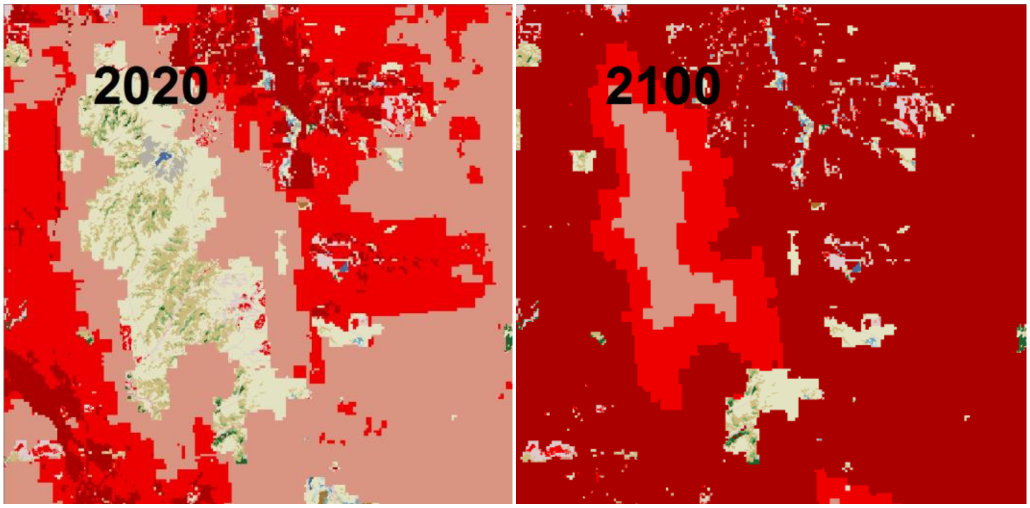
1.6. Close the ***Model Builder*** window.

2. Run the ***Land Cover*** model in the ***ICLUS*** toolbox for the 2020 decade.
   2.1. Double-click on the ***Land Cover*** model in the ***ICLUS*** toolbox in the ***ArcCatalog*** window. The model will open and display the required input parameters.
   2.2. ***ICLUS Raster***: select **bhc2020a2**.
   2.3. ***Clip Extent***: select **clipext**.
   2.4. ***NLCD***: select **nlcd2011cc**.
   2.5. ***Land Cover Output***: navigate to and enter **C:\AGWA\gisdata\tutorial_ICLUS_SouthPlatte\Outputs\2020a2**.
   2.6. ***Output Coordinate System***: **NAD_1983_UTM_Zone_13N**

2.7. Click ***OK*** and the model will run. The output land cover layer will appear in ArcMap upon completion of the model.



3. Now run the ***Land Cover*** model in the ***ICLUS*** toolbox for the 2100 decade.
   3.1. Double-click on the ***Land Cover*** model in the ***ICLUS*** toolbox in the ***ArcCatalog*** window. The model will open and display the required input parameters.
   3.2. ***ICLUS Raster***: select **bhc2100a2**.
   3.3. ***Clip Extent***: select **clipext**.
   3.4. ***NLCD***: select **nlcd2011cc**.
   3.5. ***Land Cover Output***: navigate to and enter **C:\AGWA\gisdata\tutorial_ICLUS_SouthPlatte\Outputs\2100a2**.
   3.6. ***Output Coordinate System***: **NAD_1983_UTM_Zone_13N**
   3.7. Click ***OK*** and the model will run. The output land cover layer will appear in ArcMap upon completion of the model.
4. Next visualize the new land cover datasets
   4.1. Right click the layer name of the ***2020a2*** dataset in the ***Table of Contents*** and select ***Properties*** from the context menu that appears.
   4.2. Select the ***Symbology*** tab from the form that opens.
   4.3. In the ***Show*** box on the left side of the form, select ***Unique Values*** and click the  button on the right.
   4.4. Click the file browser button, navigate to and select ***nlcd2011cc***.
   4.5. Hit apply and close windows.
   4.6. Repeat 4.1-4.6 for the ***2100a2*** layer.
5. Compare the Land Cover Grids

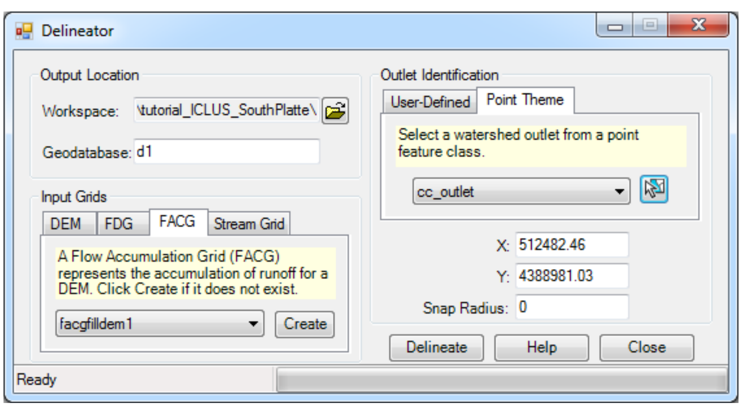


Zoom in to an urban area (an area with a lot of red pixels), and compare the 2020 and 2100 grids. Notice the increased urbanization in the 2100 grid, with more area being covered by low, medium, and high intensity development.

Part 2: Modeling Runoff at the Basin Scale Using SWAT

In Part 2, you will evaluate the impact of land use change from 2020 to 2100 using the land cover grids you created in Part 1. This will be done using the SWAT model in AGWA. Watershed delineation, discretization, and parameterization will be covered, along with precipitation input file preparation, model execution, and results visualization.

6. Perform the watershed delineation by selecting ***AGWA Tools > Delineation Options > Delineate Watershed***.



6.1. ***Output Location*** box

6.1.1. ***Workspace*** textbox: navigate to and select/create **C:\AGWA\workspace\tutorial_ICLUS_SouthPlatte**

DESCRIPTION The workspace specified is the location on your hard drive where the delineated watershed is stored as a feature class in a geodatabase.

6.1.2. ***Geodatabase*** textbox: enter **d1**

NOTE You will be required to change the name of the geodatabase if a geodatabase with the same name exists in the selected workspace.

6.2. ***Input Grids*** box

6.2.1. ***DEM*** tab: select **filldem10m** (do not click Fill)

6.2.2. ***FDG*** tab: select **fdgfilldem10m** (do not click Create)

6.2.3. ***FACG*** tab: select **facgfilldem1** (do not click Create)

6.2.4. ***Stream Grid*** tab: do nothing

6.3. ***Outlet Identification*** box

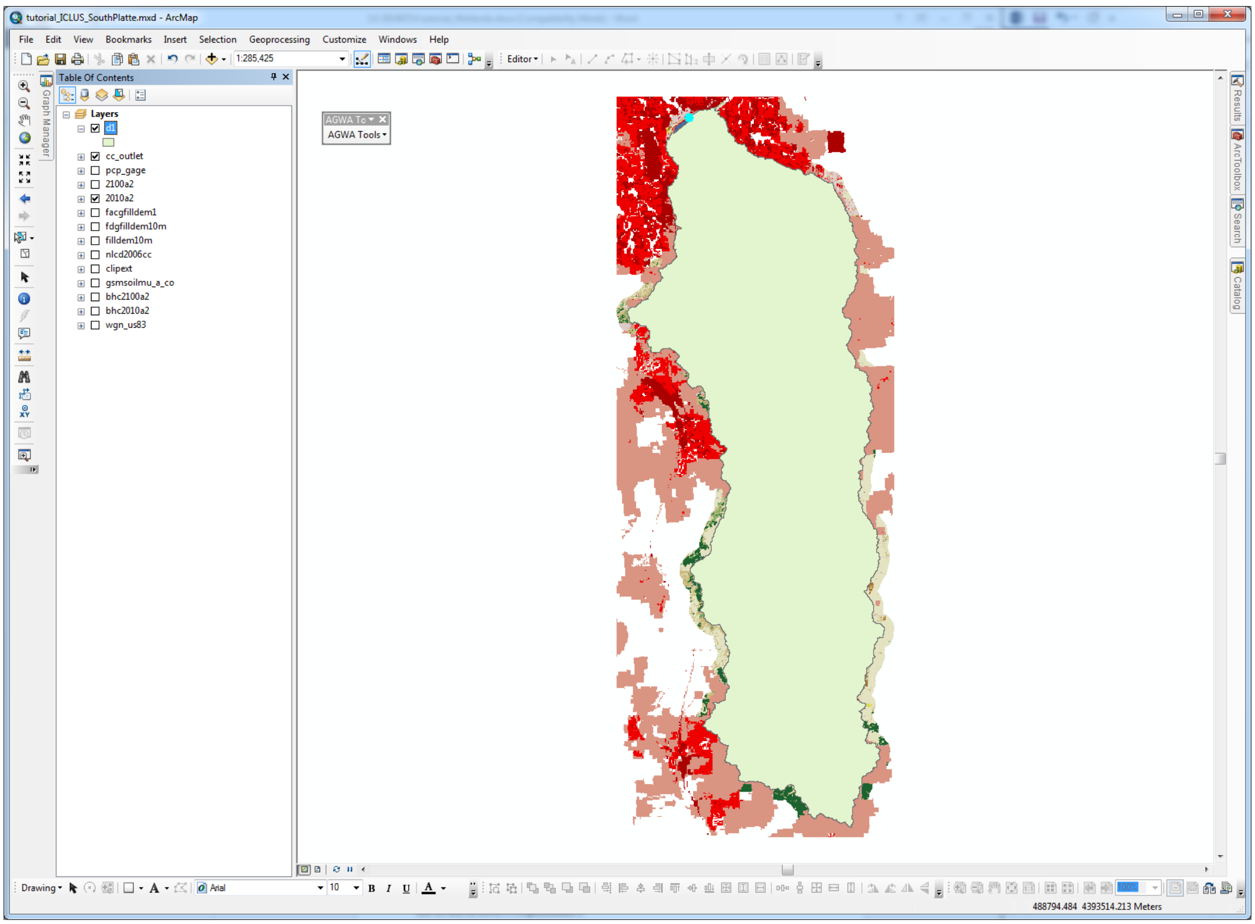
6.3.1. ***Point Theme*** tab

6.3.1.1. ***Outlets theme***: select **cc_outlet**.

6.3.1.2. Click the ***Select Feature*** button and click and drag to draw a rectangle around the point.

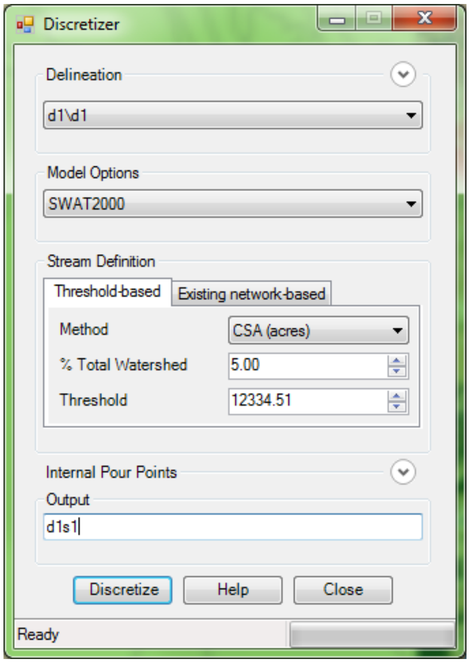
6.4. Click ***Delineate***.

6.5. Save the map document and continue to the next step.



At this point, the Cherry Creek watershed is delineated. The workspace specified is the location on your hard drive where the delineated watershed is stored as a feature class in a geodatabase. The discretization created next will also be stored in the geodatabase.

7. Perform the watershed discretization by selecting ***AGWA Tools > Discretization Options > Discretize Watershed***.



7.1. ***Input*** box

7.1.1. ***Delineation***: select **d1\d1**

7.2. ***Model Options*** box

7.2.1. ***Model***: select **SWAT2000**

7.3. ***Stream Definition*** box

7.3.1. ***Method***: do nothing (the default is acres)

7.3.2. ***% Total Watershed***: set to **5.00%**

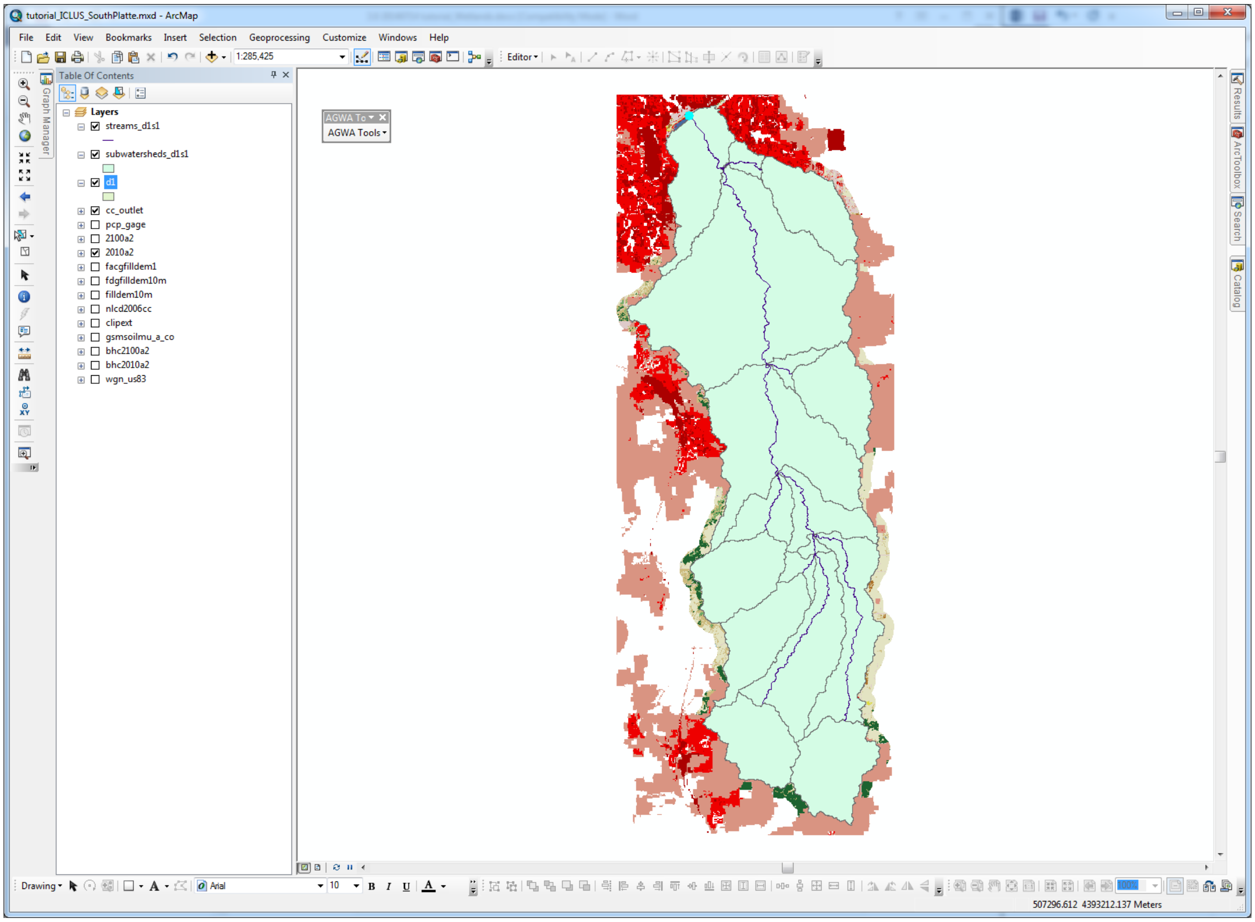
7.3.3. ***Threshold***: do nothing (this value will change when you change the % Area above)

7.4. ***Output*** box

7.4.1. ***Name***: enter **d1s1**

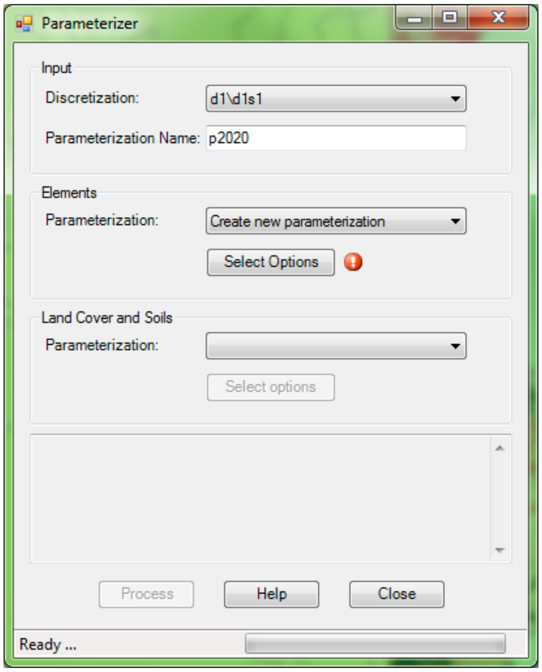
7.5. Click ***Discretize***.

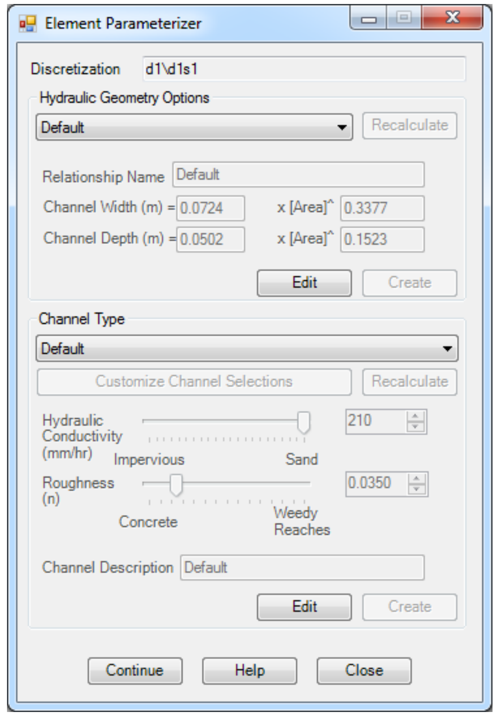
7.6. Save the map document and continue to the next step.



Discretizing breaks up the delineation/watershed into model specific elements and creates a stream feature class that drains the elements. The CSA, or Contributing/Channel Source Area, is a threshold value which defines first order channel initiation, or the upland area required for channelized flow to begin. Smaller CSA values result in a more complex watershed, and larger CSA values result in a less complex watershed. The default CSA in AGWA is set to 2.5% of the total watershed area. The discretization process created a subwatersheds layer with the name **subwatersheds_d1s1** and a streams map named **streams_d1s1**. In AGWA discretizations, are referred to with their geodatabase name as a prefix followed by the discretization name given in the *Discretizer* form, e.g. **d1\d1s1**.

8. Perform the element, land cover, and soils parameterization of the watershed by selecting ***AGWA Tools*** > ***Parameterization Options*** > ***Parameterize***.
   8.1. ***Input*** box
      8.1.1. ***Discretization***: select **d1\d1s1**
      8.1.2. ***Parameterization Name***: enter **p2020**
   8.2. ***Elements*** box
      8.2.1. ***Parameterization***: select **Create new parameterization**
      8.2.2. Click ***Select Options***. The ***Element Parameterizer*** form opens.





8.3. In the ***Element Parameterizer*** form

8.3.1. ***Hydraulic Geometry Options*** box

8.3.1.1. Select the **Default** item.

Do not click the ***Recalculate*** button.

Do not click the ***Edit*** button.

8.3.2. ***Channel Type*** box

8.3.2.1. Select the **Default** item.

Do not click the ***Recalculate*** button.

Do not click the ***Edit*** button.

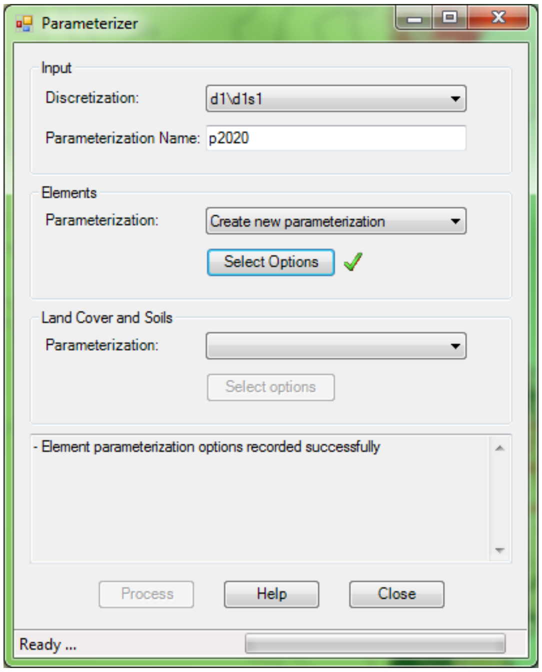
8.3.3. Click ***Continue***. You will be returned to the ***Parameterizer*** form to create the Land Cover and Soils parameterization.

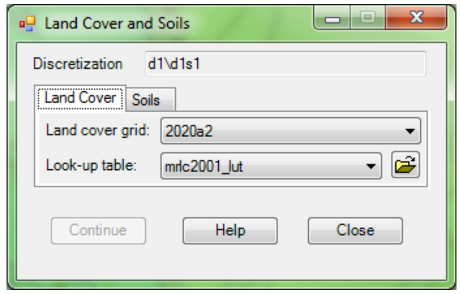
Element parameterization defines topographic properties of the subwatershed and channel elements. The properties defined depend on the model, but examples of SWAT properties include mean elevation, max flow length, and average slope for subwatershed elements and routing sequence, average slope, and channel dimensions for channel elements. The *Hydraulic Geometry Options* set channel dimensions using relationships between channel contributing area and channel depth/height. The *Channel Type* selection sets the infiltrability, roughness, and for KINEROS, the armoring of the channel elements. The channel type parameters can vary from developed, concrete channels with low roughness and zero infiltrability to natural, very weedy reaches with high roughness and high infiltrability. The **Default** *Hydraulic Geometry Options*, unless edited, is equivalent to the *Walnut Gulch Watershed , AZ* relationship. The **Default** *Channel Type*, unless edited, is equivalent to the *Natural* channel type.

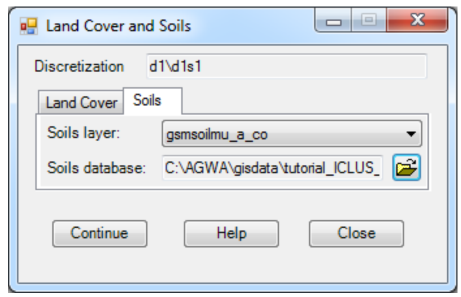
8.4. Back in the ***Land Cover and Soils*** box of the ***Parameterizer*** form

8.4.1. ***Parameterization***: select **Create new parameterization**

8.4.2. Click ***Select Options***. The ***Land Cover and Soils*** form opens.







8.5. In the ***Land Cover and Soils*** form

8.5.1. ***Land Cover*** tab

8.5.1.1. ***Land cover grid***: select **2020a2**

8.5.1.2. ***Look-up table***: select **mrlc2001_lut**

8.5.2. ***Soils*** tab

8.5.2.1. ***Soils layer***: select **gsmsoilmu_a_co**

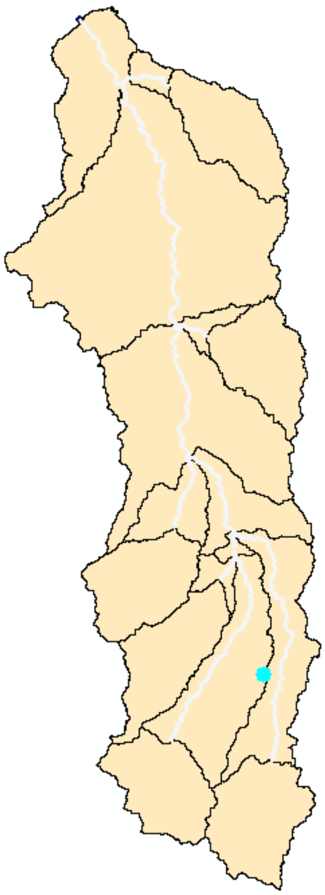
8.5.2.2. ***Soils database:*** navigate to and select **C:\AGWA\gisdata\tutorial_ICLUS_SouthPlatte\wss_gsmsoil_CO_[2006-07-06]\soildb_US_2003.mdb**

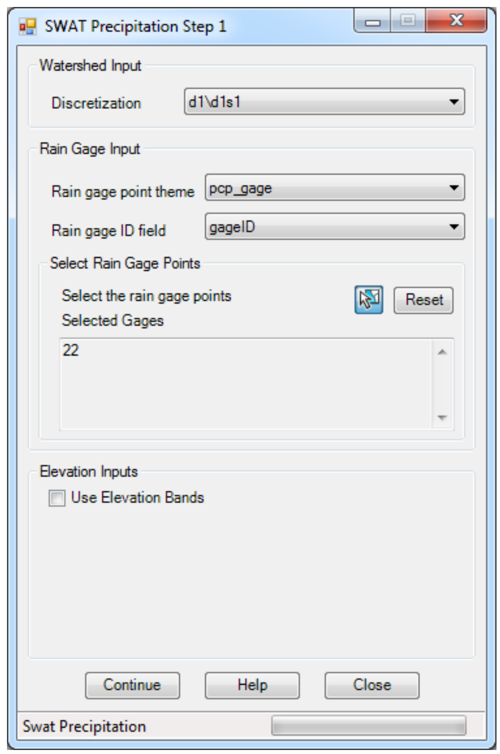
8.6. Click ***Continue***. You will be returned to the ***Parameterizer*** form where the ***Process*** button will now be enabled.

8.7. In the ***Parameterizer*** form, click ***Process***.

Land cover and soils parameterization defines land cover and soils properties of the subwatershed elements. The properties defined depend on the model, but examples of SWAT properties include the dominant soil type/id, curve number, and percent cover for subwatershed elements.

9. Write the SWAT precipitation file for the watershed by selecting ***AGWA Tools > Precipitation Options > Write SWAT Precipitation***.





9.1. ***SWAT Precipitation Step 1*** form

9.1.1. ***Watershed Input*** box:

9.1.1.1. ***Discretization***: **d1\d1s1**

9.1.2. ***Rain Gage Input*** box:

9.1.2.1. ***Rain gage point theme***: **pcp_gage**

9.1.2.2. ***Rain gage ID field***: **gageID**

9.2. ***Select Rain Gage Points*** box

9.2.1.1. Click the ***Select Feature*** button to select the single raingage in the view (the figure, above left, displays the location of the gage). The id number, ***22***, of the selected gage will be displayed in the ***Selected Gages*** textbox.

9.2.2. ***Elevation Inputs*** box:

9.2.2.1. ***Use Elevations Bands*** checkbox: leave unchecked.

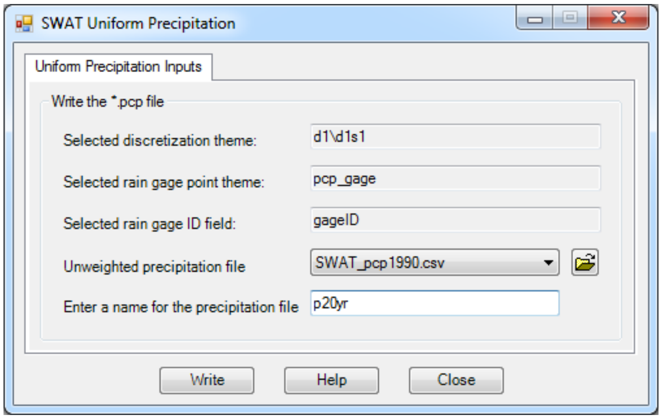
10.1.3. ***Selected rain gage ID field***: ***gageID***

10.1.4. ***Unweighted precipitation file***: **SWAT_pcp1990.csv**

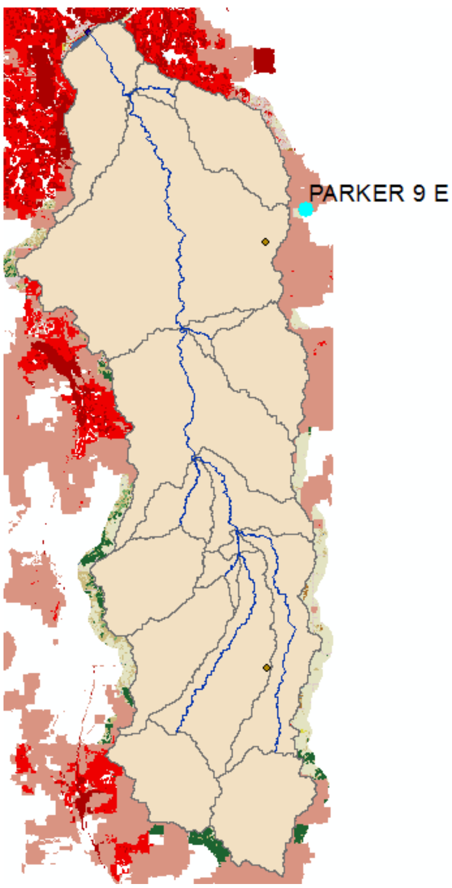
10.1.5. ***Enter a name for the precipitation file***: **p20yr**

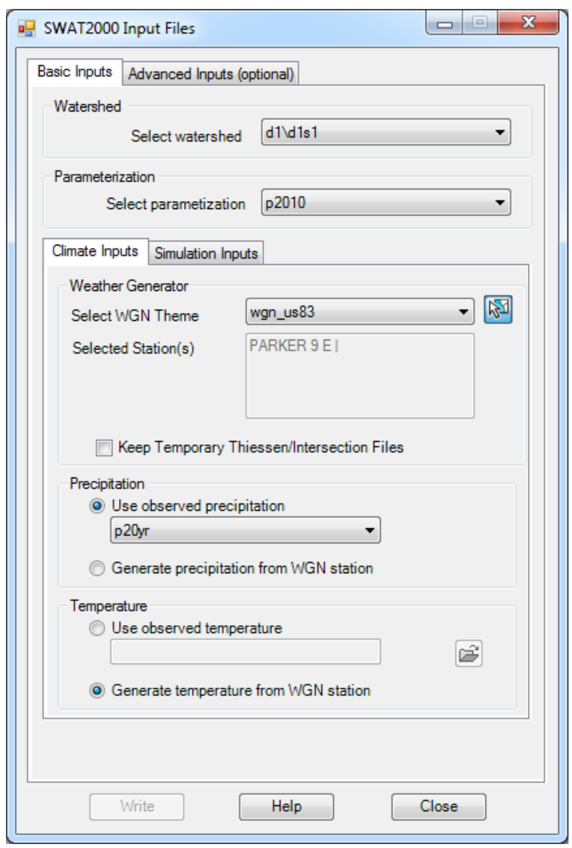
TIP Using the gage ID of the selected gage as the filename can help keep track of the precipitation files in case other files are used to compare to in different simulations.

10.1.6. Click ***Write***.



11. Write the SWAT input files by selecting ***AGWA Tools > Simulation Options > SWAT2000 Options > Write SWAT2000 Input Files***.





11.1. ***Basic Inputs*** tab:

11.1.1. ***Watershed*** box: **d1\d1s1**

11.1.2. ***Parameterization*** box: **p2020**

11.1.3. ***Climate Inputs*** tab:

11.1.3.1. ***Weather Generator*** box:

11.1.3.1.1. ***Select WGN Theme***: **wgn_us83**

11.1.3.1.2. ***Selected Station***: **PARKER 9 E** (see above left for location)

11.1.3.1.3. ***Keep Temporary Thiessen/Intersection Files***: leave unchecked

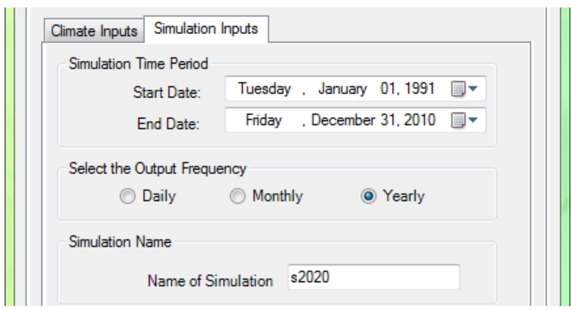
11.1.3.2. ***Precipitation*** box:

11.1.3.2.1. ***Use observed precipitation***: **p20yr**

11.1.3.3. ***Temperature*** box:

11.1.3.3.1. **Generate temperature from WGN station**

11.1.4. ***Simulation Inputs*** tab:



11.1.4.1. ***Simulation Time Period*** box:

11.1.4.1.1. ***Start Date***: **Friday, January 1, 1991**

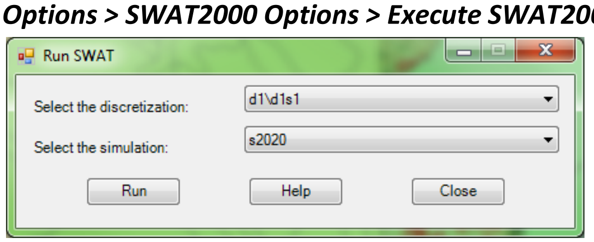
11.1.4.1.2. ***End Date***: **Wednesday, December 31, 2010**

11.1.4.2. ***Select the Output Frequency*** box: **Yearly**

11.1.4.3. ***Simulation Name*** box: **s2020**

11.1.5. Click ***Write***.

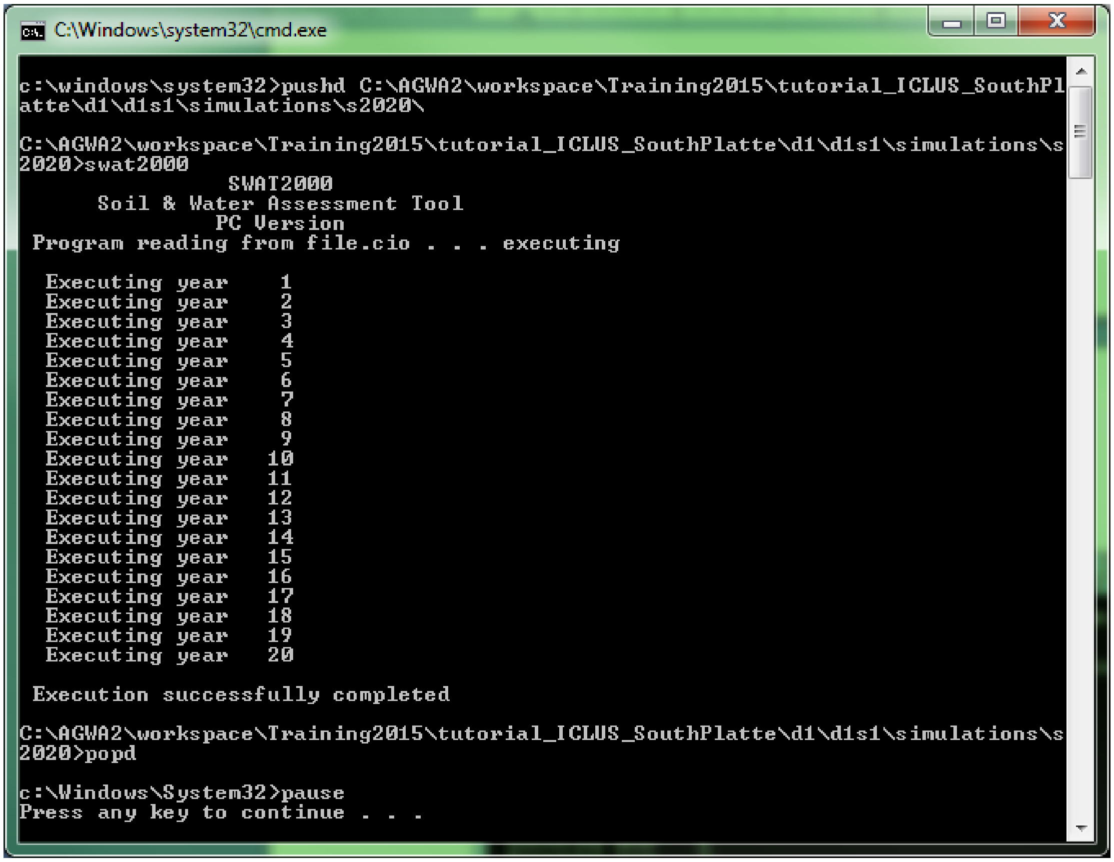
12. Execute the SWAT model for the Cherry Creek watershed by selecting ***AGWA Tools > Simulation Options > SWAT2000 Options > Execute SWAT2000 Model***.



12.1. ***Select the discretization***: **d1\d1s1**

12.2. ***Select the simulation***: **s2020**

12.3. Click ***Run***. The command window will stay open so that successful completion can be verified. Press any key to continue.



12.4. Click the ***Close*** button to close the ***Run SWAT*** form.

13. Import the ***s2020*** results by selecting ***AGWA Tools > View Results > SWAT Results > View SWAT2000 Results***.

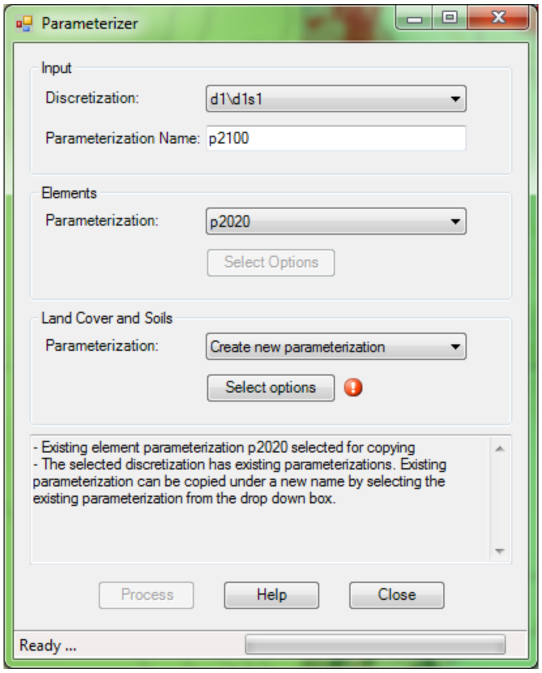
    13.1. ***Watershed***: **d1\d1s1**

    13.2. ***Simulation***: click ***Import***

        13.2.1. Click ***Yes*** when asked to import the ***s2020*** simulation.

At this point, the 2020 land cover has been simulated; 2100 land cover will be parameterized and simulated next. Model input/output files were written into a subdirectory of the workspace following the name of the geodatabase and discretization.

14. Rerun the land cover and soils parameterization of the watershed with the 2100 land cover by selecting ***AGWA Tools*** > ***Parameterization Options*** > ***Parameterize***.



14.1. ***Input*** box

14.1.1. ***Discretization***: select **d1\d1s1**

14.1.2. ***Parameterization Name***: enter **p2100**

14.2. ***Elements*** box

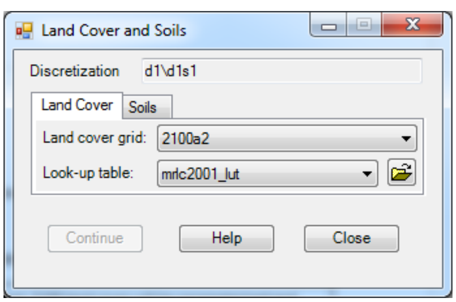
14.2.1. ***Parameterization***: select **p2020**

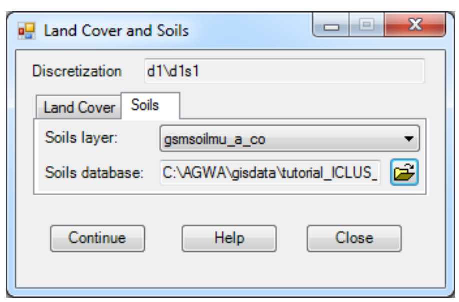
14.3. ***Land Cover and Soils*** box

14.3.1. ***Parameterization***: select **Create new parameterization**

14.3.2. Click ***Select Options***. The ***Land Cover and Soils*** form opens.

14.4. In the ***Land Cover and Soils*** form





14.4.1. ***Land Cover*** tab

14.4.1.1. ***Land cover grid***: select **2100a2**

14.4.1.2. ***Look-up table***: select **mrlc2001_lut**

14.4.2. ***Soils*** tab

14.4.2.1. ***Soils layer***: select **gsmsoilmu_a_co**

14.4.2.2. ***Soils database:*** navigate to and select **C:\AGWA\gisdata\tutorial_ICLUS_SouthPlatte\wss_gsmsoil_CO_[2006-07-06]\soildb_US_2003.mdb**

14.5. Click ***Continue***. You will be returned to the ***Parameterizer*** form where the ***Process*** button will now be enabled.

14.6. In the ***Parameterizer*** form, click ***Process***.

15. Write the SWAT simulation input files representing the new parameterization by selecting ***AGWA Tools > Simulation Options > SWAT2000 Options > Write SWAT2000 Input Files***.

15.1.1. ***Watershed*** box: **d1\d1s1**

15.1.2. ***Parameterization*** box: **p2100**

15.1.3. ***Climate Inputs*** tab:

15.1.3.1. ***Weather Generator*** box:

15.1.3.1.1. ***Select WGN Theme***: **wgn_us83**

15.1.3.1.2. ***Selected Station***: **PARKER 9 E** (see above left for location)

15.1.3.1.3. ***Keep Temporary Thiessen/Intersection Files***: leave unchecked

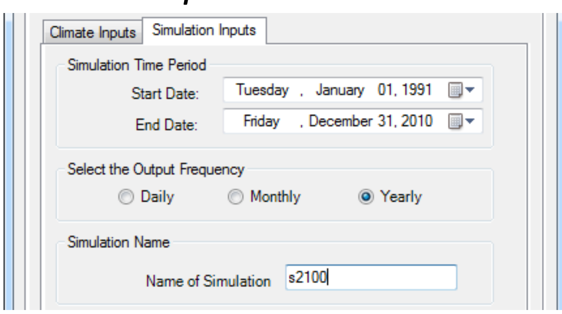
15.1.3.2. ***Precipitation*** box:

15.1.3.2.1. ***Use observed precipitation***: **p20yr**

15.1.3.3. ***Temperature*** box:

15.1.3.3.1. **Generate temperature from WGN station**

15.1.4. ***Simulation Inputs*** tab:



15.1.4.1. ***Simulation Time Period*** box:

15.1.4.1.1. ***Start Date***: **Friday, January 1, 1991**

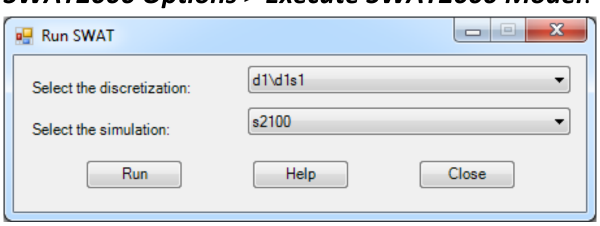
15.1.4.1.2. ***End Date***: **Wednesday, December 31, 2010**

15.1.4.2. ***Select the Output Frequency*** box: **Yearly**

15.1.4.3. ***Simulation Name*** box: s**2100**

15.1.5. Click ***Write***.

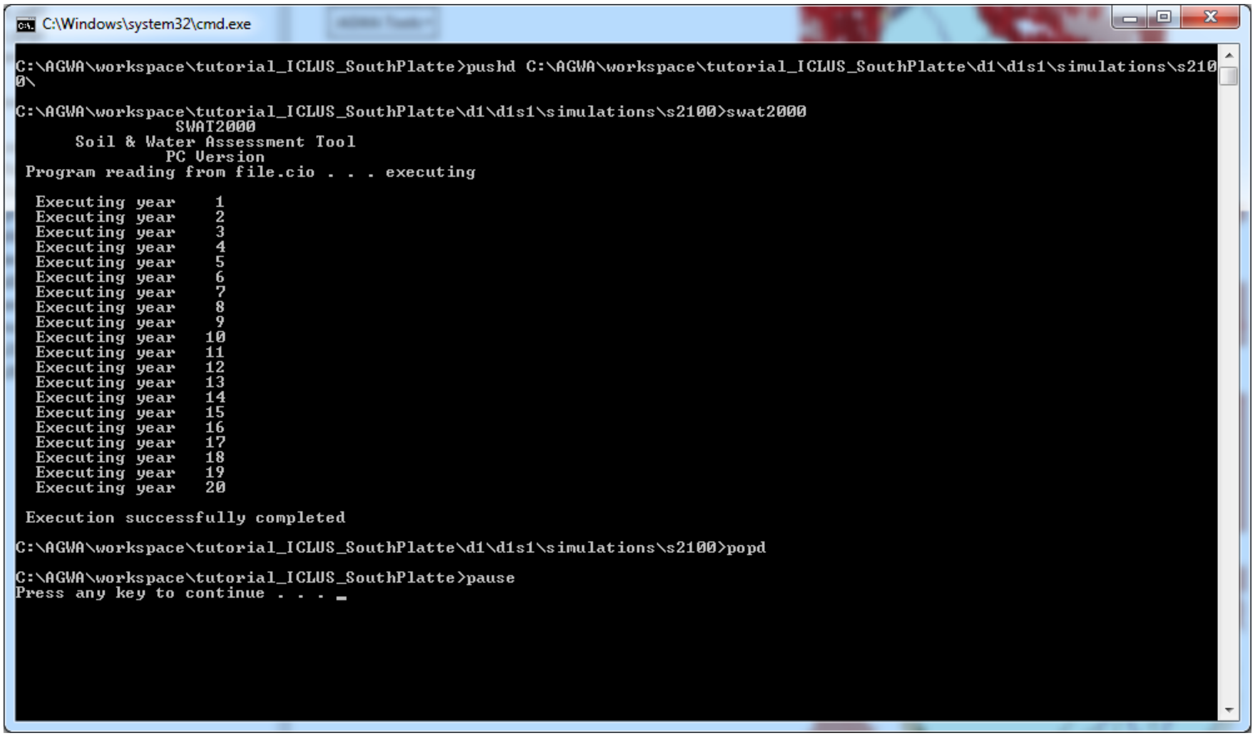
16. Execute the SWAT model for the 2100 land cover by selecting ***AGWA Tools > Simulation Options > SWAT2000 Options > Execute SWAT2000 Model***.



16.1. ***Select the discretization***: **d1\d1s1**

16.2. ***Select the simulation***: **s2100**

16.3. Click ***Run***. The command window will stay open so that successful completion can be verified. Press any key to continue.



16.4. Click the ***Close*** button to close the ***Run SWAT*** form.

17. Import the ***s2020*** results by selecting ***AGWA Tools > View Results > SWAT Results > View SWAT2000 Results***.

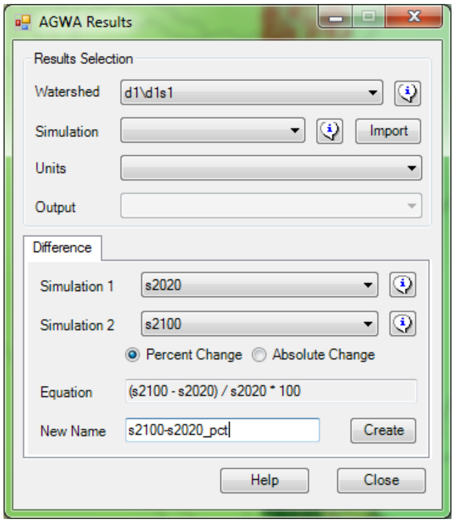
17.1. ***Watershed***: **d1\d1s1**

17.2. ***Simulation***: click ***Import***

17.2.1. Click ***Yes*** when asked to import the ***s2100*** simulation.

These imported **2010a2** and **2100a2** results will then be differenced to visually see how the land cover changes impact the hydrology of the watershed.

18. Difference the 2020 and 2100 simulation results.



18.1. ***Difference*** tab

18.1.1. ***Simulation1***: select **s2020**

18.1.2. ***Simulation2***: select **s2100**

18.1.3. Select ***Percent Change*** radiobutton

18.1.4. ***New Name***: enter **s2100-s2020_pct**

18.1.5. Click ***Create***

19. View the differenced results.

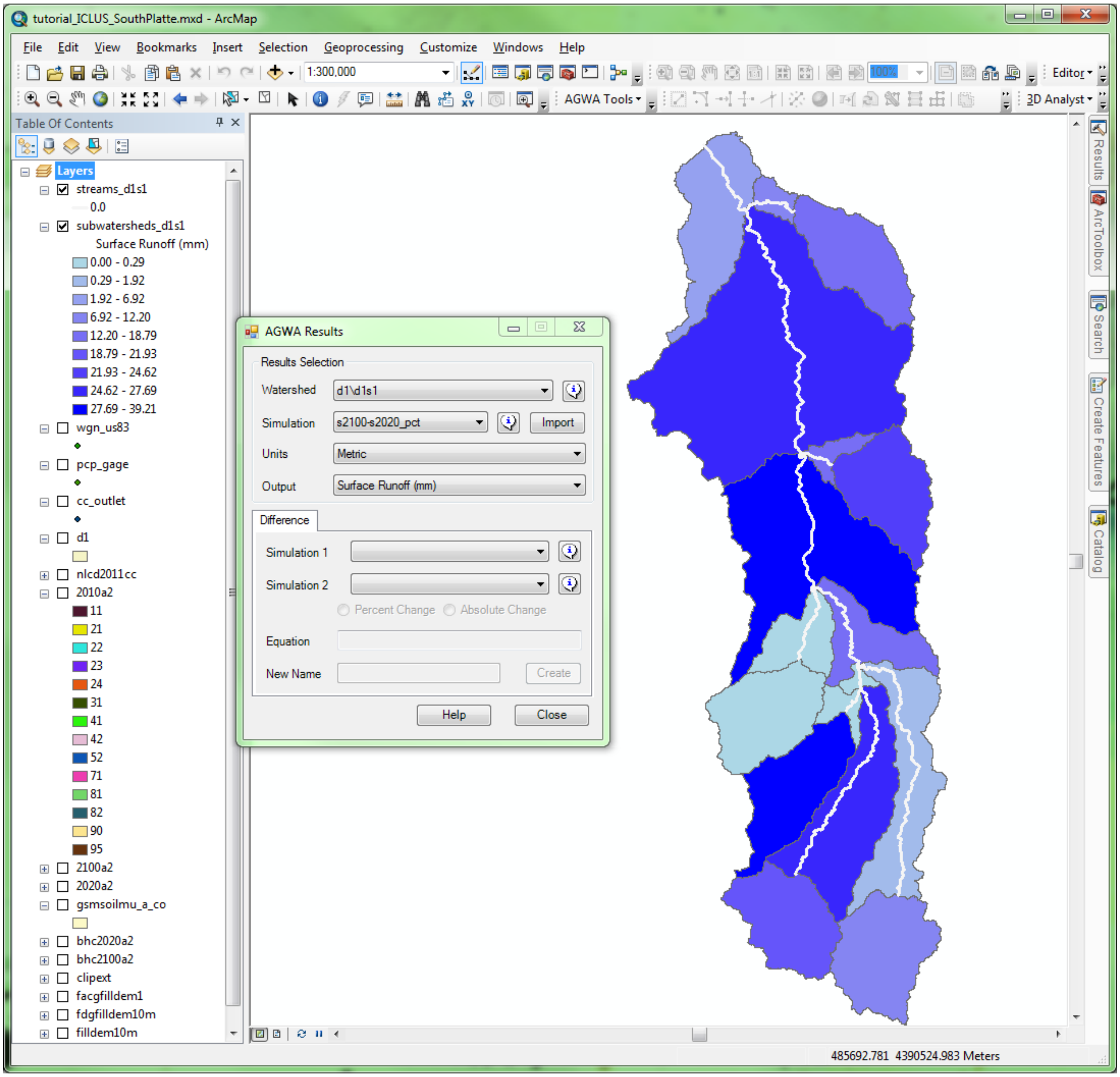
19.1. ***Results Selection*** box

19.1.1. ***Watershed***: select **d1\d1s1**

19.1.2. ***Simulation***: select **s2100-s2020_pct**

19.1.3. ***Units:*** select **Metric**

19.1.4. ***Output***: select **Surface Runoff (mm)**

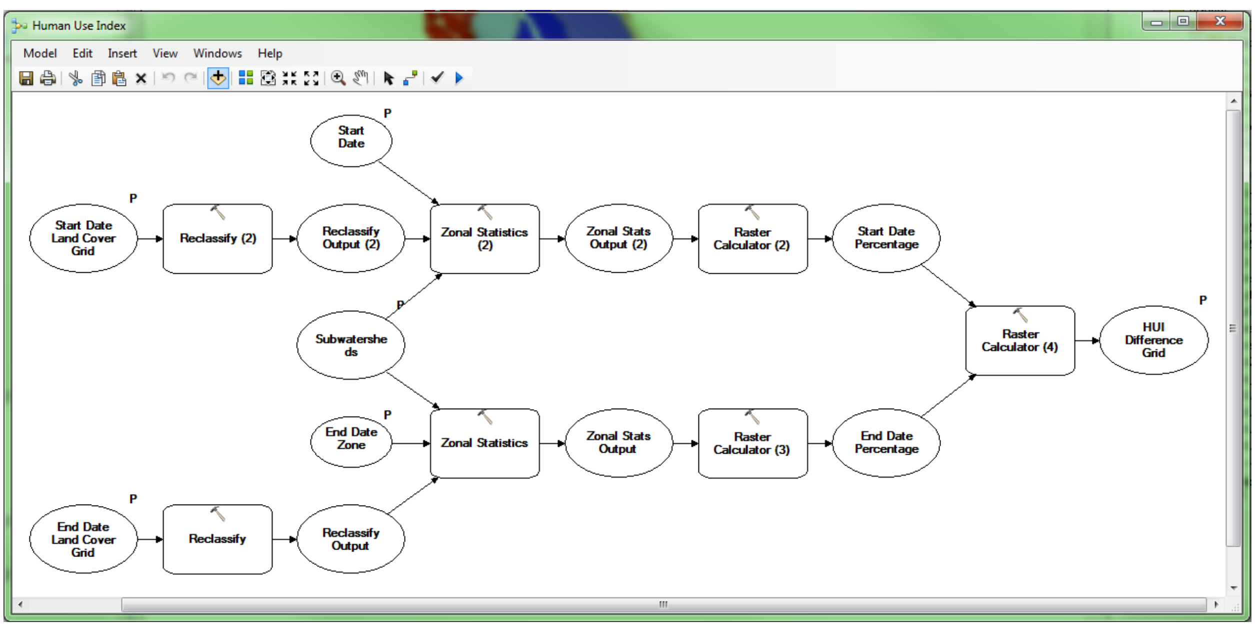

tutorial_ICLUS_SouthPlatte.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:300,000
AGWA Tools
Editor
3D Analyst
Table Of Contents
Layers
streams_d1s1
0.0
subwatersheds_d1s1
Surface Runoff (mm)
0.00 - 0.29
0.29 - 1.92
1.92 - 6.92
6.92 - 12.20
12.20 - 18.79
18.79 - 21.93
21.93 - 24.62
24.62 - 27.69
27.69 - 39.21
wgn_us83
pcp_gage
cc_outlet
d1
nlcd2011cc
2010a2
11
21
22
23
24
31
41
42
52
71
81
82
90
95
2100a2
2020a2
gsmsoilmu_a_co
bhc2020a2
bhc2100a2
clipext
facgfilldem1
fdgfilldem10m
filldem10m
AGWA Results
Results Selection
Watershed
d1\d1s1
Simulation
s2100-s2020_pct
Import
Units
Metric
Output
Surface Runoff (mm)
Difference
Simulation 1
Simulation 2
Percent Change
Absolute Change
Equation
New Name
Create
Help
Close
Results
ArcToolbox
Search
Create Features
Catalog
485692.781 4390524.983 Meters

Some of the subwatersheds should experience over 30% increase in surface runoff caused by changes in land cover between 2020 and 2100. Results vary from subwatershed to subwatershed. If you view the land cover grid underneath the subwatersheds layer, you can see the relationship between urban growth and increased surface runoff over the course of the century.

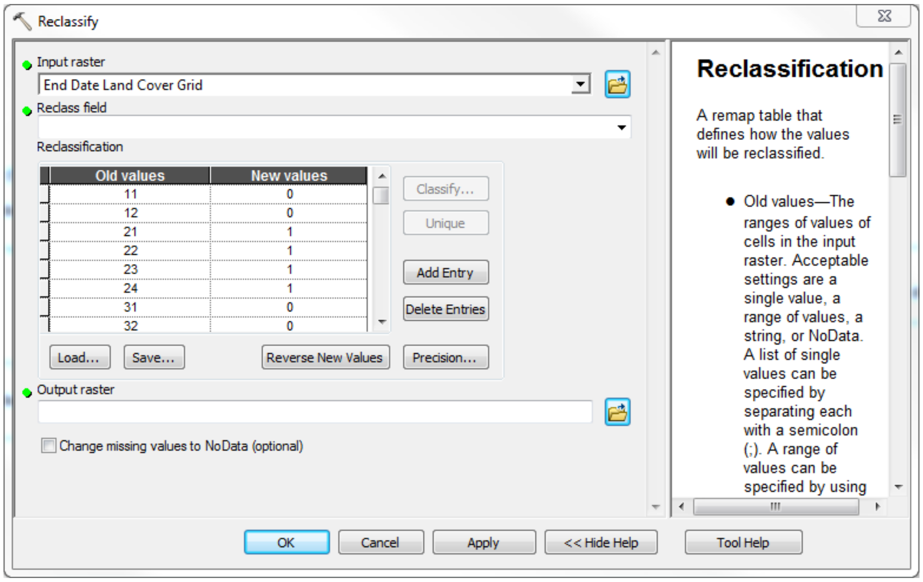
Part 3: Calculating change in Human Use Index (HUI) from ICLUS data

In Part 3, you will use the land cover grids you created in Part 1 to calculate the change in Human Use Index (HUI) between 2020 and 2100. HUI includes NLCD land cover classes "Developed, Open Space"; "Developed, Low Intensity"; "Developed, Medium Intensity"; "Developed, High Intensity"; "Pasture/Hay"; and "Cultivated Crops".

20. Navigate to the ***ICLUS*** toolbox and explore the ***Human Use Index*** model.
    - 20.1. Open ***ArcCatalog*** by clicking the ***ArcCatalog*** button .
    - 20.2. Navigate to ***C:\AGWA\gisdata\tutorial_ICLUS_SouthPlatte*** to find and open the ***ICLUS_101.tbx*** toolbox.
    - 20.3. Right-click on the ***Human Use Index*** model and choose ***Edit*** to explore the model in ***Model Builder***.



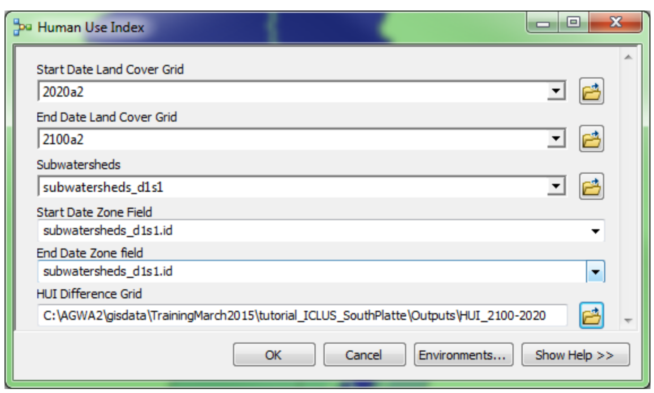
20.4. Double click the ***Reclassify*** tool.



20.5. This tool is used to sort the NLCD classes from the grid you created in Part 1 into an HUI class (given a value of 1) and a non-HUI class (given a value of 0). The resulting grid is a binary raster that is fed into the ***Zonal Statistics*** tool, where it is averaged by subwatershed, then made into a percentage using the ***Raster Calculator*** tool. Notice these tools are used twice in the model, once for the start date (2020 in this exercise), and once for the end date (2100 in this exercise). The resulting grids are differenced for the final output.

20.6. Close the ***Model Builder*** window.

21. Run the ***Human Use Index*** model in the ***ICLUS*** toolbox.



21.1. Double-click on the ***Human Use Index*** model in the ***ICLUS*** toolbox.

21.2. ***Start Date Land Cover Grid***: select **2020a2**.

21.3. ***End Date Land Cover Grid*** : select **2100a2**.

21.4. ***Subwatersheds***: select **subwatersheds_d1s1**.

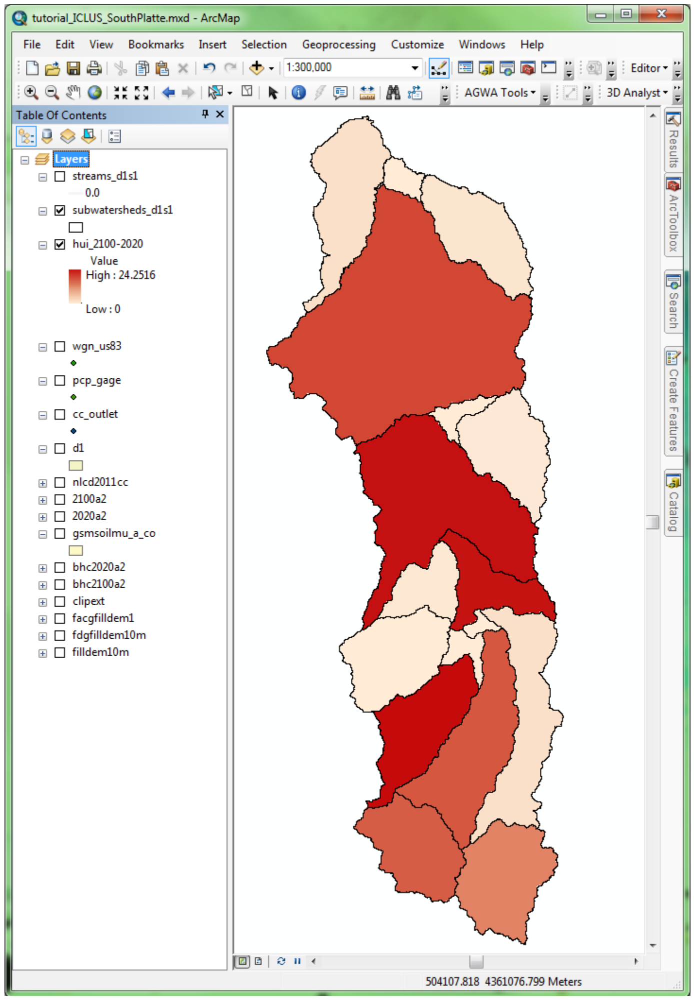
21.5. ***Start Date Zone Field***: select **id** or **subwatersheds_d1s1.id** if the SWAT results are displayed

21.6. End Date Zone Field: select **id** or **subwatersheds_d1s1.id** if the SWAT results are displayed

21.7. ***HUI Difference Grid***: navigate to and enter **C:\AGWA\gisdata\tutorials\tutorial_ICLUS_SouthPlatte\Outputs\HUI_2100-2020**.

21.8. Click ***OK*** to run the model.

22. Examine and Symbolize the HUI Difference Grid



After the model has run, the resulting grid will appear in the table of contents. This grid represents the change in % of HUI area between 2100 and 2020 by subwatershed, according to the A2 ICLUS scenario.

22.1. First, change the symbolization of the new layer. Double-click on the layer in the table of contents, and go to the ***Symbology*** tab. Change the color ramp to a color scheme of your choice.

22.2. To better show subwatershed boundaries, turn on the ***subwatersheds_d1s1*** layer. Make sure it is above the new ***HUI_2100-2020*** layer in the table of contents.

22.3. Double-click on the ***subwatersheds_d1s1*** layer, and go to the ***Symbology*** tab. Select ***Features: Single Symbol*** Change the color to ***Hollow***. The resulting image should appear like the above image, with the color scheme of your choosing.

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