Assignment 1 Report

4603 / 5603 GIS in the Social and Natural Sciences

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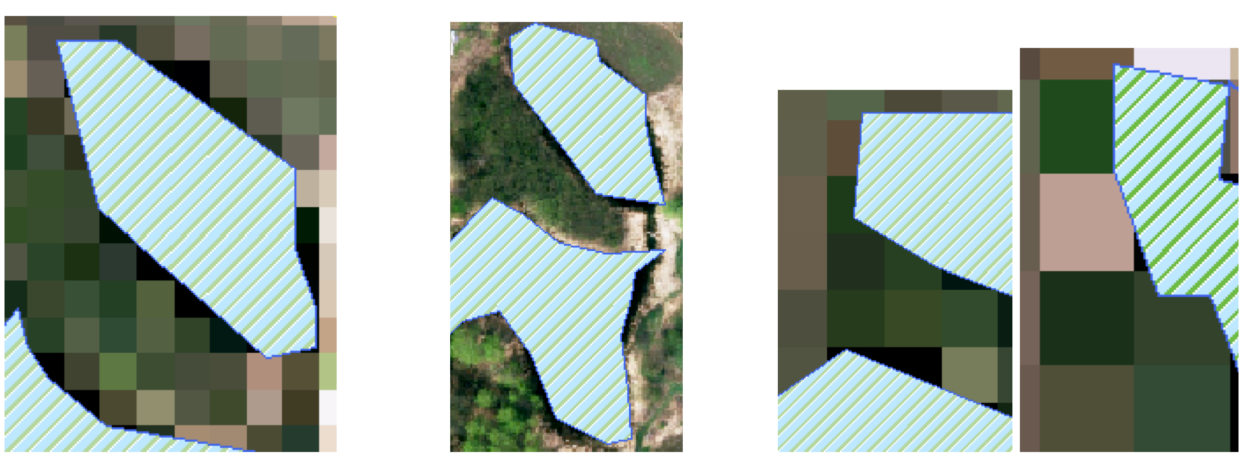
Introduction:

The goal is to finalize a suitable resolution for a production of spatial layers that describe distribution of ponds.
The raster image maps that are provided are with 0.6, 5,10 and 15 meters resolution. The maps use the projected coordinate system NAD_1983_UTM_Zone_15N. Theoretically, higher the resolution, the better the quality. Detail depends on the scale.

Analysis:

The scale is 1:3964 for a 0.6 meter/pixel resolution map. This scale shows the area that covers all the 9 ponds in the map. The map with 0.6 meters resolution features are closer to real world ponds, objects surrounding the ponds. With this scale and resolution, the features seem more clear. By adjusting the scale, we can navigate between coarse and finer details as well as for more or less generalization. However, there is less change when it comes to 10 mts and 15 mts resolutions when adjusting the scale, it seems to have coarse details and less generalization. In the case of 0.6 mts resolution image, the generalization does not change the geometry too much with changes in scale, which is not the case with other resolutions. In comparison with 5 meters / pixel resolution, there is certainly coarser detail than the 0.6 mts resolution. But the map still seems to have pixels and features smoothened with a larger scale. With large scale resolution for 5 meters, a small block of the map looks as follows in comparison to 0.6 mts, 10 mts, 15 mts resolution:



5 meters	0.6 meters	10 meters	15 meters
Total Area: 8961.23 mts	Total Area: 9032.18 mts	Total Area: 9311.07 mts	Total Area:3073.57 mts
Total Perimeter: 1183.07 mts	Total Perimeter: 1204.94 mts	Total Perimeter:1282.97 mts	Total Perimeter: 222.87 mts

Assessing polygon mapping quality

Discussing approach for polygon detection algorithm to generate ground truth:

If we assume that 0.6 meters is the best possible resolution and if we used edge detection and polygon detection algorithms over raster images, it seems possible to compare the quality of manual mapping of the ponds with that of automated mapping. We can generate a set of 9 ground truth polygons each of which represent the ponds. We can then use downsampling resolution tools to downsample a polygon P from resolution 0.6 mts to 5 mts and calculate the area. We can use the area of the polygon which was downsampled from 0.6 to 5 mts resolution to assess quality of polygon from both manual mapping as well as automated polygon detection mapping to assess the quality of downsampled polygon area. This approach might provide insights into estimated error in manual mapping of the ponds between the resolutions more accurately. A rough estimate of error from manual mapping of the ponds between resolutions of 0.6 mts and 5 mts is 9032.18 - 8961.23 = 70.95 mts. In this case scale seems to make the accuracy sensitive, so scale was kept constant for both resolutions to measure the error estimate more accurately.

Accuracy & Reliability:

It seems difficult to choose between 0.6 meters and 5 meters. It seems the accuracy of the data should preserve the information from the map. This also helps to improve reliability. It depends on how accurate this data can be extracted to assess real world data to make evaluations and assessments towards decision making. Since the long term goal is to describe distribution of ponds in the whole country, then higher resolution might be of more importance. More generally, Remote sensing over smaller regions of interest seems to require higher resolution. For example, from the 9 ponds from the map we have, the 2,3,6 and 7 ponds seem smaller as resolution decreases from 0.6 meters to 15 meters. The standard high resolutions range used for raster images is 30 centimeters to 5 meters in general. It is the tradeoff between higher feature spatial accuracy vs lower feature spatial resolution. However, from [3]it seems 1 meter resolution seems to work well for pond mapping, from a research finding. In this case, 0.6 meters seems to be closer to 1 meters than other available resolutions for this task.

Cost:

The cost is higher in the case of 0.6 meters resolution since the high resolution imagery is expensive. Additionally there are also costs of storage, and working with such high resolution also seems to need better computing power, since high resolution images take more processing time.

Efficiency:

With higher resolution, it seems more clear to map the ponds and it seems easier to conduct crowd sourced mapping options as well. Even for an automatic polygon detection approach, a higher resolution seems to help better. For generating maps that can be referred as a ground truth, it seems to require the best possible resolution, which in this case is 0.6 mts. Given that [3]it seems 1 meter resolution seems to work well for pond mapping, it may then be better for not only manual mapping but also for automating the process with more advanced Deep Learning algorithms.

Recommended and proposed solutions:

1. For optimal, faster, approximately accurate maps - 5 mts resolution seems fine.
2. For best, accurate, efficient, reliable spatial layers as well as long term goals of automation - 0.6 mts seems like the best option.
3. For mixed, better automation - we can use 0.6 mts resolution maps and map the ponds which serves as ground truth, which can serve

as an optimal benchmark for building manual as well as automated mapping tools. Then we can use 5 mts resolution so that we get an assessment of error, tolerance of polygon mapping errors. This also makes it easier to use ground truth images and downsample to 5 meters and train a Deep learning model and use the model for future maps with 5 meters resolution or even smaller resolution as well.

References:

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