Urbanization of the Boise area from 1999-2014

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Introduction

Boise, Idaho has a unique mix of land types. Wedged between the mountains of Boise National Forest and vast fields of agriculture, Boise is still a rapidly growing city. The population of Boise in 1999 was around 170,000 people, and in 2014 had reached almost 212,000 people. Could a city support this increase of population without rapidly urbanizing to create more housing, jobs, and schooling for that many people? Probably not. In this report, we are going to track the urbanization of the greater Boise area in Idaho between the years 1999 and 2014.

Study Area and Data

To track the urbanization of Boise, Idaho, I used Google Earth Engine Explorer to acquire data and analyze this data. The study area is a rectangular area of about 250 square miles in southwest Idaho that includes the city of Boise. Figure 1 shows our study area. I used Google Earth Engine Explorer to get my data for the study area. The data is Landsat TOA Percentile Composite, and I used data from the years 1999, 2004, 2009, and 2014. I chose these years because the most recent year of this Landsat data is 2014, and I wanted to use a fifteen-year span to show the difference in urban areas. I then included 2004 and 4009 to evaluate the data every 5 years and show the gradual change in urbanization.

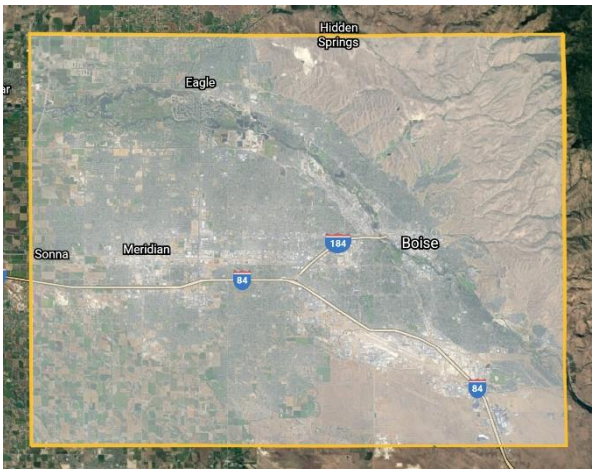

Figure 1. Study Area

Methods

To evaluate this data, there were quite a few steps once the data was gathered to begin the research. Our goal is to show how the Boise area has been urbanized over time. Here is the outline of the step-by-step process:

1. Download Landsat data from 1999, 2004, 2009, and 2014 into the Google Earth Engine workspace.

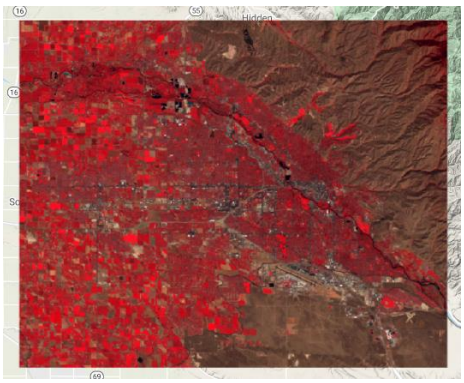

Figure 2. 1999 Mask

2. Apply the same size mask (the size being our study area) to each Landsat image. The masks are created by drawing a rectangle for the first image, and then matching the exact rectangle for the next three images. Display these masks in RGB 4,3,2 so that we can clearly see the difference in each land type. I also made the BV range 10-120 so that the colors of each band were easier to distinguish from each other.

3. Create classes for vegetation, mountain, water, and urban areas. I chose to include the mountain land type because the mountains cover a generous amount of our study area, and I did not want them to be confused with vegetation or urban area because the color of the mountains can be close to both of those other land types. Because our study area is quite large, I created these classes by selecting 45 reference points for each type of land, with a total of 180 reference points per image. I chose red for vegetation, yellow for mountains, blue for water, and white for urban area. I kept these colors consistent for all four images that were studied.

Figure 3. 1999 Classification Reference Points

Figure 5. Classes

4. Train a classifier to display our results in a new model. For this step, I used the Random Forest Classifier and kept the resolution at 30m. I kept these parameters the same for each year of data.

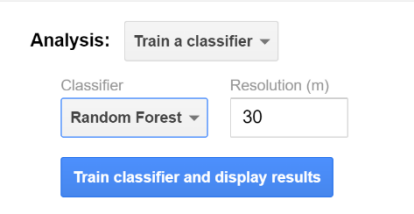

Figure 4. Training Parameters

5. Repeat steps 3 and 4 for all of our masks. I deleted the classes after each classification and chose new reference points for each image. If you do not do this, then the resulting model would be the same for each image.

6. Compare the amount of urban space in each new model. Because I classified urban area as white for each image, the more white on the resulting model for each year means the more urban area.

Results

After completing steps 1 through 5 as discussed above, the final step is to compare the amount of urban space in each new model. For each year, the amount of white area shows the amount of the study area that is taken up by urban space. Here are the results of each classification:

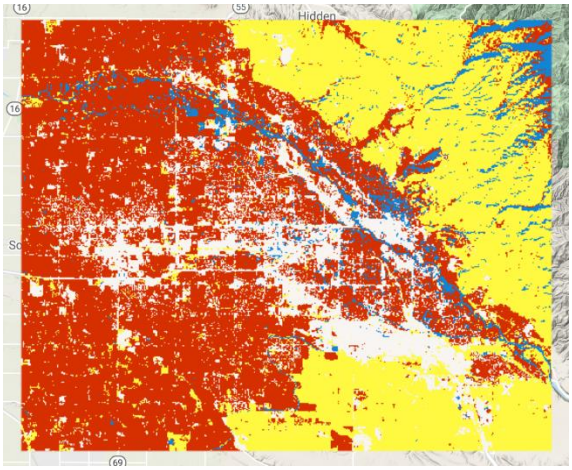

Figure 5. 1999 Model

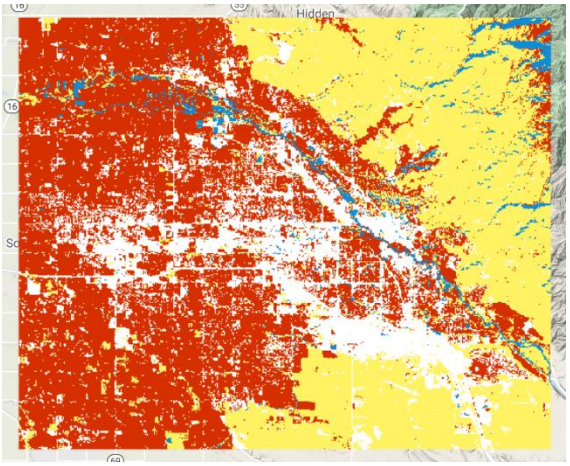

Figure 6. 2004 Model

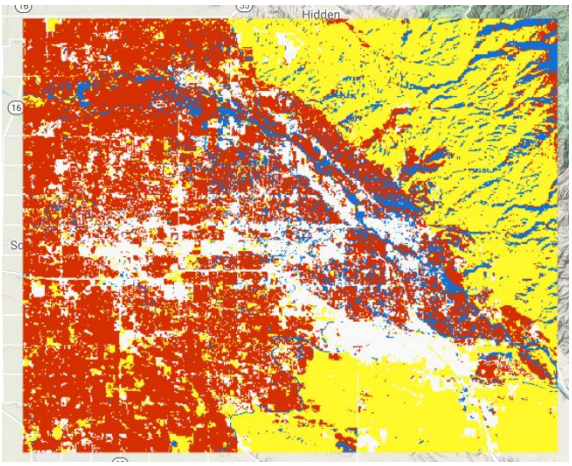

Figure 7. 2009 Model

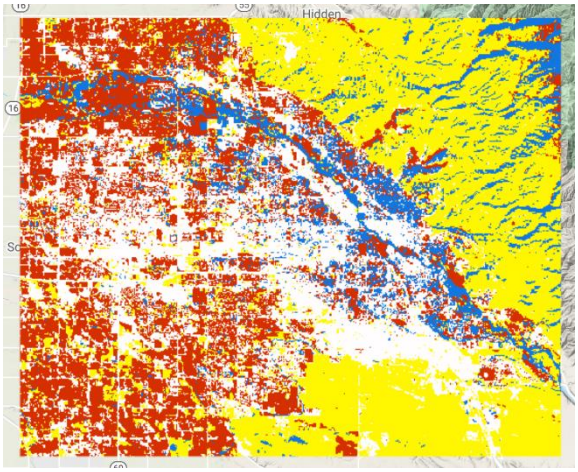

Figure 8. 2014 Model

Let's analyze what these figures mean. Firstly, for the purposes of this study we can ignore the water and mountains (blue and yellow) on these images because they aren't going to be changing much between each image. Not much urban development is being built on water or mountains in this area. Figure 5 shows the classification of our 1999 image. There is not much white shown on this figure. Mostly, we see red, which is vegetation. This makes sense, because in 1999, the area surrounding Boise was mostly agricultural land. Figure 6 shows the land five years later in 2004. We can see that there is some more white on our model in 2004, as urban area began to increase. The

Boise area in 2009 is shown through Figure 7. If we look at the northwest quadrant of our image, we can see how urban area increased even more in the five years since 2004. Finally, we have our 2014 model in Figure 8. Here, we can see the scattering of white all over what was previously red in the first three images. Especially when comparing the amount of red (vegetation) in 1999 to in 2014, we can clearly see the increase of urban area in Boise since 1999, and the decrease of agricultural land.

Conclusions

It is evident that the city of Boise, Idaho and the surrounding area has been urbanized greatly since the year 1999 to keep up with a rapidly growing population. What was once vast agricultural land is now a large, bustling city. This study only tracked a 15-year span, and the data only shows growth until 2014. Today, 5 years later, it is almost inevitable that those models would be covered with even more urban area than in our most recent image. It is important for cities to continue to grow, but when is it time for them to stop? The urbanization of cities supports a growing population, but what happens to the agricultural land and other vegetation that gets destroyed in its place? Agriculture is essential to feeding our world, and the growth of vegetation supports all life on Earth. These Landsat data and GIS methods are very important in tracking the growth of urban space and the decline of vegetation in the world. If we keep expanding urban cities at this rate, how long before there is no vegetation left?

References

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