ArcGIS Desktop Toolbox: USNG Rollup

Overview

The ArcGIS USNG rollup toolbox was developed to provide data management and processing controls to incoming and outgoing tabs of raster data to USNG polygon cells. The tool itself is a wrapper around a local SQLite database that maintains hash-like identifiers of all incoming data so to prevent data duplication, reduce processing time, and manage sporadic sources for the user. Generating statistics of raster values (mean, median, max, etc.) per polygon in a shapefile or feature class is trivial with out of the box tools – generating a system to manage this data for hundreds of input raster sources, each with a paired polygon, is the purpose of this tool.

Running the tool

The current iteration of the USNG rollup tool is separated into three functions: process raster data, export polygon data, and clear database. Each of these steps is tied to the underlying SQLite database. A view of this is shown below for clarity on what is happening behind the scenes.

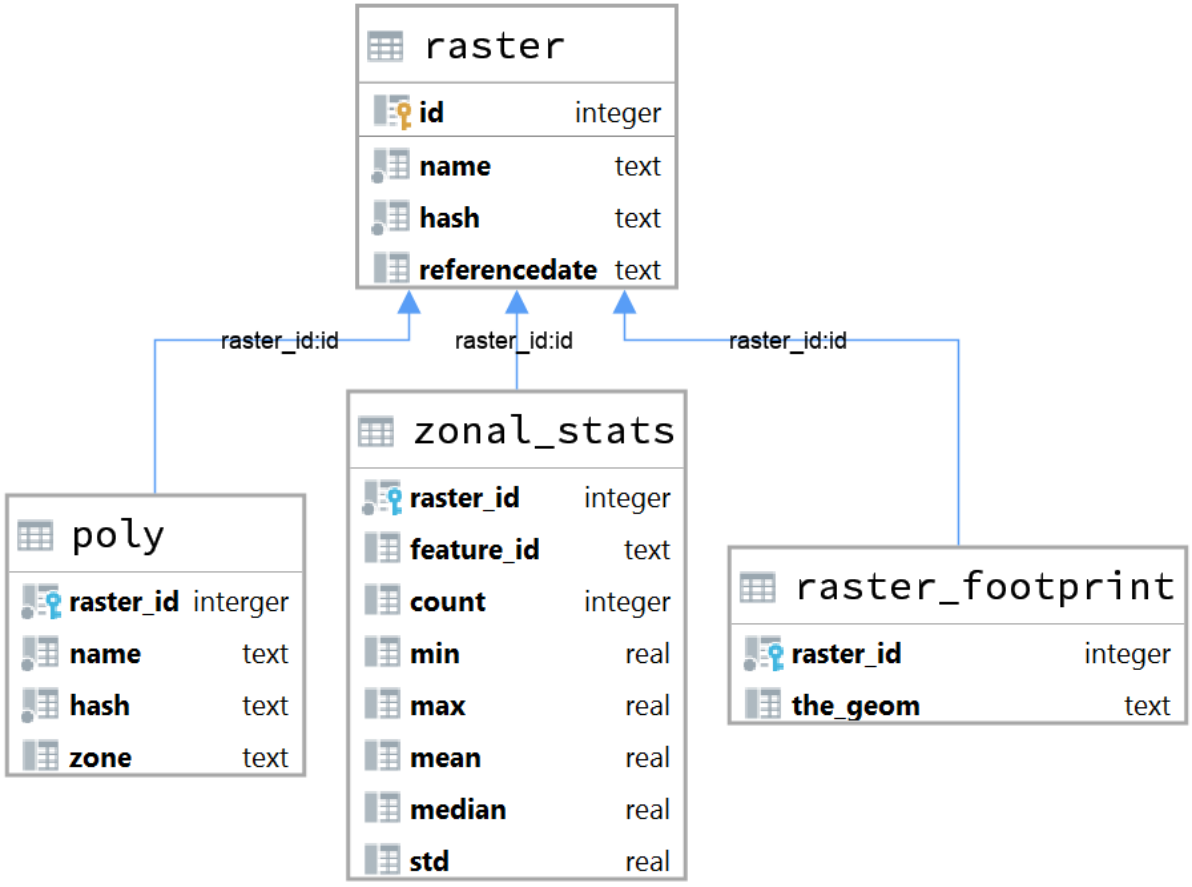

FIGURE 1 – THE SQLITE DATABASE DIAGRAM

Step 1: Process Raster Data

This step is the primary function to interact with the tool – it creates the local database for the first time and updates the existing database every time thereafter.

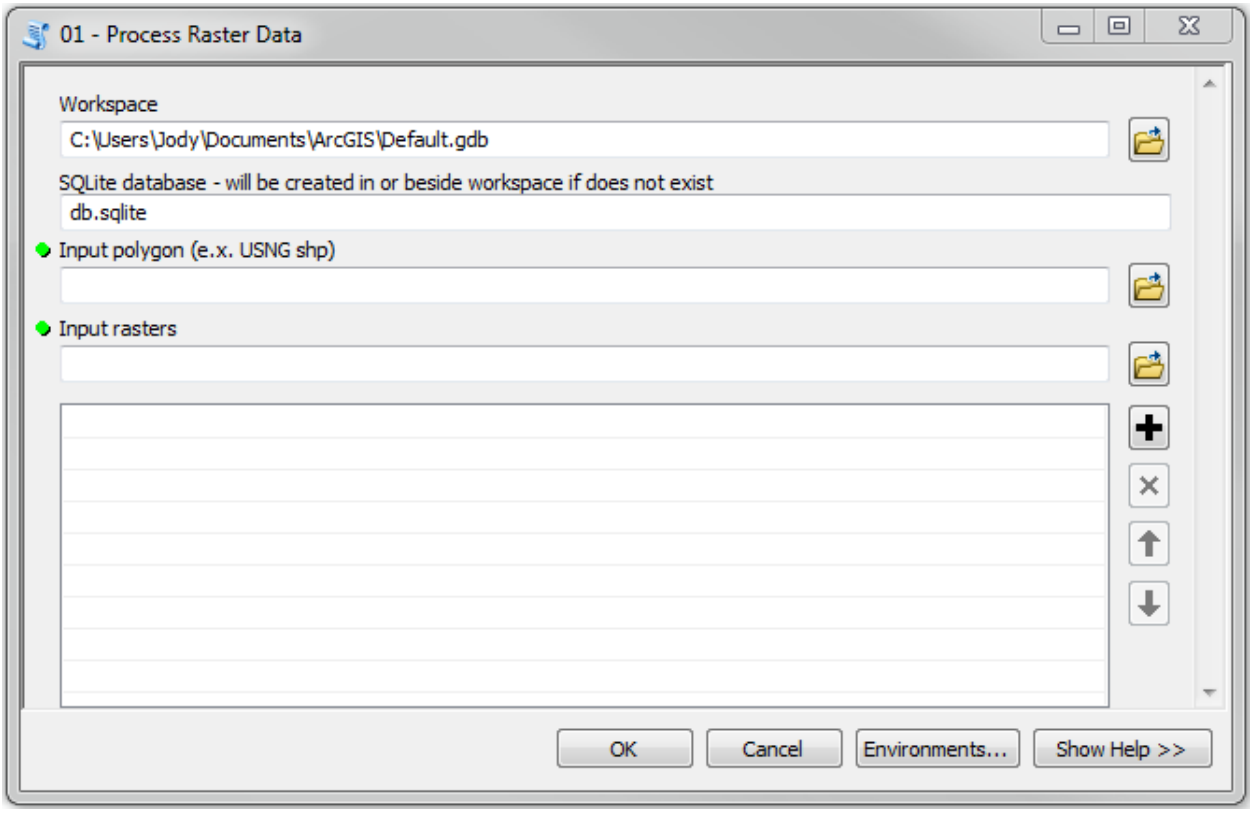

FIGURE 2 – THE PROCESS RASTER DATA GUI

This is the expected starting point for any user. The tool will first ask for a workspace location and the name of a local database. If the workspace location is a folder the tool will create a database inside of the folder. If the workspace is a geodatabase, as seen above, then the SQLite database will be created in the parent folder (C:\Users\Jody\Documents\ArcGIS). The next steps are to select input files for processing – a single polygon shapefile and a set of one or more raster datasets. Once this data has been selected and the 'OK' button has been clicked the tool will begin processing statistics for each raster listed.

Once running, the tool will iterate through each of the input rasters listed. It will create a hash-like entry for both the polygon and the current raster. If the raster also contains a timestamp in the file name, it will be processed and stored. These data will be entered into the poly and raster tables (fig 1). These hashes will be used, and checked against, for every file run through the tool. If the tool detects that a given raster-polygon pair has been processed in an earlier run it will skip that pair so not to duplicate data. In short, a user could add every raster in a folder to this tool, over and over again – it would only process new data.

Once a raster-polygon pair has passed the initial checks it moves into processing. The polygon dataset is converted into a raster file of the same projection, extent, and cell size as the input raster. Using the

unique OID/FID from the polygon file, raster statistics (min, max, mean, median, stdev) are generated for each unique entry. These are then passed into the zonal_statistics table for storage. Finally, the extent data for the input raster is passed as a WKT geometry to the raster_footprint table – which will serve as a reference guide when generating the output data.

This same process is repeated for each input raster if it passes the initial duplicate checks. Special care has been taken to validate that the format of the raster (geotif, GRID, gdb raster, etc.) and of the polygon (shp, gdb feature class) don't have any impact on the function of the USNG grid toolkit.

Step 2: Process additional data

To process additional data into the database, simply open up the 01 – Process Raster Data tool and set the workspace and database name as before. Select polygon and raster data as needed. The tool will automatically check if the new data is already in the database and handle it accordingly. Any new data will update the database for later export.

Step 3: Export Polygon Data

This step in the toolchain is for when the user has decided that enough raster data has been analyzed and a summary polygon file is needed.

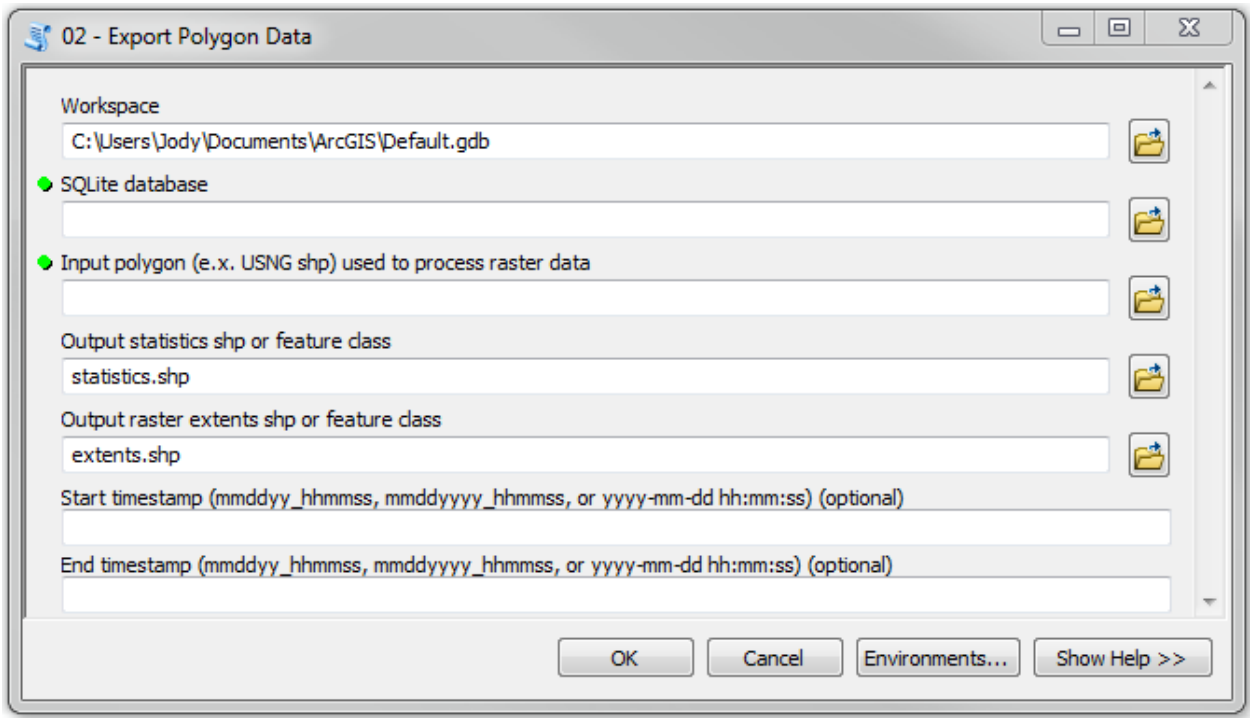

FIGURE 3 – THE EXPORT POLYGON DATA GUI

The export polygon data tool takes the SQLite database and an input polygon, typically the USNG cell shapefile, and extracts all of the previously processed data from step 1 and step2. It then creates a copy of the input polygon and attaches all statistical data to the new file. Optionally, a user can specify a start and end timestamp which will limit what data is attached to the output polygon. If a start time and end time are specified, only rasters in that range are appended to the output file.

statistics

OBJECTID *	Shape *	USNG_1KM	Shape_Leng	Shape_Length	Shape_Area	count_1	min_1	max_1	mean_1	median_1	std_1
5	Polygon	17R NJ 7443	6131.662631	6131.662631	1191440.600582	18934	0.00004	7.868435	2.704065	1.746844	2.458469
6	Polygon	17R NJ 7444	4438.420491	4438.420491	1231211.024921	73	0.097394	1.699547	0.754908	0.667309	0.435031
7	Polygon	17R NJ 7445	4438.739403	4438.739403	1231448.602352	7	0.036875	0.629739	0.403274	0.36255	0.199448
8	Polygon	17R NJ 7446	4439.193748	4439.193748	1231623.60422	57	0.136238	2.516985	1.401615	1.490699	0.710585
9	Polygon	17R NJ 7447	4439.517289	4439.517289	1231818.941305	47	0.012129	1.880789	0.289984	0.178639	0.334494
10	Polygon	17R NJ 7448	4439.804703	4439.804703	1231986.697177	208	0.008448	3.989353	2.319299	2.84045	1.068413
11	Polygon	17R NJ 7449	4438.98369	4438.98369	1232031.970363	371	0.001155	5.079698	1.102382	0.334898	1.461165
12	Polygon	17R NJ 7450	4441.635877	4441.635877	1232497.004339	4	0.052026	0.595506	0.283716	0.243666	0.210599
13	Polygon	17R NJ 7451	4440.692136	4440.692136	1232471.139843	19981	0.000155	4.120087	0.723006	0.632163	0.516792
14	Polygon	17R NJ 7452	4441.020136	4441.020136	1232672.564271	65744	0.000012	5.991504	1.326266	0.995823	1.32111
15	Polygon	17R NJ 7453	4441.478498	4441.478498	1232927.377992	53908	0.000023	6.293061	1.845276	1.030312	1.999383
16	Polygon	17R NJ 7454	4441.706184	4441.706184	1233059.672133	41149	0.000047	5.981087	1.249546	0.78355	1.353038
17	Polygon	17R NJ 7455	4442.144583	4442.144583	1233277.698464	3757	0.000183	2.18786	0.376052	0.300465	0.308428
18	Polygon	17R NJ 7456	4442.511256	4442.511256	1233517.243353	1	0.031861	0.031861	0.031861	0.031861	0
19	Polygon	17R NJ 7457	4442.874576	4442.874576	1233695.797869	79	0.001446	1.005281	0.313008	0.251036	0.25077
20	Polygon	17R NJ 7458	4443.099405	4443.099405	1233815.680291	99	0.00576	1.522924	0.40054	0.244789	0.393101
21	Polygon	17R NJ 7459	4443.463961	4443.463961	1234023.559939	76	0.02259	1.869049	0.523053	0.248535	0.547535

1 (0 out of 438 Selected)

FIGURE 4 – THE ATTRIBUTE TABLE OF A USNG POLYGON WITH STATISTICS FROM A SINGLE RASTER

The new attribute columns on the shapefile will be named count_1, mean_1, count2, mean_2, etc. for every raster dataset in the database unless filtered by the start and end timestamp. A second output polygon will be created that gives the relevant lookup information for each set of statistics.

OBJECTID *	Shape *	Shape_Length	Shape_Area	rasterid	name	date
1	Polygon	0.798601	0.039486	1	Irma_DG_MO_FEMAHNRAP_020618_161215	2/6/2018 4:12:15 PM

FIGURE 5 – THE ATTRIBUTE TABLE FOR THE RASTER EXTENTS POLYGON (REFERENCE)

In this second file the raster extents, along with the name, date, and raster ID are provided. The rasterid column identifies each set of statistics. For example, using fig. 4 and fig. 5, the raster "Irma_DG_MO_FEMAHNRAP_020618_161215" has a rasterid value of 1, which corresponds to the data columns count_1, min_1, max_1, mean_1, median_1, and std_1 in the output USNG polygon.

STEP 4 (optional): Clear Database

This tool accepts only one input – the location of the SQLite database. It then deletes all tables used by the tool so the workspace is clean. Alternatively, a user could go and delete the database using windows explorer.

Adding the tool to ArcMap

Navigate to the github repository and either clone or download the zip archive to your local machine. Unpack the zip archive if necessary.

https://github.com/NLTGit/raster_to_usng_rollup

https://github.com/NLTGit/raster_to_usng_rollup/archive/master.zip

Using the catalog panel, navigate to the location on disk where the folder resides.

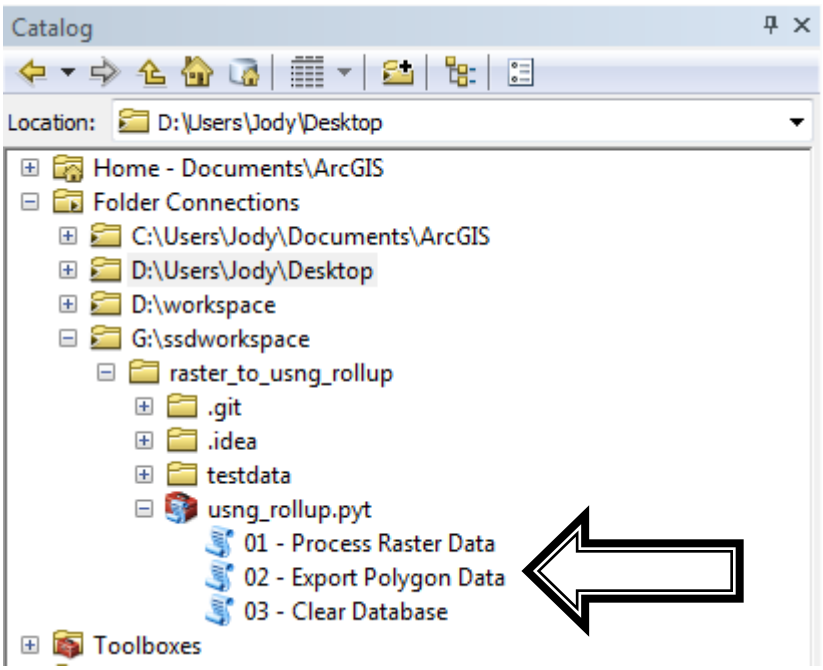

FIGURE 6 – CATALOG VIEW OF THE TOOLBOX

Clicking on any of the tools in the toolbox should bring up a new window in the ArcMap GUI (seen in fig. 2 and fig. 3). If a large red X appears through the toolbox you may need to install the ArcGIS Background Geoprocessing on your machine (http://desktop.arcgis.com/en/arcmap/10.3/analyze/executing-tools/64bit-background.htm). This was required to run python toolboxes on vanilla installs of ArcGIS 10.6 and 10.7 on windows10x64. Other versions of ArcGIS have not been tested at this time.

Output

Using this toolkit managing raster stats for multiple timestamped inputs should be straightforward. The output files will give a polygon shapefile or feature class with statistical data as attributes and an extents reference table with every raster providing statistical data to the analysis.

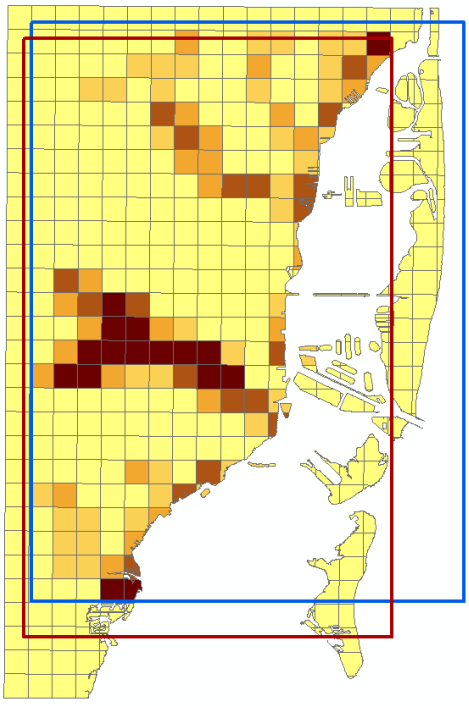

FIGURE 7 (RIGHT) – INPUT POLYGON (USNG CELLS) SHOWING THE COUNT_1 COLUMN AND REFERNCE EXTENTS FOR TWO RASTERS

Help

Contact jody.hoon-starr@nltgis.com with questions, concerns, or bugs. Bugs can also be reported on github.