

Batch DEM download & geoprocessing

A utilization of batchDEM.py

Nicholas P. Taliceo

GIS 6317, Fall 2016



Outline

1 Purpose

- Why is this script needed?
- About the script

2 Demonstration

- Nantucket County, Massachusetts USA
 - Why is this a good case study?
 - Demonstration
- Dallas County, Texas USA

3 File logistics & documentation

- Contents within batchDEM folder
- Limitations & delimitations
- Further work

Outline

1 Purpose

- Why is this script needed?
- About the script

2 Demonstration

- Nantucket County, Massachusetts USA
 - Why is this a good case study?
 - Demonstration
- Dallas County, Texas USA

3 File logistics & documentation

- Contents within batchDEM folder
- Limitations & delimitations
- Further work

Purpose

Why is this script needed?

- Suppose you are working on some project for a vast area, requiring the use of several *digital elevation models* or DEMs.

Digital Elevation Model

A *digital elevation model* (DEM) is a digital or cartographic/geographic raster dataset of *elevations* displayed in xyz-coordinates.

- If one is working at the county or state level and there *is not* the presence of pre-merged DEMs, then the download and merger of these DEM files can take *a significant amount of time for the user*.

Purpose

Why is this script needed?

- Moreover, with the increasing amount of files to download and merge, there is an ever-increasing risk for human error to be incurred.
- Further, manual geoprocessing tasks associated with these newly acquired files can also take *a significant amount of time*.

Geoprocessing

Any GIS operation used to manipulate data. Any geoprocessing operation requires an input dataset, performs a geospatial operation on this input, and returns the result of the operation as new output dataset.

Outline

1 Purpose

- Why is this script needed?
- About the script

2 Demonstration

- Nantucket County, Massachusetts USA
 - Why is this a good case study?
 - Demonstration
- Dallas County, Texas USA

3 File logistics & documentation

- Contents within batchDEM folder
- Limitations & delimitations
- Further work

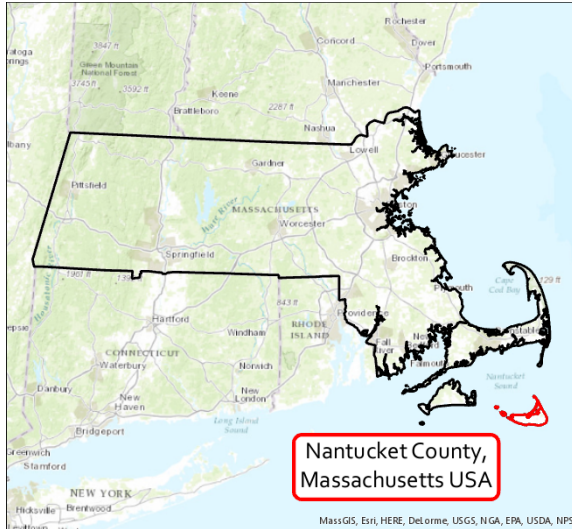
What does this script do?

- ① Download large quantities of DEM files from the web.
- ② Perform other GIS tasks associated with DEM files that would otherwise take large amounts of time to complete.
 - Re-projection of DEM files.
 - Conversion of files to another raster type (i.e., Esri grid file) based on a pre-existing file with a defined coordinate system.
 - The creation of a *raster mosaic*, or merger of all DEM files.
 - Incorporate the results into a current map frame of an Esri ArcGIS Pro project.

Outline

- 1 Purpose
 - Why is this script needed?
 - About the script
- 2 Demonstration
 - Nantucket County, Massachusetts USA
 - Why is this a good case study?
 - Demonstration
 - Dallas County, Texas USA
- 3 File logistics & documentation
 - Contents within batchDEM folder
 - Limitations & delimitations
 - Further work

Nantucket County



Nantucket County

- Nantucket County consists of one island, *Nantucket Island*, located on the coast of Massachusetts USA.
- Nantucket County consists of 8 separate 7.5-Min DEM Terrain Data models. These models, by name, are:
 - 1 Great Point
 - 2 Nantucket
 - 3 Nantucket OE S
 - 4 Siasconset
 - 5 Siasconset OE E
 - 6 Siasconset OE S
 - 7 Siasconset OE SE
 - 8 Tuckernck Island
- The data for this can be found at www.WebGIS.com.

What makes Nantucket a good example?

- Due to the relatively small set of data, this demonstration does not take a long time to compute.
- This entire county is relatively well-known and therefore is more relevant to a wider audience.
- Because Nantucket is an island, one can *clearly* interpret the elevation model; the surrounding area is at a height of zero due to all exterior boundaries being at sea level.

Nantucket county demonstration

The general script processes are as follows:

- 1 Input the current working directory of the output folder (which comes with the zipped folder).
 - Be sure to copy and paste the folder location exactly as it appears in File Explorer!

```
Please your working directory: H:\GIS6317\Final\batchDEM\output  
The folder location has been set!
```

- 2 Copy and paste the web address directly from your web browser to the script. If this website exists, then the script will continue. Else, you will be given another opportunity to give a correct URL address.

```
Please input the url link EXACTLY as it appears in your browser: http://www.webgis.com/terr\_pages/MA/dem75/nantucket.html  
Searching through the input url...  
Finding downloadable files...
```

Nantucket county demonstration

- ③ If the script finds zipped file links on this website, then it'll download all of these files.
- The script will download all of the zipped files.
 - Then, the script will extract all files and save as a new folder of the same name as the zipped folder.
 - Finally, the script will search through these folders, and if a .dem file exists, the script will re-name the .dem file with the name of its parent folder, and save in your main output directory.

Name	Date modified	Type
1634858	12/16/2016 5:01 PM	File folder
1634859	12/16/2016 5:01 PM	File folder
1634860	12/16/2016 5:01 PM	File folder
1634861	12/16/2016 5:01 PM	File folder
1634862	12/16/2016 5:01 PM	File folder
1634863	12/16/2016 5:01 PM	File folder
1660437	12/16/2016 5:01 PM	File folder
1660626	12/16/2016 5:01 PM	File folder
chatham-w	12/16/2016 5:01 PM	File folder
providence	12/16/2016 5:01 PM	File folder
providence-e	12/16/2016 5:01 PM	File folder
1634858.dem	12/16/2016 5:01 PM	DEM File
1634859.dem	12/16/2016 5:01 PM	DEM File
1634860.dem	12/16/2016 5:01 PM	DEM File
1634861.dem	12/16/2016 5:01 PM	DEM File
1634862.dem	12/16/2016 5:01 PM	DEM File
1634863.dem	12/16/2016 5:01 PM	DEM File
1660437.dem	12/16/2016 5:01 PM	DEM File
1660626.dem	12/16/2016 5:01 PM	DEM File

Figure: Downloaded folders and extracted DEM files in output folder.

Nantucket county demonstration

- ④ After the file download, the script will then prompt the user whether or not s/he wants to re-project the DEM files with a known file with coordinate system.
 - I am using a *shapefile* of Nantucket County, named `NantucketCounty.shp`. This file is located in the this package, under `batchDEM > demo > nantucket`.

```
Files have successfully finished downloading! Congratulations!  
Would you like to re-project your DEM files (Y/N)?
```

- ⑤ Next, the script will prompt the user if s/he wants to convert the DEM files to raster (i.e., Esri Grid files).
 - Note that the Python console window will output several statements regarding the x,y coordinate system. These are just intermediary steps of the tool, and is normal.

```
Convert the DEM files to raster (Y/N)?
```

Nantucket county demonstration

- After the file conversion option, the user will be given the option to create a new *raster mosaic*, or merger of the new raster files or original .dem files.

```
Create a new raster mosaic of the dem files (Y/N)?
```

- If the user indicates 'yes', then the script will print out all of the DEM files that it recognizes and subsequently will merge.
- The script gives the opportunity to exclude some or all files, in the event that there are duplicates or simply unwanted files.

```
The files to be merged are:
['H:\GISC6317\Final\batchDEM\output\1660437.tif',
'H:\GISC6317\Final\batchDEM\output\1634861.tif',
'H:\GISC6317\Final\batchDEM\output\1634862.tif',
'H:\GISC6317\Final\batchDEM\output\1634859.tif',
'H:\GISC6317\Final\batchDEM\output\1634858.tif',
'H:\GISC6317\Final\batchDEM\output\1634860.tif',
'H:\GISC6317\Final\batchDEM\output\1660626.tif',
'H:\GISC6317\Final\batchDEM\output\1634863.tif']
Do you want to exclude some DEM files (Y/N)?:
```

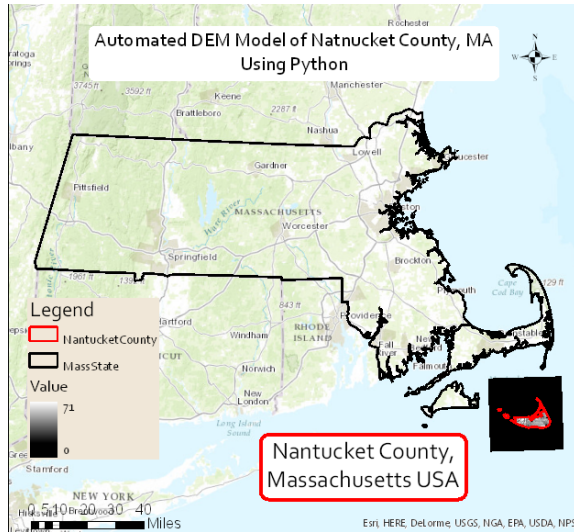
- The output file is named `merged_rasters` by default and is saved in the output folder, or your original output directory.

Nantucket county demonstration

- ⑦ Finally, the script will prompt the user if s/he wants to incorporate the new raster mosaic into a current map.
 - The current map frame must already exist.
 - What's more, this option only works when using Esri's ArcGIS Pro to create your maps.
 - You must give the full pathname of the ArcGIS Project File (.aprx file extension).
 - An example map can be found in `demo > nantucket > Nantucket.aprx`.

```
Add the merged raster mosaic to your map (Y/N)? Y
Please input the entire path name of the .aprx file of map being worked on:
C:\Users\Nick\Desktop\demo\Nantucket\Nantucket.aprx
aprx variable successfully created!
A map has been found!
Adding the raster mosaic to your project...
The raster mosaic has been successfully added to your project!
```


Nantucket county demonstration—results



Outline

- 1 Purpose
 - Why is this script needed?
 - About the script
- 2 Demonstration
 - Nantucket County, Massachusetts USA
 - Why is this a good case study?
 - Demonstration
 - Dallas County, Texas USA
- 3 File logistics & documentation
 - Contents within batchDEM folder
 - Limitations & delimitations
 - Further work

Dallas county demonstration

- Similarly, we can perform similar DEM extraction and manipulation on Dallas County, Texas USA.
- The data for this analysis can be found at www.WebGIS.com.



Dallas county demonstration

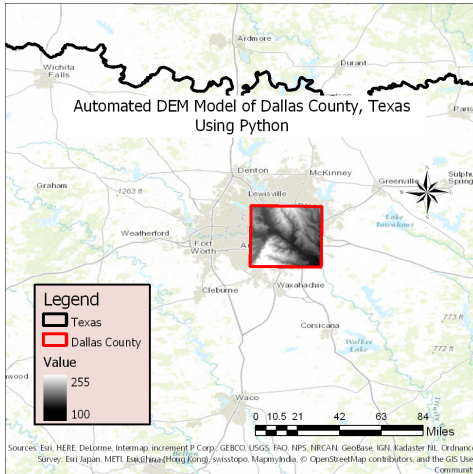
The same tasks for the user hold for the Dallas County example.
For this task, the user must:

- ➊ Input the working directory (i.e., the output folder).
- ➋ Input the URL address for the website containing the DEM files.
- ➌ Complete the other geoprocessing tasks (re-project, convert to raster, create a raster mosaic, and add to a current project).

Problem: In this example, the individual DEMs for the county have broken links! However, larger DEM files do exist. Unfortunately, these DEM files extend beyond that of Dallas County.

- Solution: In ArcGIS Pro, one must manually perform a Raster Clip (Geoprocessing > Data Management Tools > Raster > Raster Processing > Clip).

Dallas county demonstration—results



Outline

- 1 Purpose
 - Why is this script needed?
 - About the script
- 2 Demonstration
 - Nantucket County, Massachusetts USA
 - Why is this a good case study?
 - Demonstration
 - Dallas County, Texas USA
- 3 File logistics & documentation
 - Contents within batchDEM folder
 - Limitations & delimitations
 - Further work

What's included in this folder?

The main folder that you will download, likely as a ZIP file, is batchDEM. In this folder, you will encounter several sub-folders:

- `graphics`—A folder containing all relevant graphics associated with this document.
- `demo`—This folder contains the demo materials for both the Nantucket and the Dallas examples. Included are the ArcGIS Pro workspaces, shapefiles, and an output folder for web-scraped DEM files.
- `batchDEM.py`—The main script that utilizes web scraping to download DEM files and then completes various geoprocessing operations.
- `webScrapeDEM.py`—This is the first component of the large script. It only asks for a download directory and link to the web.
- `fileConversionDEM.py`—This is another Python script that assumes one already has the DEM files downloaded. From there, the script asks for the file location, and performs various geoprocessing tasks.
- `README.txt`—A readme file for these folders/files.

Outline

- 1 Purpose
 - Why is this script needed?
 - About the script
- 2 Demonstration
 - Nantucket County, Massachusetts USA
 - Why is this a good case study?
 - Demonstration
 - Dallas County, Texas USA
- 3 File logistics & documentation
 - Contents within batchDEM folder
 - **Limitations & delimitations**
 - Further work

Limitations & delimitations

- If the user provides an output location that does not exist, then the script will break.
 - Solution: Be certain that your output location exists; copy/paste the pathname of your output from File Explorer directly to the script.
- At the moment, the user cannot selectively choose particular files to download on a website. For instance, there exist websites that contain DEM information for all counties on a single webpage. In this case, the user cannot select only one county, but must download *all* data.
 - Solution: When the script prompts the user to exclude some information at the time of mosaic creation, one can simply exclude extraneous information. However, this can be tedious.

Limitations & delimitations

- This script requires the local installation of Python 3.x (which can be downloaded [here](#)). Additionally, several modules are needed:
 - arcpy (which means you will likely need an license of ArcGIS Pro, or equivalent)
 - bs4, or the [Beautiful Soup](#) module
 - Other modules such as: os, urllib.request, requests, zipfile, which *should* be included with the general Python installation. However, if not installed, a Python module installation guide can be found [here](#).

Outline

- 1 Purpose
 - Why is this script needed?
 - About the script
- 2 Demonstration
 - Nantucket County, Massachusetts USA
 - Why is this a good case study?
 - Demonstration
 - Dallas County, Texas USA
- 3 File logistics & documentation
 - Contents within batchDEM folder
 - Limitations & delimitations
 - Further work

Further work

- ① Make the Python console window more user-friendly.
 - Create more spaces between prompts, delete extra information, etc.
- ② Create an executable file or interactive interface to increase ease of use.
- ③ Incorporate the option to convert .dem files to several other raster types.
- ④ Incorporate the option to search for, and download files based on keywords (e.g., 'Nantucket' or 'Dallas').

Summary

- The `batchDEM.py` script is the principle file that both downloads and performs geoprocessing operations on DEM files.
- The `webScrapeDEM.py` file only searches for and downloads DEM files to your local drive.
- Finally, the `fileConversionDEM.py` takes pre-existing DEM files and performs geoprocessing operations on them.
- Outlook
 - Although this script works well for specific tasks, it can still be generalized for a wider array of data and geoprocessing tasks.
 - This script also has the potential of being fine-tuned for easier user accessibility.

For Further Reading I



M. Gould.

Digital Elevation Model (DEM)

U.S. Department of the Interior,

<http://tahoe.usgs.gov/DEM.html> (2012).



What is geoprocessing?

Environmental Systems and Research Institute, Inc.,

<https://pro.arcgis.com/en/pro-app/help/analysis/geoprocessing/basics/what-is-geoprocessing-.htm>
(2016).