**Prepare Rasters for Maxent Tool for ArcGIS**

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**Introduction**

Maxent software (http://www.cs.princeton.edu/~schapire/maxent) is frequently used for presence-only species distribution modeling. Maxent requires, however, that input ASCII raster files be aligned with one another and have the same spatial extent. This tool pre-processes raster data in preparation for Maxent modeling to ensure that all rasters have the same extent, same cell size, and aren't missing data.  There are two version of this geoprocessing modeling. The advanced version is for the ArcGIS Advanced license. The basic version is the the ArcGIS Basic license. Both versions require Spatial Analyst. The difference between the two is that the advanced version creates a polygon shapefile that shows the difference between the template raster and the processed raster. Ideally, this should generate a polygon with empty output, but if it doesn't you can use it to diagnose problems.  The tool first resamples the raster, then uses a focalmean (3x3 and 5x5) to fill gaps, and mosaics the resampled, 3x3, and 5x5 rasters together, and converts to ASCII.

There is a second tool that can be used to upscale data. Upscaling is useful when simple resampling is insufficient. For example, if you have a 30 meter classified vegetation map simply using the majority resample to resample to 1000 meter cell size would be insufficient because it would just tell you about the majority vegetation type present. Better would be to count the number of pixels of the vegetation type of interest within the 1000 meter cells and calculate the proportion of that vegetation type. This also solves the problem of having to treat the data as categorical in Maxent. Vegetation type would have to be treated as a categorical variable whereas proportion of X vegetation is a continuous variable.

**Tools**

1. Prepare Rasters for Maxent (Advanced)

Parameters:

1. Input Raster - Raster that you wish to prepare for Maxent

2. Input Template Raster – Raster with the same cell size, extent, and cell alignment that you wish all other rasters to have

3. Resampling Technique – NEAREST, BILINEAR, CUBIC, or MAJORITY (see ArcGIS documentation for more details)

4. Spatial Reference for Raster – Make the same as the template raster

5. Cell size - Make the same as the template raster

6. Pixel type – For continuous rasters set to 32\_bit\_float

7. Output raster – ArcGIS-ready raster format such as .tif, .img, or no extension for GRID format

8. Output folder – A folder to store intermediate outputs. You may want to delete this upon successful completion

9. Output ASCII Raster – Maxent-ready ASCII raster file. Make sure to add .asc for the extension.

10. Output Difference Polygon – Geodatabase feature class or shapefile showing areas where the output and template rasters do not overlap. Since the purpose of this tool is to make them align perfectly you should get an ‘empty output’ if the extent matches the template perfectly.

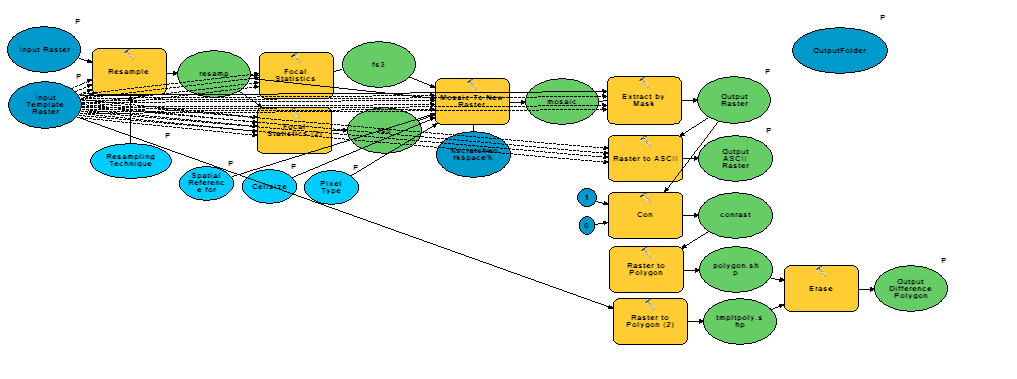


Figure 1: Model showing the main steps used in the Prepare Rasters for Maxent tool. The tool resamples, performs focal statistics and mosaicking to fill gaps, clips the raster to the template, and then converts to ASCII for use in Maxent.

2. Prepare Rasters for Maxent (Basic)

Same tool as the above but without the final step of creating the difference polygon. Useful for users with a Basic ArcGIS license.

3. Upscale Rasters for Maxent (Advanced)

Parameters:

1. Input Raster - Raster that you wish to prepare for Maxent

2. Input Template Raster – Raster with the same cell size, extent, and cell alignment that you wish all other rasters to have

3. Spatial Reference for Raster – Make the same as the template raster

4. Cell size - Make the same as the template raster

5. Pixel type – For continuous rasters set to 32\_bit\_float

6. Output folder – A folder to store intermediate outputs. You may want to delete this upon successful completion

6. Output raster – ArcGIS-ready raster format such as .tif, .img, or no extension for GRID format

7. Output ASCII Raster – Maxent-ready ASCII raster file. Make sure to add .asc for the extension.

8. Output Difference Polygon – Geodatabase feature class or shapefile showing areas where the output and template rasters do not overlap. Since the purpose of this tool is to make them align perfectly you should get an ‘empty output’ if the extent matches the template perfectly.

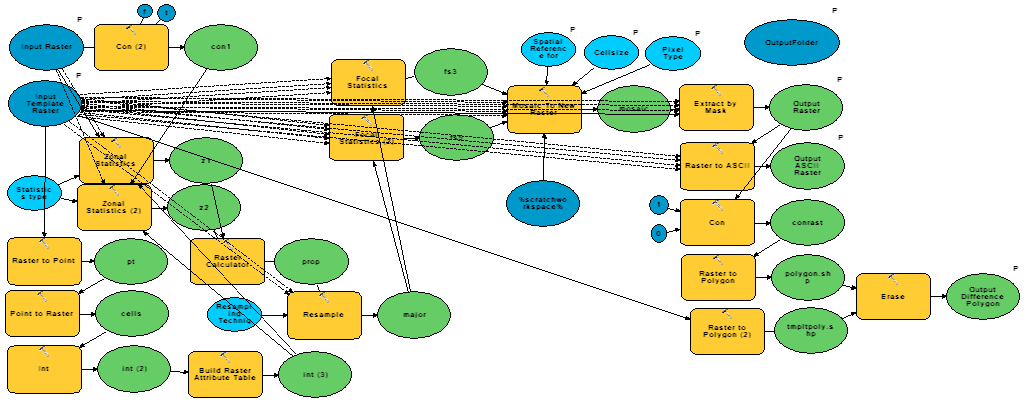


Figure 2: Model showing the main steps used in the Upscale Rasters for Maxent tool. The tool resamples, performs focal statistics and mosaicking to fill gaps, clips the raster to the template, and then converts to ASCII for use in Maxent. It has the added benefit of upscaling finer-resolution data to a coarser resolution. It does this using zonal statistics to get the cell count for cells of interest (e.g. vegetation type of interest) and then divides that by the total cell count to get the proportion of cells of interest in each of the coarser template cells.

4. Upscale Rasters for Maxent (Basic)

Same as above but without the final step of creating the difference polygon.

**Example of upscaling**

In the example below we take tree cover derived from a 30 meter vegetation classification and upscale it to represent proportion tree cover in 1000 meter cells. The advantage is two-fold. First, we are able to preserve small amounts of tree cover in the final raster whereas simple majority resampling would lose this information. Second, we convert a categorical vegetation map into a continuous variable making it easier to interpret in Maxent. There are a couple of reasons for not doing the Maxent modeling at the 30 meter resolution. First, all data layers need to be the same resolution and if there are coarse rasters it may make sense to have them all at the coarser scale. Second, the resolution of our input occurrence points may be limited if the records are from museum databases. Third, in some instances having neighborhood information is more informative than the actual value of a particular grid cell. Finally, there is something to be said for coarser Maxent models running faster.

C:\Users\tdilts\Desktop\forest.tif

Figure 3: Fine-scale tree cover layer overlaid on a coarser grid (template raster).

C:\Users\tdilts\Desktop\treecover.tif

Figure 4: Resulting raster showing proportion of tree cover at the 1000 meter resolution.

Recommended citation format:

Dilts, T.E. (2015) Prepare Rasters for Maxent Tool for ArcGIS 10.1. Available at: http://www.arcgis.com/home/item.html?id=11bf7e689c92413f8d31933b3e1f56b1