User's Guide for the Agricultural Non-Point Source (AGNPS) Pollution Model Data Generator

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Background

Throughout this user guide, we refer to datasets that we used in conjunction with developing of this software for supporting cartographic research and producing the datasets to conduct research. However, this software can be used with these datasets or with more "generic" versions of data of the appropriate type. For example, throughout the guide, we refer to national land cover data (NLCD) and digital elevation model (DEM) data from the U.S. Geological Survey (USGS) at a 30-m resolution, but any digital terrain model or land cover data at any appropriate resolution will produce results. Another key point to keep in mind is to use a consistent data resolution for all the datasets per model run.

The U.S. Department of Agriculture (USDA) developed the Agricultural Nonpoint Source (AGNPS) pollution model of watershed hydrology in response to the complex problem of managing nonpoint sources of pollution. AGNPS simulates the behavior of runoff, sediment, and nutrient transport from watersheds that have agriculture as their prime use. The model operates on a cell basis and is a distributed parameter, event-based model. The model requires 22 input parameters. Output parameters are grouped primarily by hydrology, sediment, and chemical output (Young *and others*, 1995.)

Elevation, land cover, and soil are the base data from which to extract the 22 input parameters required by the AGNPS. For automatic parameter extraction, follow the general process described in this guide of extraction from the geospatial data through the AGNPS Data Generator to generate input parameters required by the pollution model (Finn *and others*, 2002.)

Before You Begin

The following steps must be taken for **each** cell resolution in **each** watershed to efficiently generate all 22 AGNPS parameters into an AGNPS v5.0 data file. Also included are a few simple steps for creating visualized output of the AGNPS v5.0 output data.

Input Files

There are a minimum of three input files needed to generate the 22 AGNPS parameters. The first file is a 30-m USGS DEM file. The second file is a USGS 30-m NLCD file. The third file must be a soil image created from the soil databases from USDA soil surveys. This image can be created from scanned separates; it also must be rectified, vectorized, and tagged before use.

There is one other image that will make the process go more smoothly. This is a "mask" of the watershed. Various methods can be used to create a watershed cutout from an image. One is provided with the Data Generator. The files

required for use with this method are an image and an ArcInfo coverage. To use this feature, see the section labeled "Create Cutout."

I. Naming Convention

A common naming convention should be used to keep track of all the files. Perhaps the most easily identifiable format is (n/w)(size)(watershed)_(parameter).(xxx), where "n/w" represents either National Water Quality Assessment (NWQA) or Weasel data, "size" is the resample cell resolution of the image, "watershed" is the name of the watershed, "parameter" is the parameter number used in a particular layer (use a leading zero for Parameters 1 through 9), and "xxx" is the extension of the file (img for image, txt for text, and so on.) For example, you would use the naming convention n1920piscola_06.img if you were working with NWQA data in an image file containing Parameter 6 at 1,920 meters in the Piscola Basin. Another important issue is dealing with the naming convention during the creation of the stacked image. The naming convention given in the "Stacking Layers" section is a suggestion and not meant to be a standard.

II. Running AGNPS Data Generator

The AGNPS Data Generator runs in ERDAS Imagine for all of the parameters and data creation, including input and output. First, you must know where the Imagine environment variables $PERSONAL, $HOME, and $IMAGINE_HOME point. To find this information, open the "Session |Commands" dialog from Imagine's main icon panel. Next, enter "message quote(getenv(<variablename>))" into the Command field. When this is completed, the returned answer is in a popup dialog box. See Figure 1 for an example.

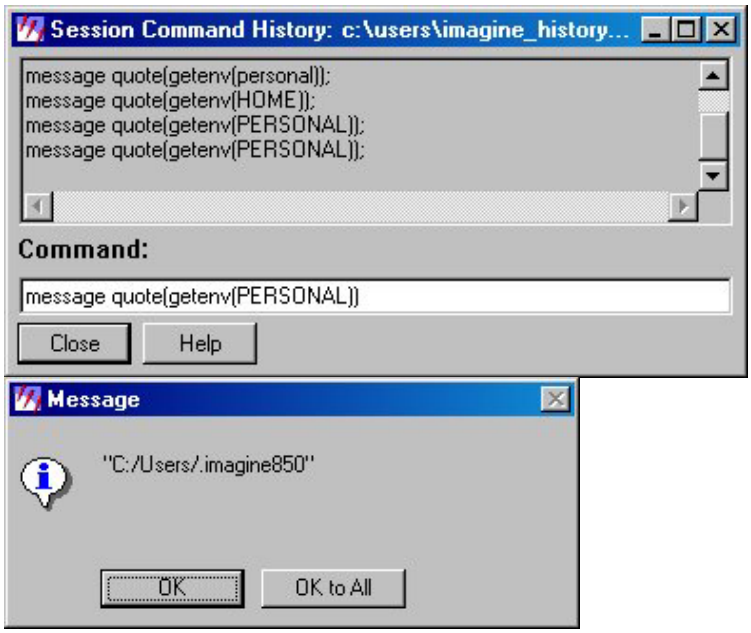

Figure 1. Steps for determining the environment variables.

To ensure that the AGNPS Data Generator will work properly, you need to have the following files in these directories. The imagine_menus.inc file should be in the $PERSONAL directory. The files agrun.exe, flood.exe, d8.exe, and gridnet.exe need to be in the $HOME directory. The file generator.exe needs to be in the $IMAGINE_HOME\Bin\NTx86 directory, and the file Generator.eml needs to be in the $IMAGINE_HOME\scripts directory. When these are verified, you need to set a few preferences. This will ensure that all statistics calculated are done properly. With Imagine running, open the preference editor by clicking on "Session |Preferences." Next, select "Image Files (General)" from the categories on the left. Change "Continuous Statistics Coverage Percentage" to 100.00, and then click on "User Save." To exit the preferences, click on "Close." When Imagine starts, after all files are in place, click on the menu labeled "Extra," and then on "AGNPS Data Generator." (See Figure 2 for a screenshot of AGNPS Data Generator.)

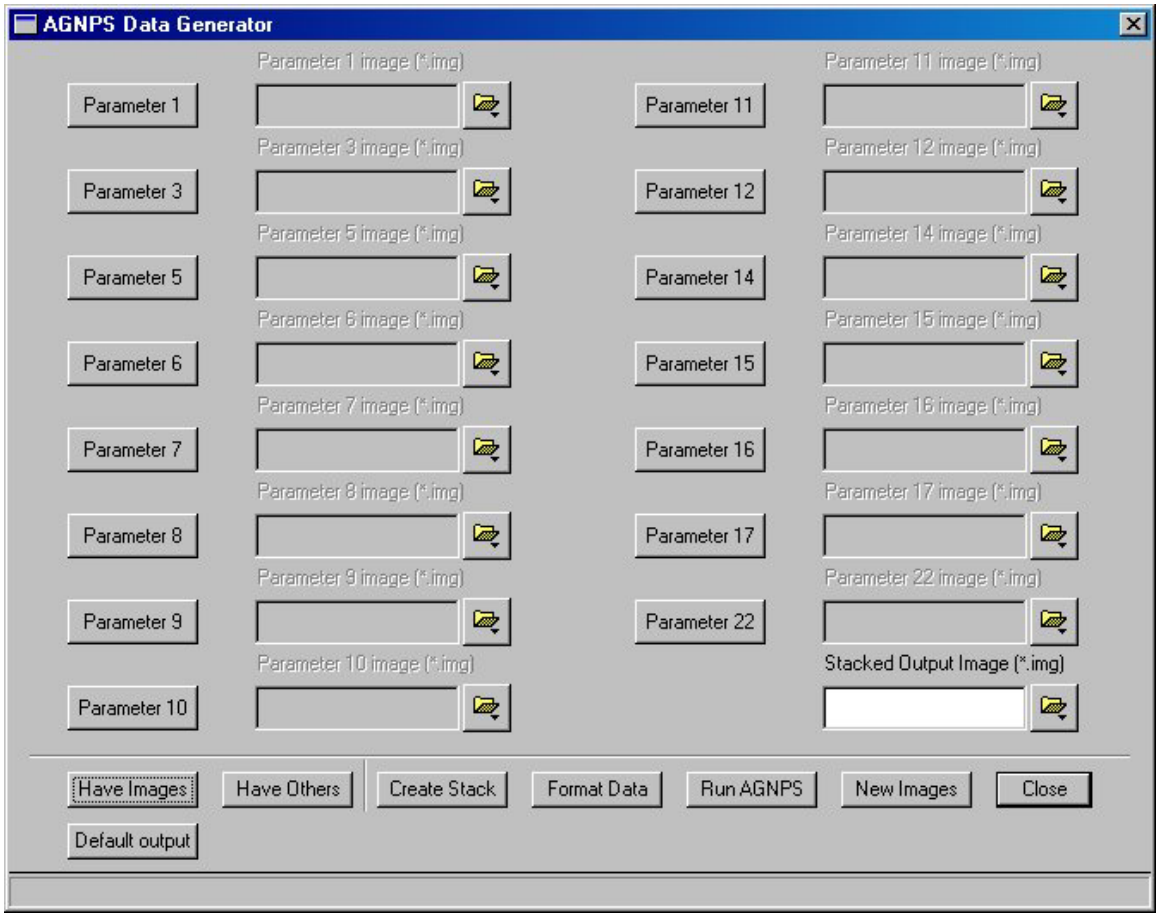

Figure 2. Screenshot of the AGNPS Data Generator.

To create a parameter, you only need to click on the button with the corresponding name. The parameters displayed are all necessary for the program to run. Pressing the "Have Others" button in the bottom left corner enables the entry of additional parameters not

included in the list. If the parameters have been created or there is no need to create new ones, simply push the "Have Images" button to unlock the file entries on the right.

Default Naming

1. Click the button labeled "Default output."
2. Type in the root filename that will be used for all outputs. (This root filename will be the name minus the parameter number, for example, n1920piscola.img; the Data Generator will place the file extensions when needed.)
3. Click the "OK" button. (See Figure 3 for an example.)

Figure 3. Example of Default Naming.

Parameter 1 (Cell Numbering)

1. Click the button labeled "Parameter 1."
2. Click the Folder Icon for the cutout image. Various methods can be used to create a watershed cutout from an image. One is provided with the Data Generator. The files needed to use this method are an image and an ArcInfo coverage. To use this feature, click on the "Create Cutout" button (see the section labeled "Create Cutout.")
3. Locate and select the cutout image, and click "OK."
4. Click the Folder Icon for the output image.
5. Locate the directory where the output image will be created, type in the name of the output file using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
6. Click "Run." (See Figure 4 for an example.)

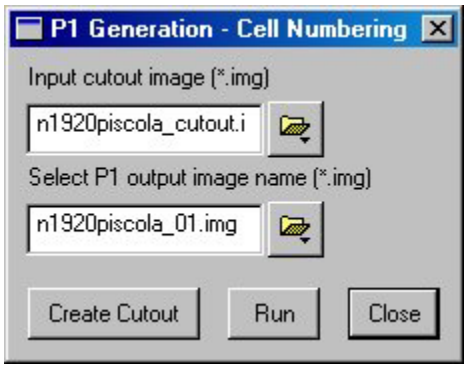

Figure 4. Example of Parameter 1 generation.

Create Cutout

1. Click the button labeled "Create Cutout" from Parameter 1.
2. Click the Folder Icon for the input image. Locate the image and click "OK."
3. Click the Folder Icon for the ArcInfo coverage. Locate and select the coverage and click "OK."
4. Click the Folder Icon for the output image. Locate the directory where the cutout image will be created, type in the name of the image using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed into the Default Output Directory.
5. Click "Run." (See Figure 5 for an example.)

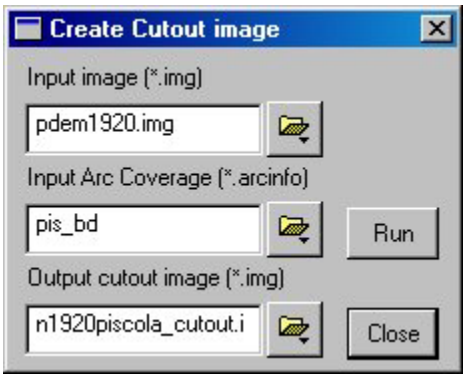

Figure 5. Example of how to create a cutout image.

Parameter 5 (Flow Direction; sinks are filled in this parameter.)

1. Click the button labeled "Parameter 5." **NOTE:** To compute Parameter 3, you must first create Parameter 5.
2. Click the Folder Icon for the original DEM.
3. Locate the DEM image, select it, and click "OK."
4. Push the "Convert" button to convert the DEM image to an ASCII file.

5. Push the "Flood" button to create the file necessary for Flow. **NOTE:** There may be a long wait for it to finish running, depending on your file size. The process will display a DOS window to show that it is running.
6. Push the "Flow" button to generate the files necessary for the flow direction. **NOTE:** This may take some time to complete.
7. Click the Folder Icon for the Flow ASCII File.
8. Locate the ASCII file of your DEM with the letter "p" appended to the end of the name.
9. Click the Folder Icon for the output image.
10. Locate the directory where the output image will be created, type in the name of the output file using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
11. Click "Run." (See Figure 6 for an example.)

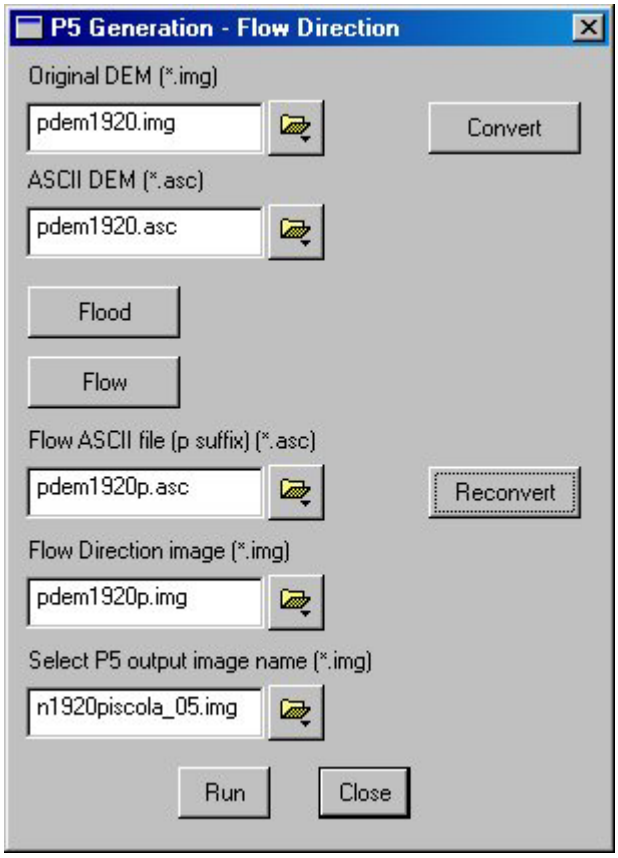

Figure 6. Example of Parameter 5 generation.

Parameter 3 (Receiving Cell Number)

1. Click the button labeled "Parameter 3." **NOTE:** To compute Parameter 3, you must first create Parameter 5.
2. Click the Folder Icon for Parameter 1.
3. Locate and select the appropriate image, and select "OK."

4. Repeat steps 2 and 3 for Parameter 5.
5. Click the Folder Icon for the output image.
6. Locate the directory where the output image will be created, type in the name of the output file using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
7. Click "Run." (See Figure 7 for an example.)

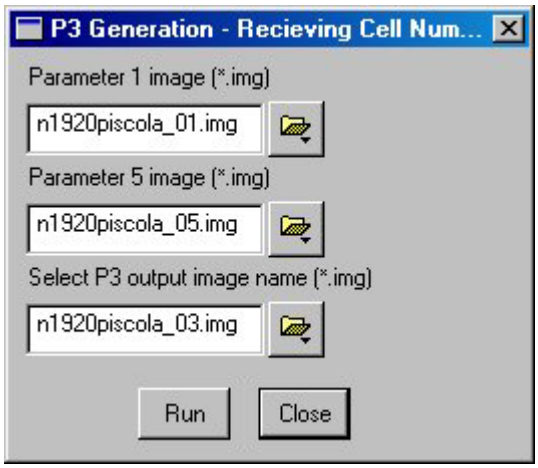

Figure 7. Example of Parameter 3 generation.

Parameter 6 (SCS Curve Number)

1. Click the button labeled "Parameter 6."
2. Click the Folder Icon for the Soils image.
3. Locate and select the Soils image, and click "OK."
   i. For example: C:\1920\n1920piscola_soil.img
4. Select the Soil Group attribute from the pulldown menu labeled "Soil Group."
5. Click the Folder Icon for the Land Cover image.
6. Locate and select the Land Cover image and click "OK."
   i. For example: C:\1920\n1920piscola_landcover.img
7. Match the appropriate attribute from the pulldown menus with the group letter to the left.
8. Click the Folder Icon for the output image.
9. Locate the directory where the output image will be created, type in the name of the output file using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
10. Click "Run." (See Figure 8 for an example.)

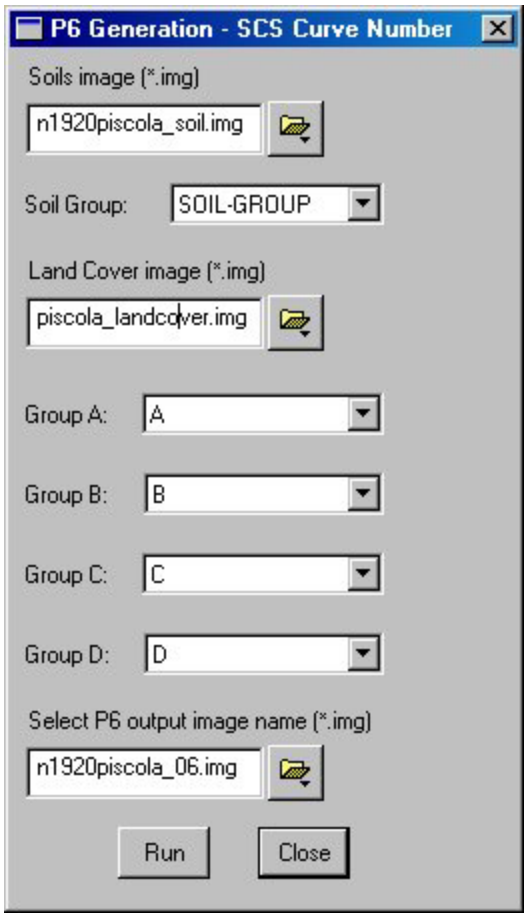

Figure 8. Example of Parameter 6 generation.

Parameter 7 (Average Land Slope)

1. Click the button labeled "Parameter 7."
2. Click the Folder Icon for DEM image.
3. Locate and select the DEM image and click "OK."
4. Locate the directory where the output image will be created, type in the name of the output file using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
5. Click "Run." (See Figure 9 for an example.)

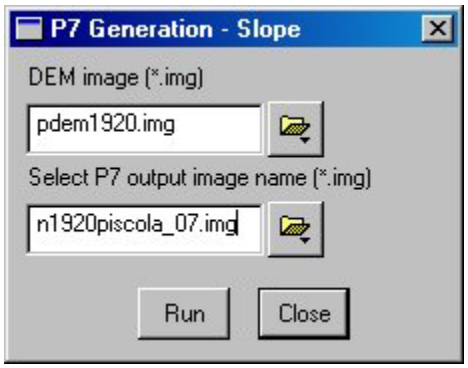

Figure 9. Example of Parameter 7 generation.

Parameter 8 (Slope Shape Factor)

1. Click the button labeled "Parameter 8."
2. Click the Folder Icon for Parameter 1.
3. Locate and select the Parameter 1 image and click "OK."
4. Repeat steps 2 and 3 for Parameter 5 and Parameter 7.
5. Click the Folder Icon for the output image.
6. Locate the directory where the output image will be created, type in the name of the output file using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
7. Click "Run." (See Figure 10 for an example.)

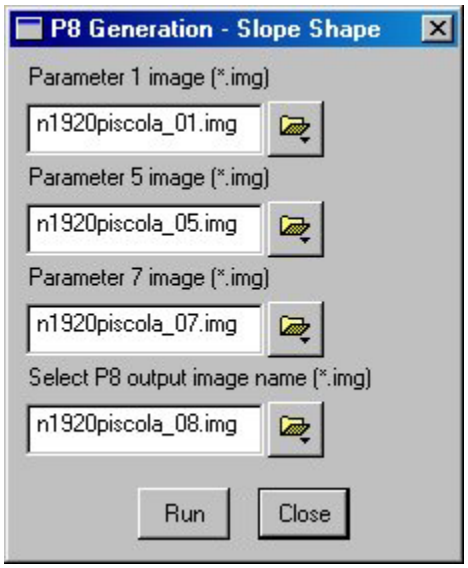

Figure 10. Example of Parameter 8 generation.

Parameter 9 (Slope Length)

1. Click the button labeled "Parameter 9."
2. Click the Folder Icon for Parameter 7.

3. Locate and select the image for Parameter 7 and click "OK."
4. Click the Folder Icon for the output image.
5. Locate the directory where the output image will be created, type in the name of the output file using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
6. Click "Run." (See Figure 11 for an example.)

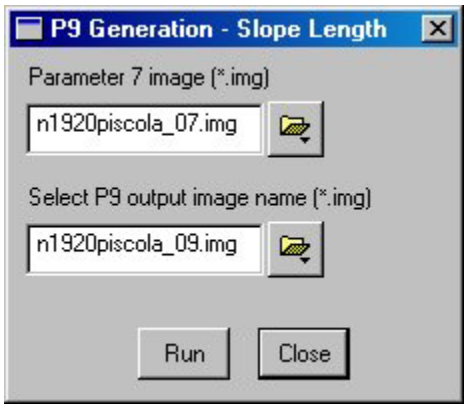

Figure 11. Example of Parameter 9 generation.

Parameters 10, 12, 14, 15, and 17 (Overland Manning's Coefficient, Cropping Factor, Surface Condition Constant, Chemical Oxygen Demand, and Fertilizer Level)

1. Click the appropriate button for the selected parameter.
2. Click the Folder Icon for the Land Cover image.
3. Locate and select the Land Cover image and click "OK."
4. Match the appropriate attribute from the pulldown menu with the description to the left (for example, Overland Mannings.)
5. Click the Folder Icon for the output image.
6. Locate the directory where the output image will be created, type in the name of the output file using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
7. Click "Run." (See Figure 12 for an example.)
8. Repeat the entire process for all parameters from the Land Cover file, including Parameters 10, 12, 14, 15, and 17.

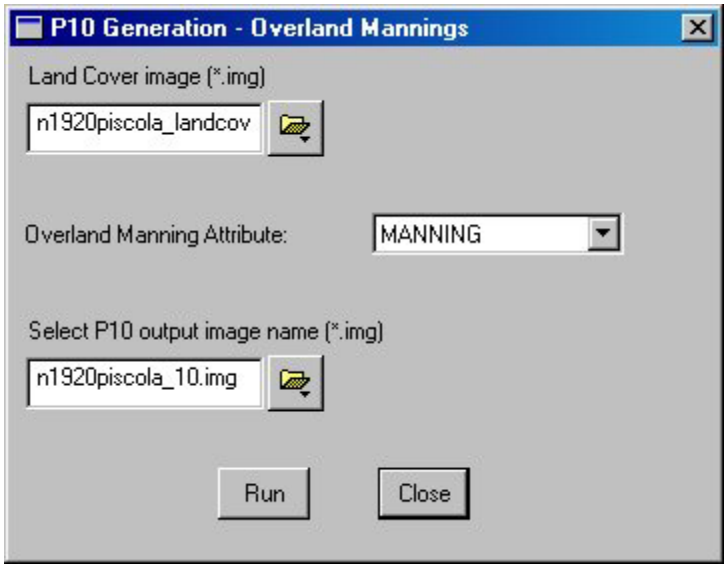

Figure 12. Example of Parameter 10 generation.

Parameters 11 and 16 (Soil Erodibility Factor and Soil Texture)

1. Follow the same methods for Parameters 10, 12, 14, 15, and 17, but use the Soils file instead of the Land Cover file. (See Figure 13 for an example.)

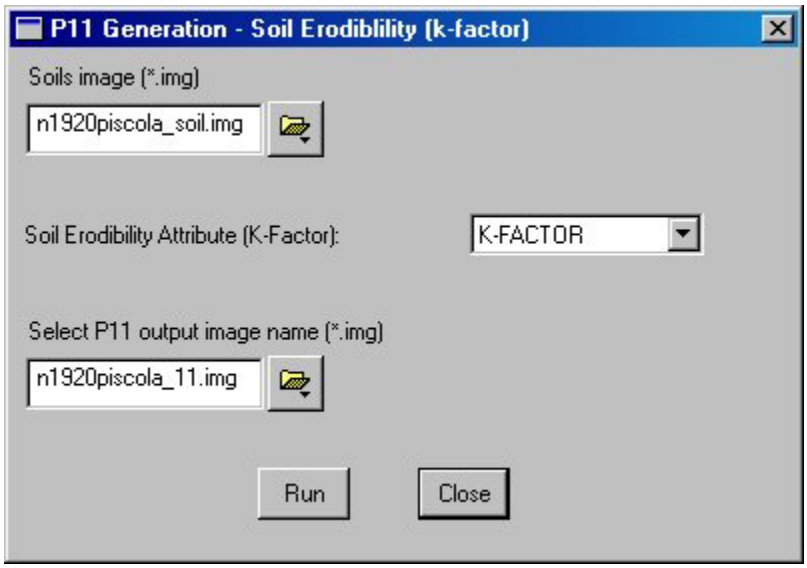

Figure 13. Example of Parameter 11 generation.

Parameter 22 (Type of Channel)

1. Click the button labeled "Parameter 22."
2. Click the Folder Icon for the Original DEM.
3. Locate and select the DEM image and click "OK."
4. **NOTE:** If Parameter 5 has been created earlier, there is no need to complete steps 5-7; just click the check box labeled "Have Already Created P5." Now

click the folder icon for the ASCII DEM, locate and select it, click "OK," and go to step 8.

5. Click the "Convert" button to convert the DEM to an ASCII file.
6. Push the "Flood" button to create the file necessary for Flow. **NOTE:** There may be a long wait for it to finish running depending on your file size. The process will display a DOS window to show that it is running.
7. Push the "Flow" button to generate the files necessary for Streams. **NOTE:** This may take some time to complete.
8. Push the "Streams" button to generate the stream file. **NOTE:** This may take some time to complete.
9. Click the Folder Icon for the Stream ASCII file.
10. Locate and select the ASCII file of the DEM with "gord" appended to the end of the filename. This file should be located in the same directory as the DEM file.
11. Push the "Reconvert" button to change the ASCII file to an image file.
12. Click the Folder Icon for the Land Cover image.
13. Locate and select the Land Cover image and click "OK."
14. Use the arrows in the box labeled "Row Containing Water" to select the row where water is in the land cover attributes. **NOTE:** To do this, open up the land cover image in a viewer, click "Raster |Attributes," and find the row containing water.
15. Click the Folder Icon for the output image.
16. Locate the directory where the output image will be created, type in the name of the output file using the naming convention, and click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
17. Click "Run." (See Figure 14 for an example.)

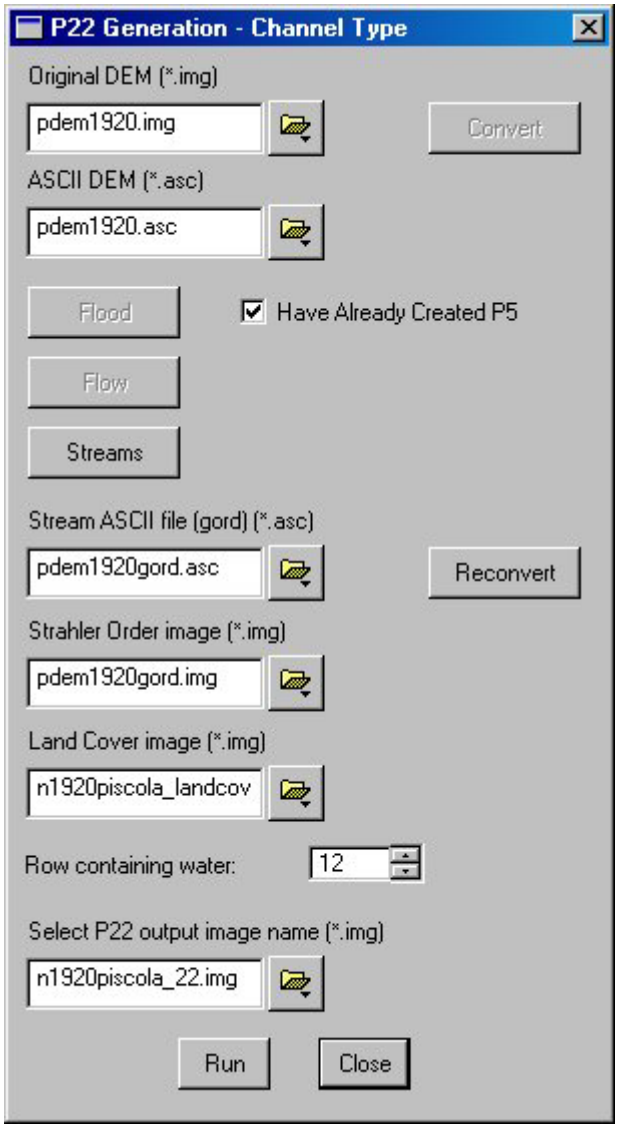

Figure 14. Example of Parameter 22 generation.

III. Stacking Layers

Using the naming convention, stack the layers for the cell resolution that was used to create a stacked image. For example, using the image file for Parameter 1, n1920piscola_01.img, the image file for Parameter 5, n1920piscola_05.img, and the image file for Parameter 7, n1920piscola_07.img, you would create a stacked image called n1920piscola_stack_01_05_07.img. (**NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.) Any stacked layers created **MUST** have layer 1 as the first layer to be stacked, and the layers **MUST** be stacked in numerical order. It is always a good idea to keep track of which layers are stacked, because this information will be needed later. Stack layers 1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, and 22 (Parameters 2 and 4 are not used at this point and Parameters 12, 18, 19, 20, and 21 are taken care of by the program.) There are two possible methods to stack the layers. The first method is to use the AGNPS Data

Generator if all the files have been generated and are in the program ready to go. (**NOTE:** If all the parameters, or just some of them, have been created in the past, just click the "Have Images" button. Next, click on the Folder Icon button. From here locate and select the corresponding parameter image and click "OK.") These steps will stack the images in AGNPS Data Generator:

1. Click on the Folder Icon for the last box, which is for the stacked output image.
2. Locate the directory where the output image will be placed after generation, and then click "OK." **NOTE:** If the Default Naming option is used, all outputs created are named and placed in the Default Output Directory.
3. Click the "Create Stack" button. (See Figure 15 for an example.)

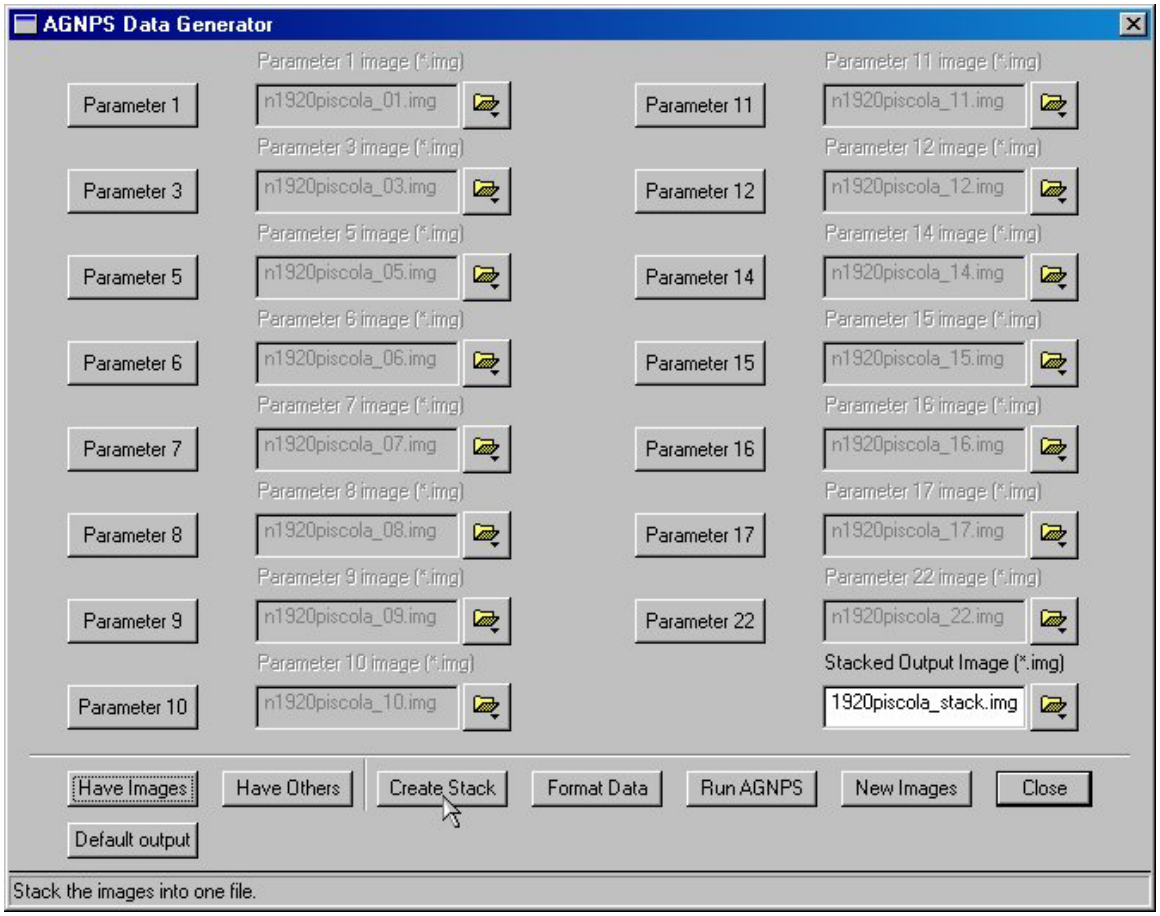

Figure 15. Example of the Stack Creation system.

An alternative method is to create the stacked image manually using Imagine:

1. Click on the "Interpreter" icon along the Imagine toolbar.
2. Choose Utilities from the Image Interpreter menu.
3. Choose Layer Stack from the Utilities menu.
4. Search for the first layer for the input file by clicking the folder icon next to the "Input file" box.

5. Once this is complete, click the "Add" button on the Layer Selection dialog box.
6. Repeat step 5 for each layer to be stacked.
7. Type what the output file will be named in the "Output file" box.
8. Click "OK."
9. Now the modeler will run. When this is done, click "OK."

Before proceeding to the next step, verify that the stack image is correct. Open the stacked image in the Imagine Viewer. Click on the "Image Information" icon on the viewer toolbar. Check that the Skip Factor X and Skip Factor Y in the Statistics Info section are both 1. If they are not, click on the sigma symbol (Σ) along the ImageInfo toolbar. Set both Skip Factors to 1 and click "OK" to recompute the statistics.

IV. Formatting Data

The "Format Data" button will take the stacked output image and reformat all the data into a data file that AGNPS version 5.0 will be able to read. It is only necessary for the output image name to be present in the Stacked Output Image box when you click Format Data." If the other files above it are not all filled in, a prompt will be shown to fill in what parameters have been stacked (see Figure 16 for an example.) **NOTE:** The outlet cell of the watershed must be known to complete the formatting of the data. Taking the Parameter 5 image and following a common flow path until it flows out of the watershed will give you this information. The flow direction for Parameter 5 is as follows:

1 = East
2 = South East
4 = South
8 = South West
16 = West
32 = North West
64 = North
128 = North East

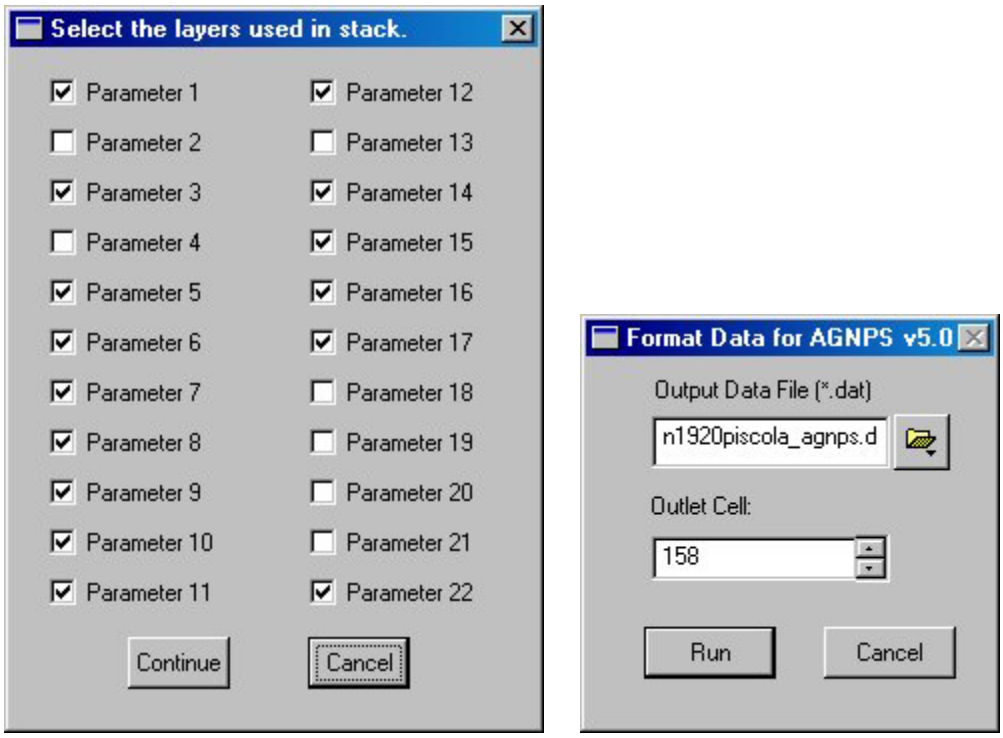

Figure 16. Example of the popup and the Format Data box.

V. Running AGNPS

The "Run AGNPS" button can be clicked when a data file has been created. This will start the AGNPS process using the data file created above. This will create an output file with the same name, but it will have the .nps extension. A message box will then appear saying whether or not AGNPS executed properly. **NOTE:** There may be a long wait for it to finish running, depending on your file size. The process will display a DOS window to show that it is running. (See Figure 17 for an example.)

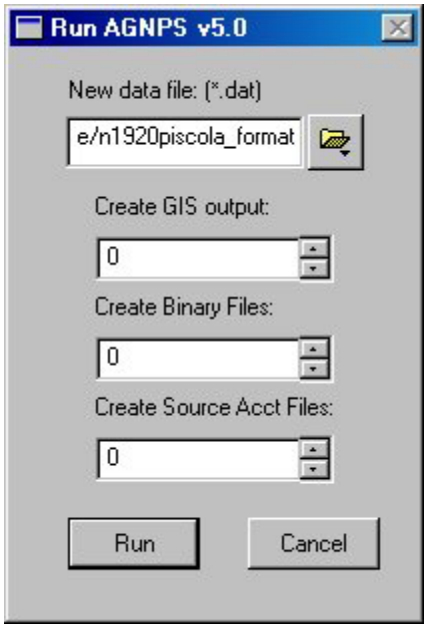

Figure 17. Example of the Run AGNPS box.

VI. Creating New Images

To create a graphical representation of the AGNPS output, click on the "New Images" button. After clicking on this button, follow these steps:

1. Click the Folder Icon for the AGNPS output data.
2. Locate and select the AGNPS output file and click "OK."
3. Click the Folder Icon for the Parameter 1 image.
4. Locate and select the Parameter 1 image and click "OK."
5. Click the Folder Icon for the Hydrology output image. **NOTE:** If Default Naming has been set up, click the "Default Names" button to place filenames into fields. Also, note that all outputs created are placed in the Default Output Directory.
6. Locate the directory where the output will be created and type in the name of the image. Now click "OK."
7. Repeat the previous two steps for the remainder of the file names.
8. Click "Run." (See Figure 18 for an example.)

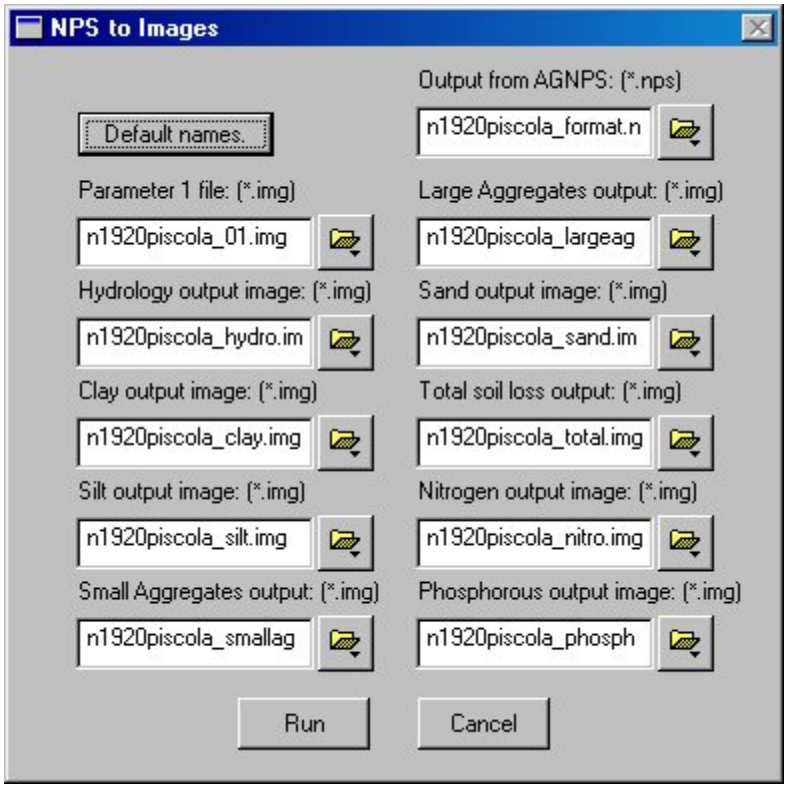

Figure 18. Example of the New Images generation box.

When the process finishes running, there will be nine new images. These images will contain a varying number of layers from the AGNPS output. A description of these images and their layers is given in ImageExplanation.txt.

References

Finn, M.P., Usery, E.L., Scheidt, D.J., Beard, T., Ruhl, S., Bearden, M., 2002, AGNPS watershed modeling with GIS databases *in* Proceedings Second Federal Interagency Hydrologic Modeling Conference, Las Vegas, Nevada, 2002, Compact Disk.

Young, R.A., Onstad, C.A., Bosch, D.D., and Anderson, W.P., 1995, AGNPS: An agricultural nonpoint source model, *in* Singh V.P. (ed.), Computer Models of Watershed Hydrology: Highlands Ranch, Colorado, Water Resources Publications, pp. 1011-1020.