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GEO TUTORIAL

#ArcGIS PRO #QGIS

BATCHING GIS TASKS: A WAY TO SPEED UP REPETITIVE PROCEDURES

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BATCHING GIS TASKS: A WAY TO SPEED UP REPETITIVE PROCEDURES

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REQUIRED RESOURCES

- ArcGIS Pro 3+ or QGIS 3+ (both are covered in this tutorial)

FEATURED DATA SOURCES

- Click here to access dataset used in this tutorial (1.151 MB).

OVERVIEW

Sometimes we must run the same tool multiple times due to different criteria applied in the analysis. Running the same tool over and over with just a slightly modified set of parameters can be time-consuming and inefficient. A better solution is to batch the task. Batching is a procedure of gathering and performing the same or similar tasks all at once. This allows us to greatly increase productivity and reduce time spent on actively doing the task. In this tutorial, you will learn how to run a batch process in both ArcGIS Pro and QGIS software. This skill will greatly improve your processing abilities.

Imagine you are an analyst working on a project related to cell services. You need to identify areas of potentially poor or no cellular service for future infrastructure expansion. You were given the task of preparing a generalized signal quality map over the continental United States. After a brief review of the literature, you learned that numerous factors, such as topography or land use will influence the quality of cell service. However, one particular parameter, the distance to the signal tower, can offer a broad understanding before proceeding with a more detailed analysis. Further review of the technical documentation showed that the maximal range of most signal towers is 25 miles. There are also a few classes of signal strength that can be determined based on the distance. After gathering all the needed data, you have come up with the following table presenting signal strength depending on the distance to the tower (Table 1). In this tutorial, you will learn how to run tasks in batch to decrease the manual repetitions needed to solve this problem.

Table 1. *General signal quality based on the approximate distance from the cellular tower*

General Signal Quality	Approximate Distance from Tower
Great signal (4 to 5 bars)	Less than 1 mile (0 to 1.5 km)
Good signal (3 to 4 bars)	1 to 2 miles (1.5 to 3 km)
Average signal (2 to 3 bars)	2 to 3 miles (3 to 5 km)
Poor signal (1 to 2 bars)	3 to 5 miles (5 to 8 km)
Very poor signal (0 to 1 bar)	5-12 miles (8 to 18 km)
Disappearing signal	Greater than 12 miles (>18 km)
No signal	Greater than 25 miles (>40 km)

DATA

To begin with, download the data available in the **Featured Data Sources** above and add it to the new project in your software of choice (ArcGIS Pro and QGIS are covered in this tutorial).

The data represents locations of signal towers across the Continental United States. The original data was prepared by the *Homeland Infrastructure Foundation-Level Data (HIFLD) program*. Data available to download in this tutorial has been lightly processed to remove unnecessary attributes and reprojected to the meter-based Coordinate Reference System: *USA Contiguous Equidistant Conic* (EPSG: 102005). A total of 23,483 point features are available in the set. The .zip archive must be extracted (unpacked) before usage.

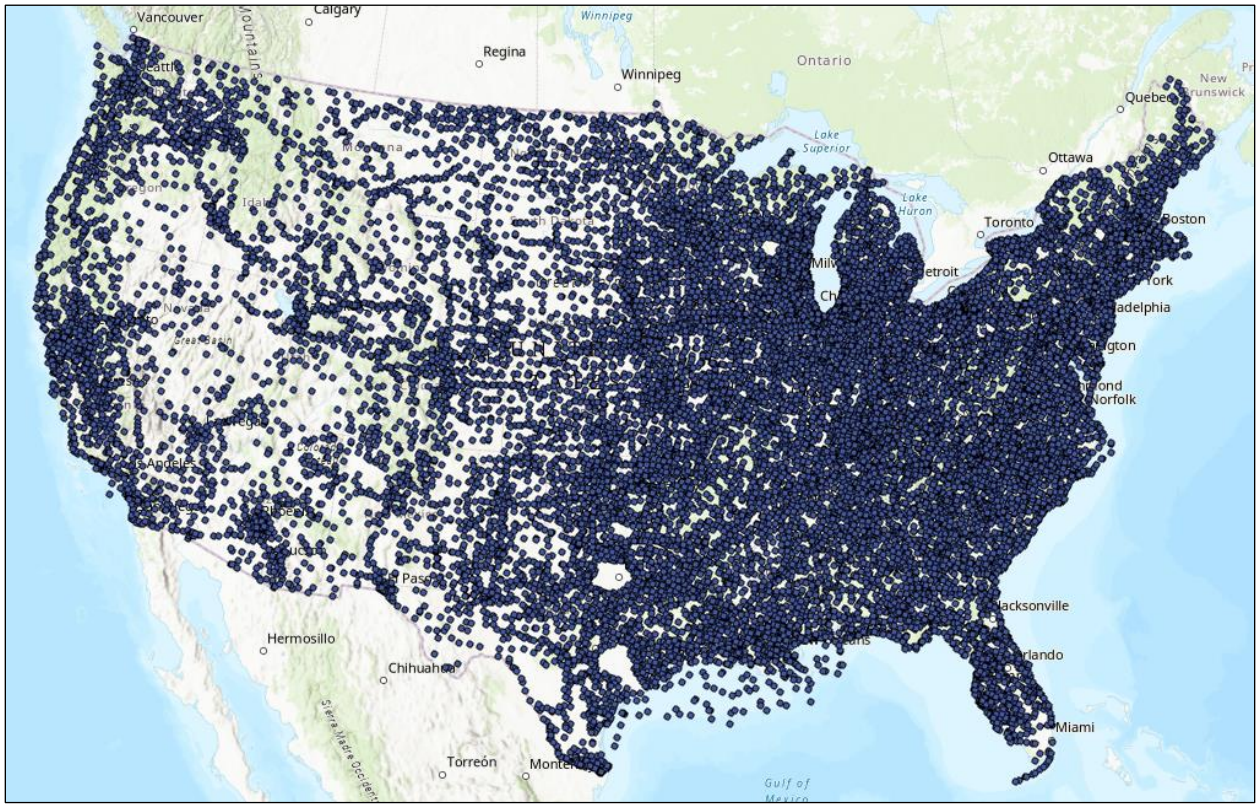

Fig. 1. *Input data presenting locations of cellular towers*

ANALYZING THE PROBLEM

To generate a range for each signal category, we will need to use the buffer tool. This tool enables the creation of a circle with a specified radius around the input data, which in our case represents the locations of cellular towers. Since there are six categories of signal strength, we would have to run the buffer algorithm 6 times to compute all ranges of interest. The only parameter that changes simultaneously is the distance parameter. While this approach works, the entire process is time-consuming and involves lots of repetitive clicking. Instead, we will use Batch Processing.

ARCGIS PRO BATCH PROCESSING

After importing the *CellularTowersUS* layer to the new project, open the *Geoprocessing tab* (choose the *Analysis* tab and select *Tools*). Then follow these steps:

A. Search for *buffer* or open the *Analysis Tools* folder, and under *Proximity* you can find *Buffer* tool.

B. Right-click on the *Buffer* tool and select *Batch* from the submenu (Fig. 2).

C. In the *Batch Buffer* window, change the *batch parameter* to ***distance [value or field]*** – this is the parameter that will change between each run of the tool in the batch process (Fig. 3).

D. Select the ***save the batch tool*** option to store the results and specify the name and location. Mark the *add output datasets to an open map* so that the results are imported to the main map after the process is done. Click *Next*.

E. We must now define the buffer generation parameters for the batched process:

   a. Set the *input features* as ***CellularTowersUS*** layers – each time the tool runs, it will calculate the buffer from that layer;

   b. Set the *output feature class* as ***Buffer_%Name%*** - the *%Name%* part will be replaced automatically with the parameters used during batching. This will allow for each layer to be named according to the distance we will define in the next step. If the *%Name%* part is not used, each layer will be called *Buffer* (or other chosen in the previous step name);

   c. the *batch distance [value or field]* parameter must be set in accordance with the signal range quality classes we have defined (Table 1). Set the first value to ***1500*** and change *unknown* to ***meters*** (or use the corresponding ***miles*** value if you prefer). Notice that right after you input the first value, the same option is displayed below. This allows you to provide the next parameter used during batching. Repeat the process for all remaining classes (Fig. 4);

   d. if you would like the resulting buffers to be merged into a single feature, change the *dissolve type* to

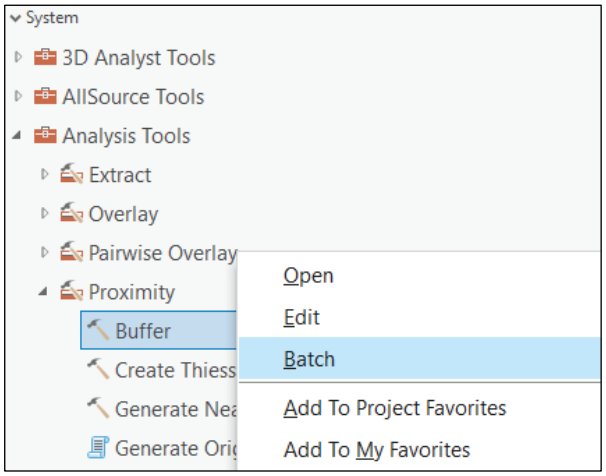

Fig. 2. *Running tool in batch process option in ArcGIS Pro is available after right-clicking the tool name in the geoprocessing toolbox.*

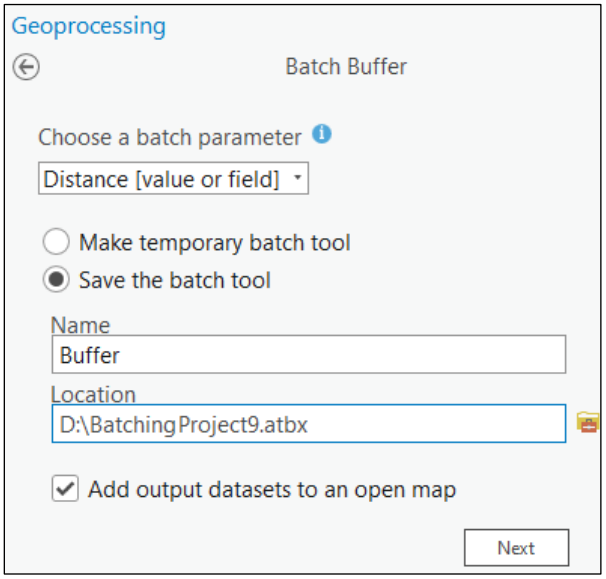

Fig. 3. *ArcGIS Pro settings in batch process allow to choose the parameter that will change in each batch.*

dissolve all output features into a single feature, otherwise, leave it as ***no dissolve***.

F. Once all the parameters are correctly set, click *Run* to start the batch process.

G. The computations may take a few minutes to finish, but you don't need to do anything else. Once the process is done, all the results will be automatically added to the map view. From this point, you can set *Symbology* to visualize different signal strengths (Fig. 8).

QGIS BATCH PROCESSING

After importing *CellularTowersUS* layer to the new project, open the *Processing Toolbox* (choose *Processing* menu, then *Toolbox*, or use the [CTRL]+[ALT]+[T] key combination). Then follow the steps:

A. Search for *buffer* in the search bar or expand the *Vector Geometry* tab and find the *Buffer* tool.

B. Right-click on the *Buffer* tool and select *Execute as Batch Process* from the submenu (Fig. 5).

C. A new window of *Batch Processing* will open. Here we set all the necessary parameters for batch processing. Notice the differences in the QGIS and ArcGIS Pro setup: on the one hand, you can have multiple parameters changing in batches; but on the other hand, the distance does not allow you to change units. This is very important, as at this point, the distance must be provided in the same unit as the default unit of the CRS of the layer (*meters* in our case). You can add multiple batches with the plus icon . Use it to create 6 rows, then set the remaining parameters:

   a. set the ***CellularTowersUS*** layer as the *input layer*. You can use the *Autofill* button once the first row is set, then just select the *fill down* option;

   b. in the *distance* provide the consecutive maximal ranges distance values in *meters* (Fig. 7);

   c. change the *dissolve result* option to ***yes*** if you want the output buffers to be merged into one feature (again, once you set the parameter in the first row, you can use the *fill down* setting in the *autofill* to automatically apply the setting to all cases);

   d. in the *buffered* cell, select the three-dot button and navigate to the location where you want to save the results. Provide the name of the

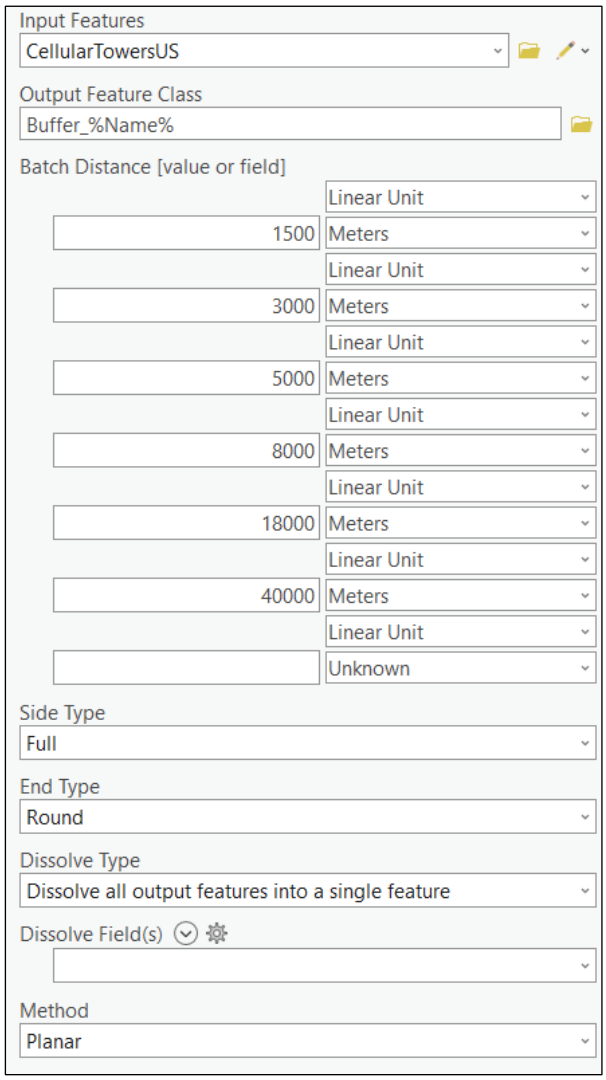

Fig. 4. *In the following window of ArcGIS Pro settings for batch processing, we define the consecutive batch parameters that will be applied to each batch.*

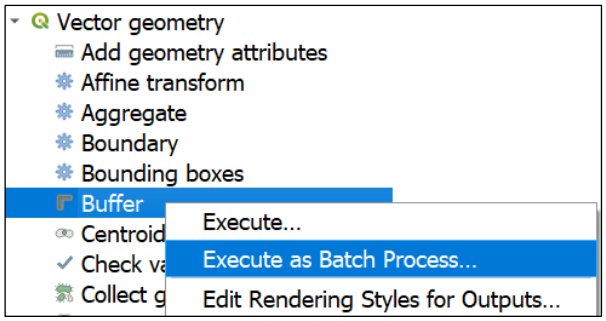

Fig. 5. *Similarly to ArcGIS Pro, in QGIS option to run batch process is available after right-clicking the tool in the Processing toolbox.*

layer, e.g., ***Buffer_Q_*** (note the _ at the end). After you have confirmed your selection, an *autofill* setting will pop up (Fig. 6). Here you can decide if you would like to use an automated naming pattern, similarly to the ArcGIS Pro setting. Choose *autofill mode* as ***fill with parameter values*** and change *parameter to use* ***distance***. This will apply the used distance value as the remaining part of the layer name (note before that we use the _ character at the end of the layer name to separate the text from the value that will be inserted in the autofill) (Fig. 7);

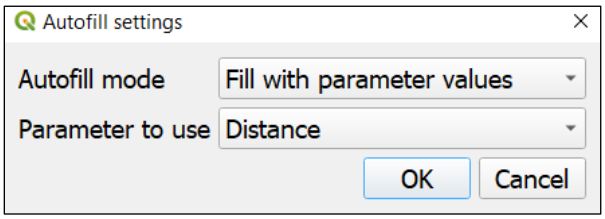

Fig. 6. *Autofill settings allow to apply an automated naming pattern to all batched outputs, based on the used parameter.*

e. check the option to *load layers on completion,* then click *Run*.

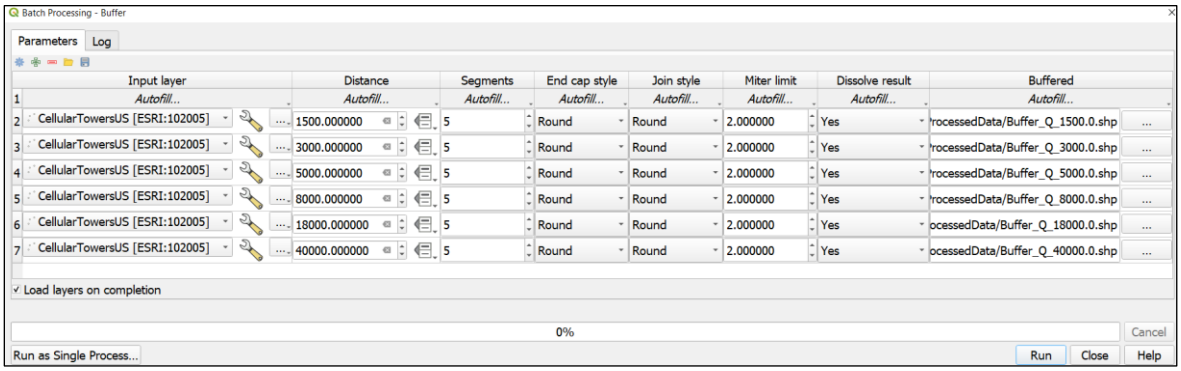

Fig. 7. *QGIS allows you to modify each parameter of the algorithm per batch; however, parameters related to the geometry have to be input in the units of the input layer CRS.*

D. The batch process should take a couple of seconds to complete, after which all the results will be added to the project. From this point, you can set Symbology to visualize different signal strengths (Fig. 8).

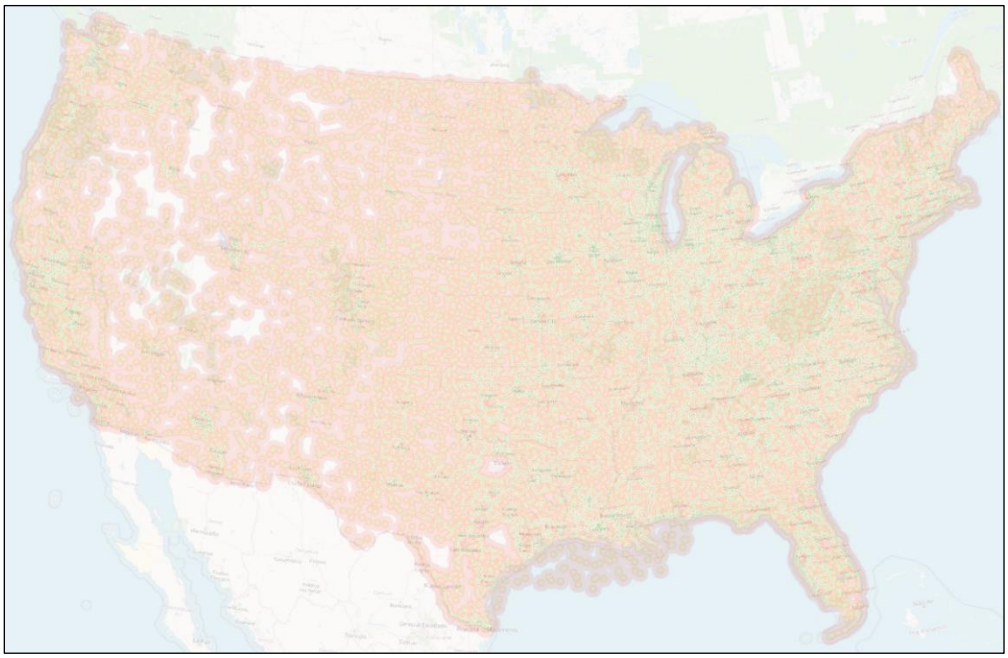

Fig. 8. *Resulting map presenting strength of the cellular signal based on the proximity to the cellular tower.*