**Ziying (Gene) Cheng  GEOG 5571  Exercise 01**

## Overview

In order to make Andros island an easier way to read at a scale of 1:1,500,000, I use generalization tools to simplify its coastline. I mainly use simplify tools and smooth tools to process lines and polygons. As for the point data, I do not find the right tools to handle it.

## Workflow

**Step 1**  I use Conversion Tool in ArcMap Toolbox to convert the E00 file to geodatabase. But the result still fails to be added to a new layer in ArcGIS Pro. Then I try the Feature Class To Shapefile Tool under the Conversion Toolsets so that the several shapefiles exist in the end. Next I create a new project in ArcGIS Pro, and add the shapefiles.

**Step 2**  I use Aggregate Points tool to gather very close points into polygons. It is the only tool that **can** deal with the point data, and the result turns to polygons, which changes the feature type. Aggregation Distance is the only parameter in this tool (figure 1), which means if the distance between two points is smaller than the entered length, these points will gather. Then I set my aggregation distance to 4000 meters and 8000 meters (figure 2).

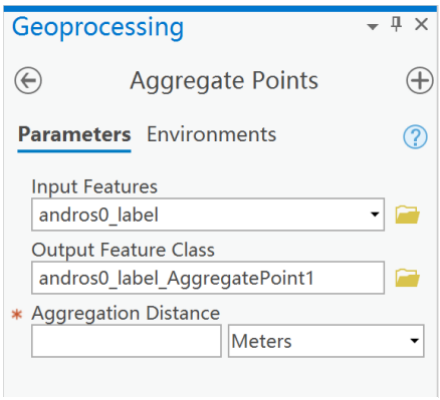


Figure 1. The processing pane of Aggregate Points Tool.

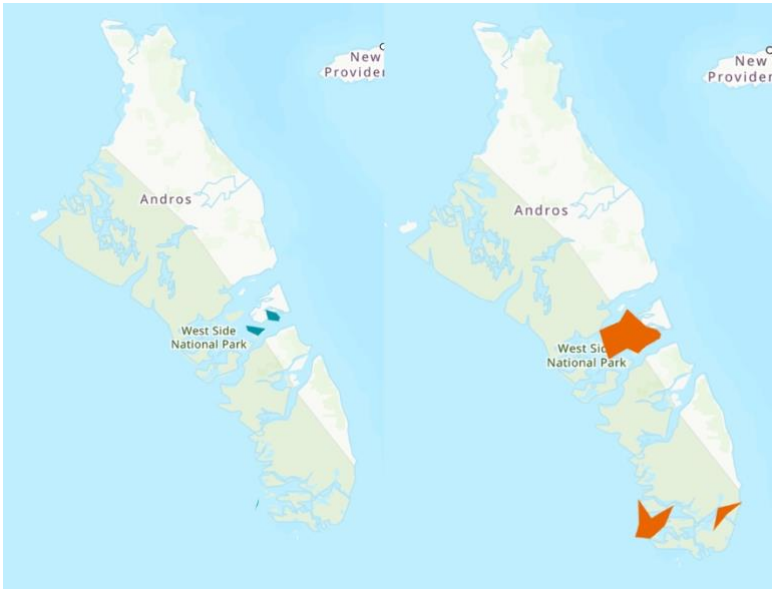


Figure 2. The outputs of Aggregate Points Tool shown by 4000 meters (left) and 8000 meters (right).

From figure 2, we can see that when aggregation distance becomes larger, more and more points turn to polygons, and the two polygons in the middle of the picture even gather to a big polygon.

**Step 3**  I use Aggregate Polygons tool to gather small and close polygons. There are three parameters in the tool, which are Aggregation Distance, Minimum Area, and Minimum Hole Size (figure 3). The aggregation distance means that if two polygon boundaries are within the

entered aggregation distance, these polygons will aggregate. The minimum area means that if the area of polygons is smaller than the entered area, they would be removed. The minimum hole size means that the polygon holes smaller than this size would be removed as well. In this exercise, I set two different numbers. One is 1000 meters, 0 and 500 square meters. Another is 2000 meters, 0 and 1000 square meters. (figure 4)

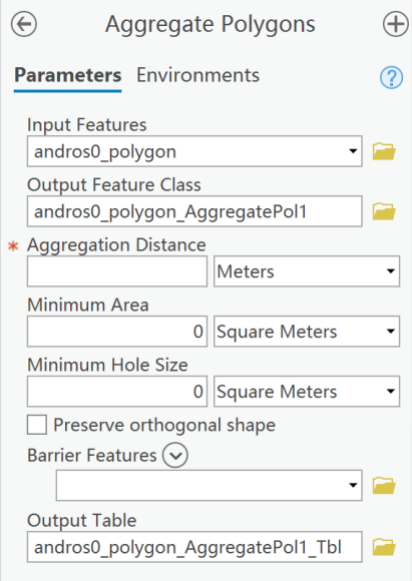


Figure 3. The processing pane of Aggregate Polygons Tool.

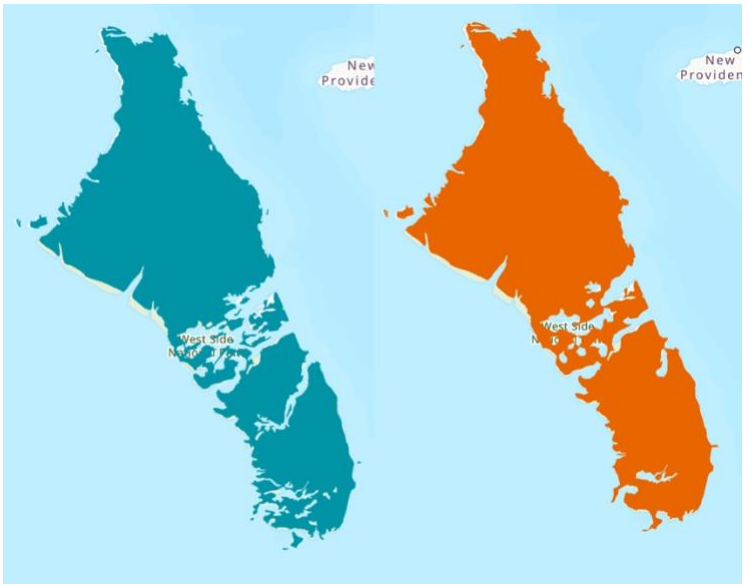

Figure 4. The outputs of Aggregate Polygons Tool shown by 1000 meters with (left) and 2000 meters (right) of aggregation distance.

From figure 4, we can see that the with the aggregation distance becoming larger, more and more small polygons aggregate to a bigger one or just incorporate into adjacent large polygons. It worth noting that these two aggregate tools can output a table indicating which polygons are aggregated and their ID as well.

**Step 4** I use Simplify Polygon tool to change the outline of Andros island by moving some points which are relatively far from others. The reason why I choose this tool owes to several broken lines, and I think the overview of the map can be simpler. There are three parameters which are Simplification Algorithm, Simplification Tolerance and Minimum Area respectively (figure 5). Retaining critical points (Douglas-Peucker), retaining critical bends (Wang-Müller) and retaining weighted effective areas (Zhou-Jones) are three different ways of algorithm. The first two ways both remove vertices by judging their critical, but the second one is more faithful. Simplification tolerance represents the degree of faithful. Larger tolerance means more unsophisticated of your coastline. The minimum area serves the minimum area that would be removed from the map. I use the Douglas-Peucker algorithm in this tool, together with 1300 meters and 500 square meters for the left ones. Input file is the outcome of 1000-meter aggregation distance from step 3. (figure 6)

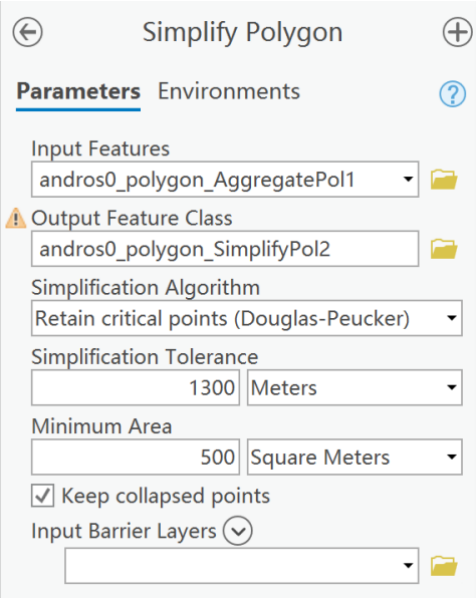


Figure 5. The processing pane of Simplify Polygon Tool.

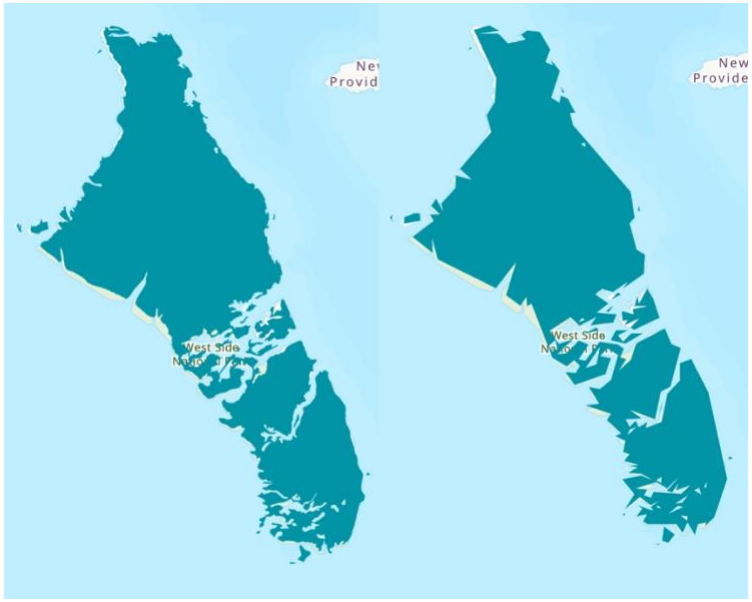

Figure 6. The output with 1000-meter aggregation distance from step 4 (left) and the output of Simplify Polygon Tool (right).

From the picture, we can see that the outline become more linear compared to the outcome with 1000-meter aggregation distance from step 4.

**Step 5** I use Smooth Polygon tool to make the outline more rounded. There are two algorithms, PAEK and Bezier interpolation. PAEK is based on the tolerance which controls the length of moving, and larger tolerance means apparent effect, but the details lost as well. I use the PAEK algorithm in this exercise and choose 2000 meters as the tolerance (figure 7).

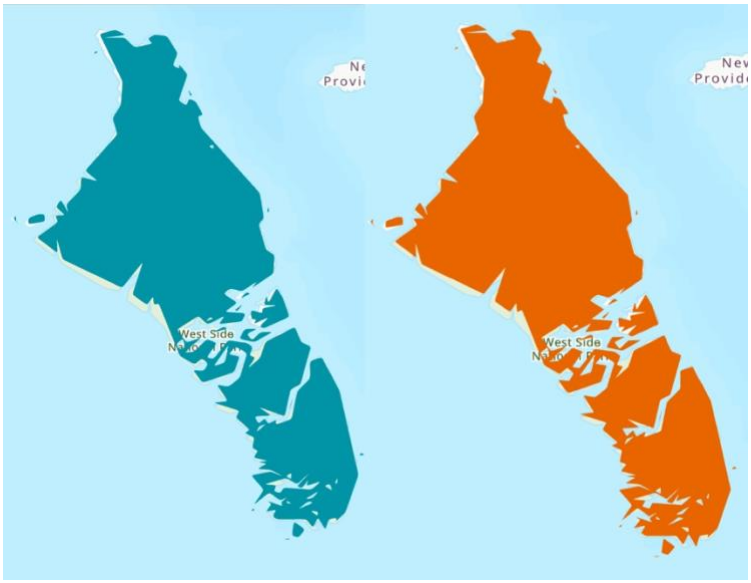

Figure 7. The outputs of Smooth Polygon Tool shown by 2000-meter (left) and 1000-meter (right) tolerance.

From the picture, we can see that the aesthetic is improved but some details are still difficult to be identified under small scales. Thus, I set the tolerance to 1000 meters (figure 7) and find that the result is not as good as the last one, so I remain the first result whose tolerance is 2000 meters.

**Step 6** Simplify Line tool has the similar purpose, similar mechanism of action and similar parameters with the Simplify Polygon tool (figure 8). I use Douglas algorithm and set the tolerance to 1500 meters and 1000 meters separately. (figure 9)

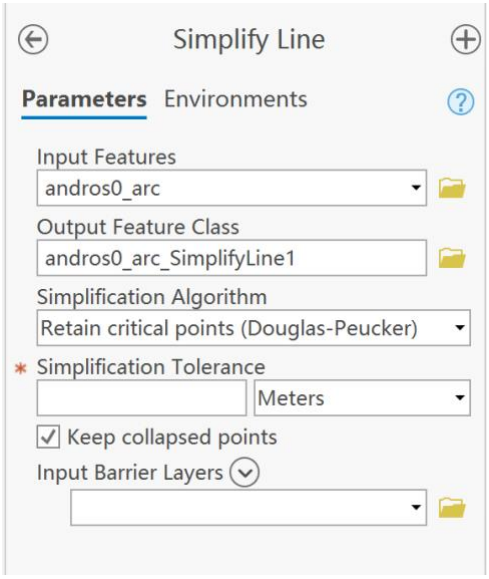


Figure 8. The processing pane of Simplify Line Tool.

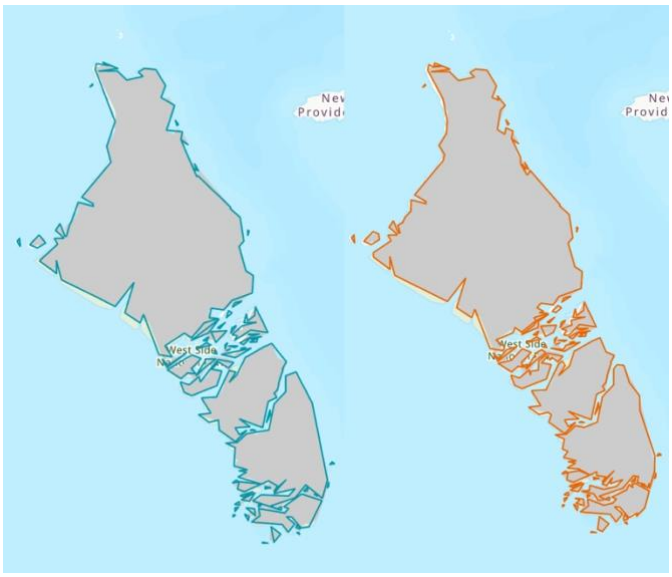

Figure 9. The outputs of Simplify Line Tool shown by 1500 meters (left) and 1000 meters (right) of tolerance and Douglas-Peucker algorithm.

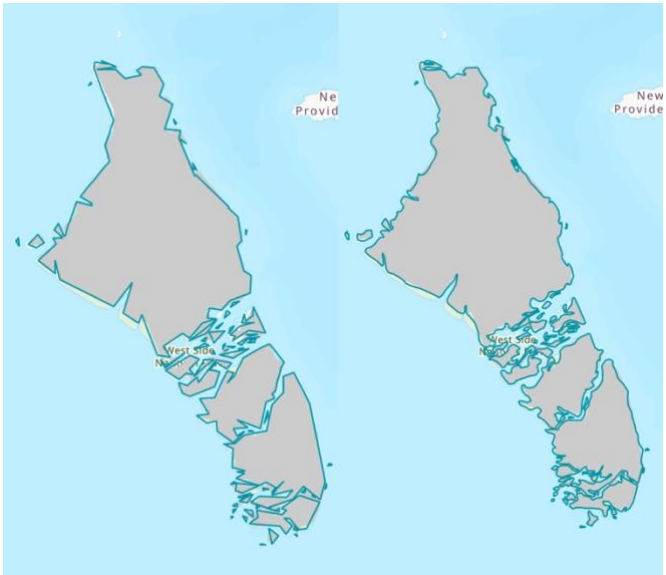

Figure 10. The outputs of Simplify Line Tool shown by Douglas-Peucker (left) and Wang-Müller algorithm and 1500 meters of tolerance.

From the picture, we can see the right one with 1000-meter tolerance is more reality. However, under the scale of 1:1,500,000, the outcome in the middle part of the island is already overlapped, which is very messy. Thus, the left one with 1500-meter tolerance might be better at this moment.

Then I change the algorithm into Wang-Müller, and set the tolerance with 1500 meters again (figure 10). Undoubtedly, the outcome is really faithful. But it looks messy as well compared to the same tolerance using the Douglas algorithm.

**Step 7** Then I use the Smooth Line tool to help make the outline more rounded. There are two parameters, Smoothing Algorithm and Tolerance (figure 11). I set the tolerance to 1500 meters and try both algorithms (figure 12).

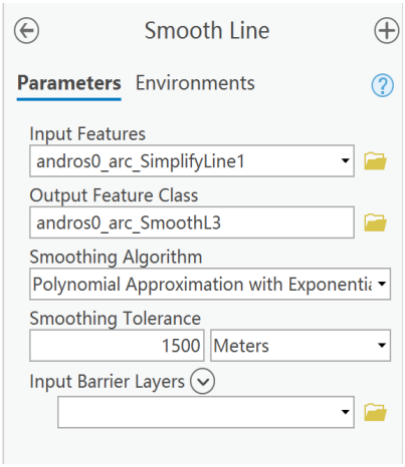


Figure 11. The processing pane of Smooth Line Tool.

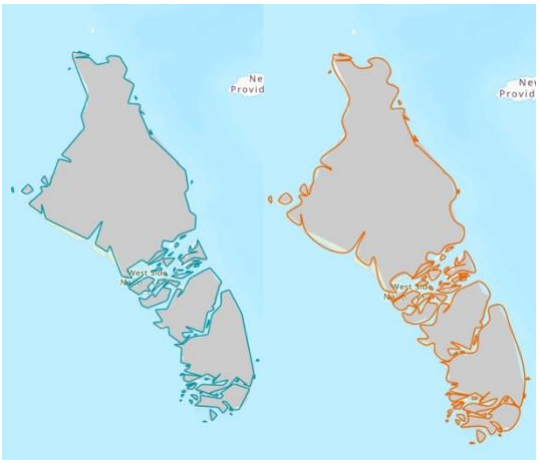

Figure 12. The outputs of Smooth Line Tool shown by PAEK(left) and Bezier interpolation(right) using 1500-meter tolerance.

From the picture, we can easily identify that the one with PAEK algorithm is better than the other one.

**Step 8** Then I use the Feature To Polygon Tool to convert the output got from the PAEK algorithm of last step from line to polygon (figure 13). Last but not least, I try to compare the result converted from line with the polygon from the left picture of figure 7 (figure 14). Thus I find that the left picture is more detailed than the right one, which means the left one is a better way of Andros island simplification under the small scale of 1:1,500,500 among all analysis. And this is also the final feature class I put in my geodatabase.

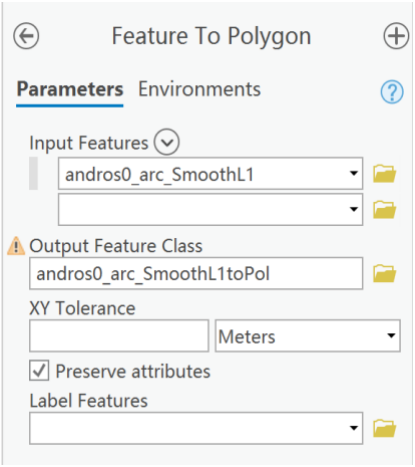


Figure 13. The processing pane of Feature To Polygon Tool.

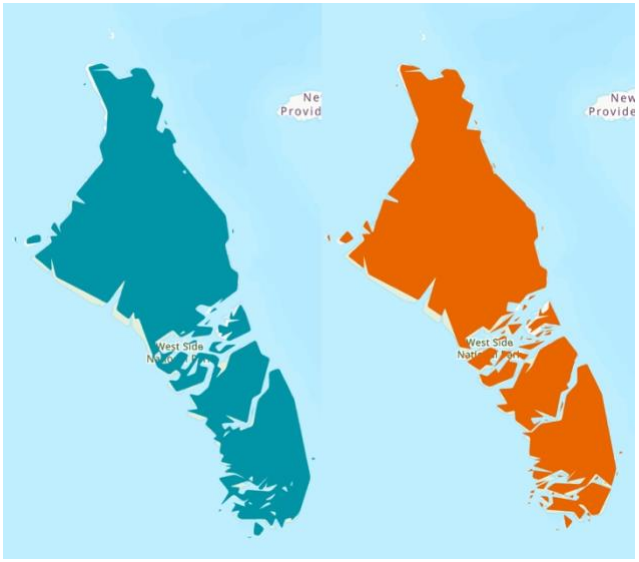

Figure 14. The final outputs of polygon simplification(left) and line simplification(right).

All in all, I spent about 2 hours learning the generalization tools in ESRI's website, 3 hours exploring and analyzing the issue in ArcGIS Pro, and spent about 2 hours finishing the write-up part.

Section two

**Aggregate Points** is related to Generalization toolsets under Cartography toolbox, and works with point feature and the output is polygon feature.

**Aggregate Polygon** is related to Generalization toolsets under Cartography toolbox, and works with polygon feature and the output is polygon feature.

**Simplify Polygon** is related to Generalization toolsets under Cartography toolbox, and works with polygon feature and the output is polygon as well.

**Smooth Polygon** is related to Generalization toolsets under Cartography toolbox, and works with polygon feature and the output is polygon as well.

**Simplify Line** is related to Generalization toolsets under Cartography toolbox, and works with line feature and the output is line feature.

**Smooth Line** is related to Generalization toolsets under Cartography toolbox, and works with line feature and the output is line feature.

**Feature To Polygon** is under Conversion toolbox, and works with line/point feature and the output is polygon feature.