

**URBAN AND RESIDENTIAL DEVELOPMENT OF ANNE ARUNDEL COUNTY AND ITS AFFECT ON
THE CHESAPEAKE BAY WATERSHED**

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Introduction

Background

When completing this project, it was thought of to complete a version like the final lab that we have done, with different aspect. Great knowledge was sparked as having learned about the Chesapeake Bay in 6th grade, when moving to Maryland from Florida in 2010. In that grade, I learned about how poor the quality of the bay was. Questions arose about why the bay quality was being degraded. This project's task is to analyze one factor contributing to poor quality of health of the bay; urban and residential development and its impact on the bay, examining time frames from 1985 to 2022.

This project is based upon the urban and residential development in Anne Arundel County and how it affects the Chesapeake Bay. Anne Arundel County was founded in 1650. Its total area is 588 mi², of the 12,407mi² that consist of Maryland. Anne Arundel has a population is 590,336 as of 2021. The Chesapeake Bay is a large estuary that runs through Maryland. It is in a part of 16 of Maryland's 23 counties and this project.

Data Description

Data Used

The Landsat data was collected from Earth Explorer. Two Files were chosen: Landsat 4/5 TM Collection 2 Level 1 from October 17, 1985 and Landsat 8/9 OLI/TIRS Collection 2 L1 from October 15, 2022; path is 015 and row is 033 (photos below). They are around the same time and have about no clouds within their photos. Anne Arundel County and the opening of the Chesapeake Bay are contained within the area. Both have bands 1-5 and 7. In the 2022 image, there is a coastal aerosol, which was not used for this project.

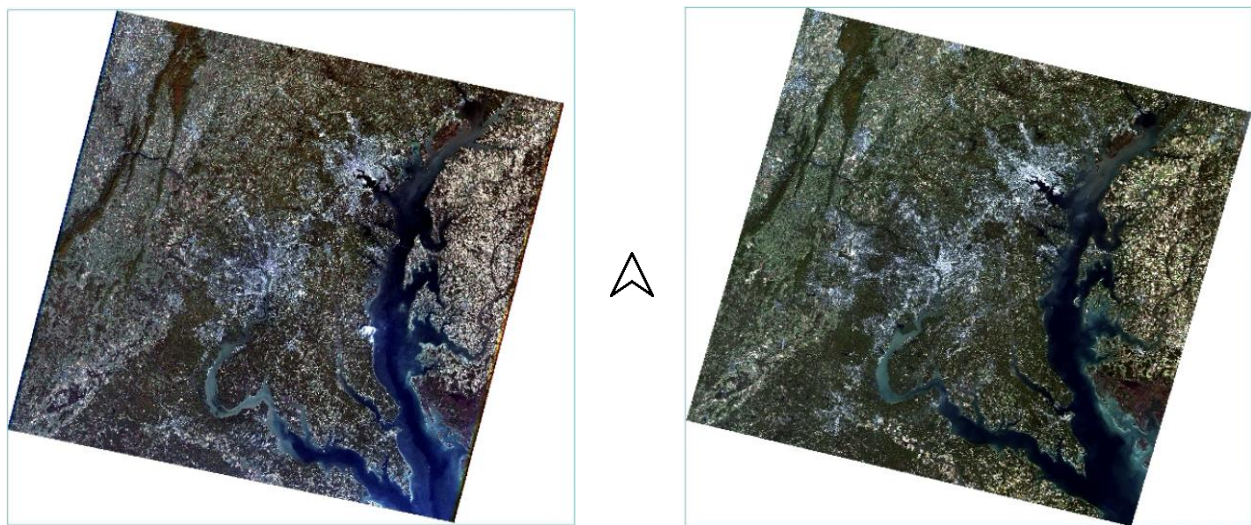


Figure 1. On the left is 1985 and on the right is 2022 with the path being 015 and the row 033.

Both were downloaded onto the computer by the same process. The '85 and '22 images were uploaded from Earth Explorer by adding the coordinates of Anne Arundel County, 39°00'N 76°36'W (-76°36'W was entered because when 76°36'W was entered it was not in the correct location). Next the whole year for the date range for 1985 and then 2022 were chosen from. I felt that doing sometime in the 80's and comparing it to a photo from the most recent year would result in many differences in urban and residential development in the area. All of the files were then downloaded, but only ...MTL.txt (multispectral) file was used. I planned to do just about what we did in the last lab; no fancy imagery was needed for this. Collection 2 Level 1 data was selected due to the fact that there was not level 2 data for 1985, and I would like to keep it the same for the various photos selected from 1985 and 2022. These images were also in the Landsat imagery category.

An Anne Arundel County Shapefile was drawn from the AA County database. The shapefile from 2020 was the most recent image found. Then the image was cropped to the Anne Arundel location.

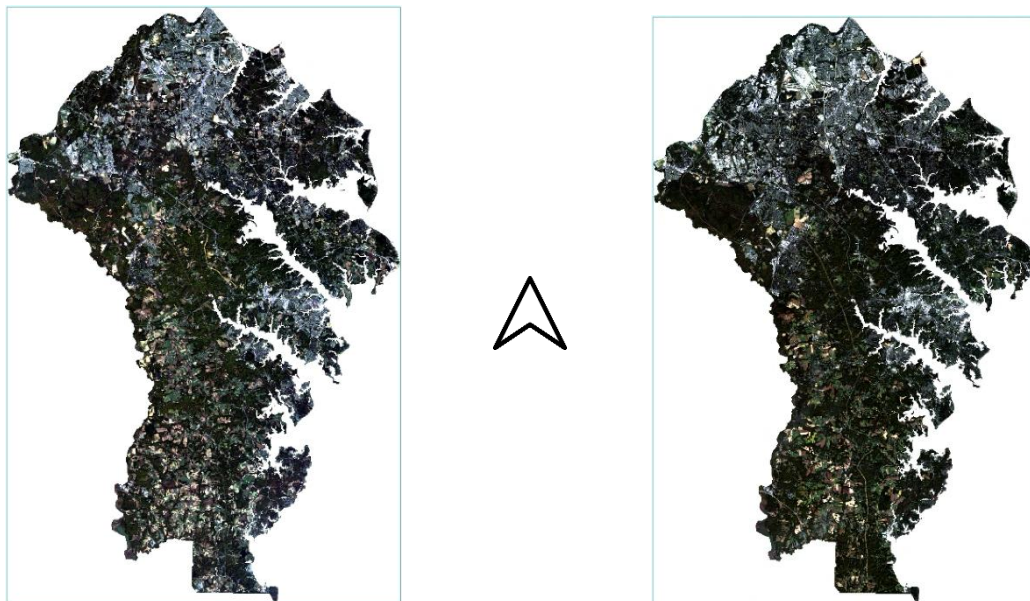


Figure 2. Anne Arundel County on the left is 1985 and on the right is 2022.

Methods

Overview of Workflow and Steps

Correcting the Photos to Anne Arundel County

The ...MTL.txt files, were taken into the most recent version of ENVI 5.6.2. Next a radiometric calibration was applied to the photos. They were then saved as the dates. Next opening ENVI Classic with the various files, bands red, green, and blue were selected and the RGB was loaded. The following was selected to make sure AAC was selected in the file: files,

overlay, vectors, open the AAC file (all have the WGS84 projection), output vector of AAC onto map. Next these items were selected: basic tools, masking, build mask, options, import EVF of county boundary, apply. A photo of AAC now resulted, but it was black and white; back portion was 1 and white portion was 0. Next basic tools, masking, apply mask, applied mask to the 2022 and 1985 photos, spatial subset, subset using EVF county boundary, mask selected, and select county mask. The photos were then saved as correct_maps_[date].

Region of Interest Tool

Next in the display of the two images, ROI Tool was selected. Eleven of each urban, residential, agriculture, forest, and water were selected. A larger portion was being sampled than in the lab, so a larger amount of area needs to be sampled using the ROI tools. Zoom was done as the verification method. NIR was used to specify which areas are water, since they show up as black in the NIR. They were then saved as [date]_ROIs.

Classification

A supervised classification for maximum likelihood was then done by selecting all items from the ROI tool. Photos were saved as Super_Max_Like_[date]. A band math was performed, like in lab; formula used was $2 * 5 - b1$ where b2 is the 2022 photo and b1 is the 1985 photo. This was saved as band_math. A post classification confusion matrix based upon ROIs was calculated to receive the overall efficiency and the kappa coefficient.

From-to-Change Detection

Entered the same as the lab, 0-3 entered as cyan blue for urban, 5-7 and 9 entered as purple for residential, 10-11 and 13-14 entered as yellow for agriculture, 15 and 17-19 entered as green for forest, and 21-24 were entered as blue for water. Side note: this will not work correctly if the original images are not processed the same in the ROI tool; urban, residential, agriculture, forest, and water. Photo was saved as band_math_colors.

ArcGIS Pro

The photos, classification and the density slice, were then saved as .tiff files and imported into ArcGIS Pro. The below are the photos, in figures and images, showing the results.

Implementation Results

Commission is incorrectly capturing various pixels while emission is excluding various pixels. The most enthralling result; in 1985, the commission error was 41.64% in urban area, which is a high result if the whole project is about the urban and residential area. Although the urban areas were high, the residential areas were low, at 7.07%. All other results fit with the analysis; water being the largest emission error in 1985 is okay as I was primarily looking at the residential and urban areas. Below are the results.

Overall Accuracy

- 1985: $17,946/21,101 = 85.0481\%$
- 2022: $20,574/21,101 = 97.5025\%$

Kappa Coefficient

- 1985: 0.7764
- 2022: 0.9630

Highest Commission Error

- 1985: 41.64% – Urban
- 2022: 5.60% – Agriculture

Highest Omission Error

- 1985: 50.69% – Water
- 2022: 3.85% – Residential

Figures and Images

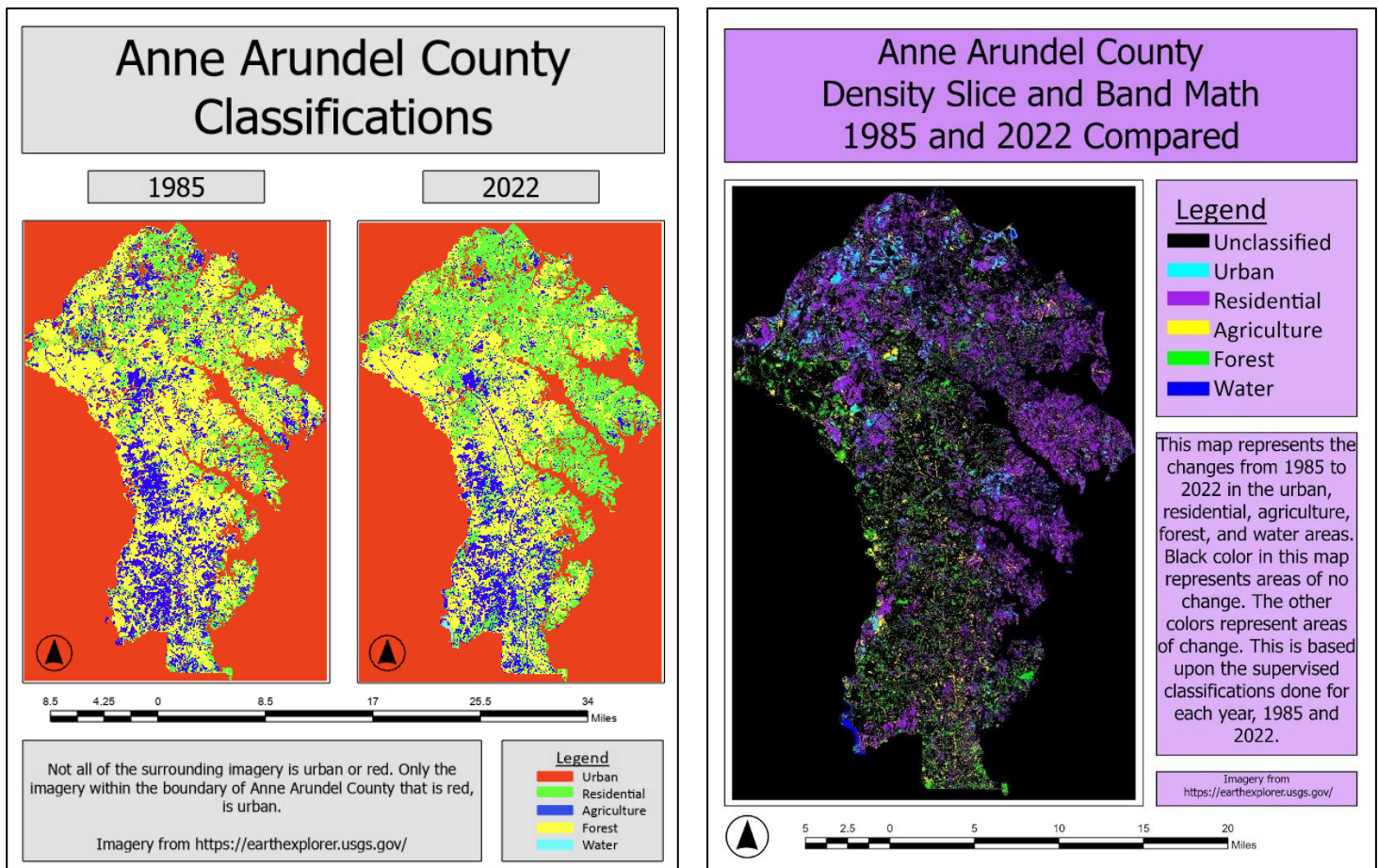


Figure 3. Left is the classification and the right are the density slice. Both are explained in maps.

Conclusion

The images have been classified comparing the differences in 1985 and 2022 in the urban and residential areas. The resulting image is the density slice image that is colored in purple. Given that Anne Arundel County does contain the capital, Annapolis, there was an increase in urbanization and residential areas. Knowing the quality of the Chesapeake Bay is decreasing from the introduction of this paper, it is no wonder the residential area and urban area, with their increasing rate, are contributing to the decline in the state of the bay. With more people moving to the area, more urbanization needs to be completed and greater upgrades to the urbanized areas, are one leading cause of the poor quality of the bay.

Future Recommendations

In the future, another round of the classification for the 1985 and 2022 images could be done with more classifications for urban, residential, agriculture, water, and forest. Or possibly, only urban and residential would be done with doing lots of pixels. Also, a classification for the whole of Maryland would be done looking into the agricultural components to see how those affect the bay from the 1980's to present. The focus for those projects was not agriculture, since Anne Arundel County was low on the grade of agriculture, thus, urbanization and residential was chosen. Another item that would be completed would be classification of the Chesapeake Bay.

Reference

N.A. (2023, September 19). Chesapeake Bay. msa.maryland.gov.

<https://msa.maryland.gov/msa/mdmanual/01glance/html/ches.html>

Data Sources

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USGS. (2022, October 15). Earth Explorer. earthexplorer.usgs.org. [EarthExplorer \(usgs.gov\)](#)

Private Member of AAC. (2020, April 8). *County Boundary*. aacounty.org.

<https://opendata.aacounty.org/datasets/county-boundary-1/explore?location=38.986782%2C-76.521131%2C10.63>