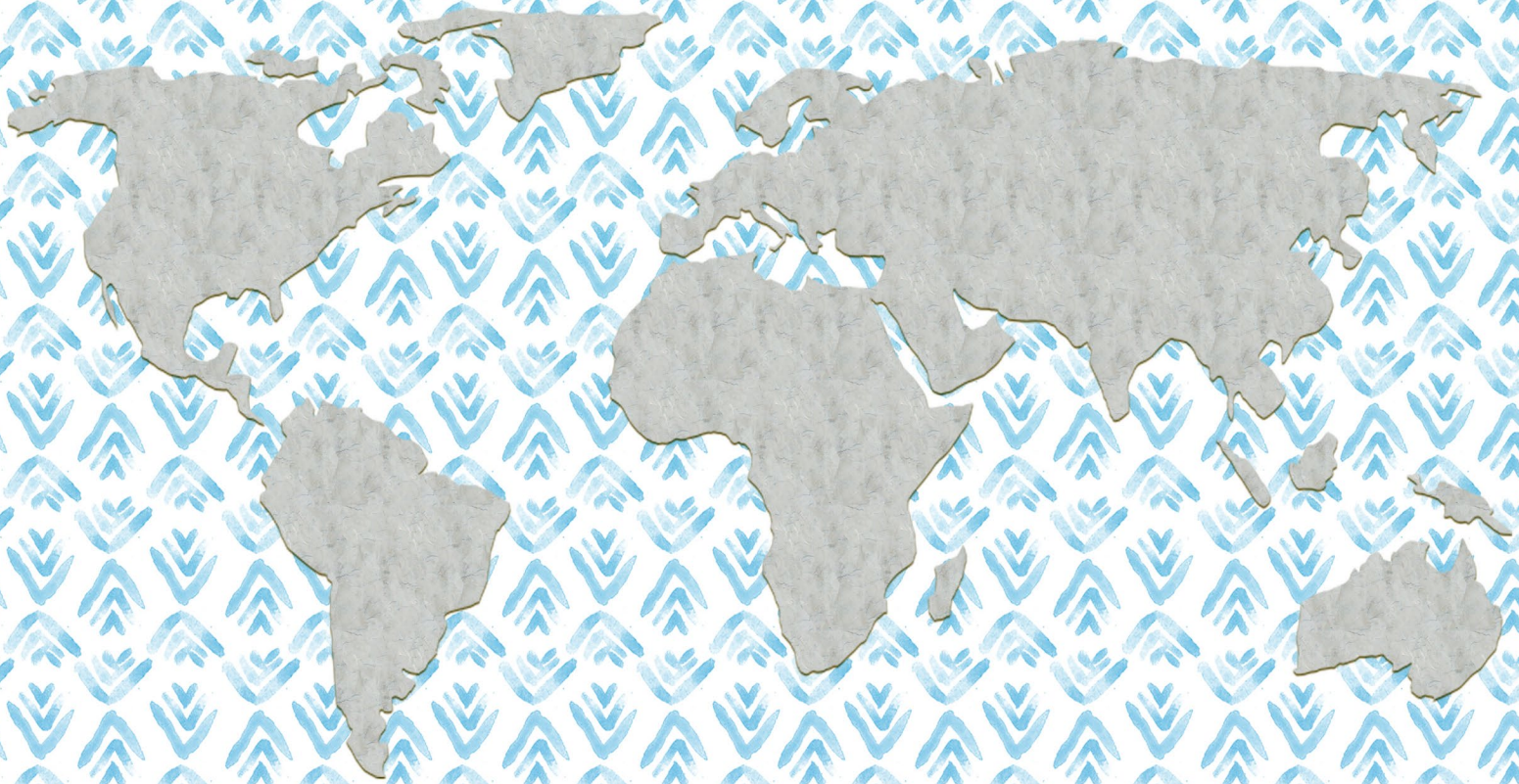


# CAPSTONE PORTFOLIO



SAVANNAH RUCKER | SLR2749@UFL.EDU

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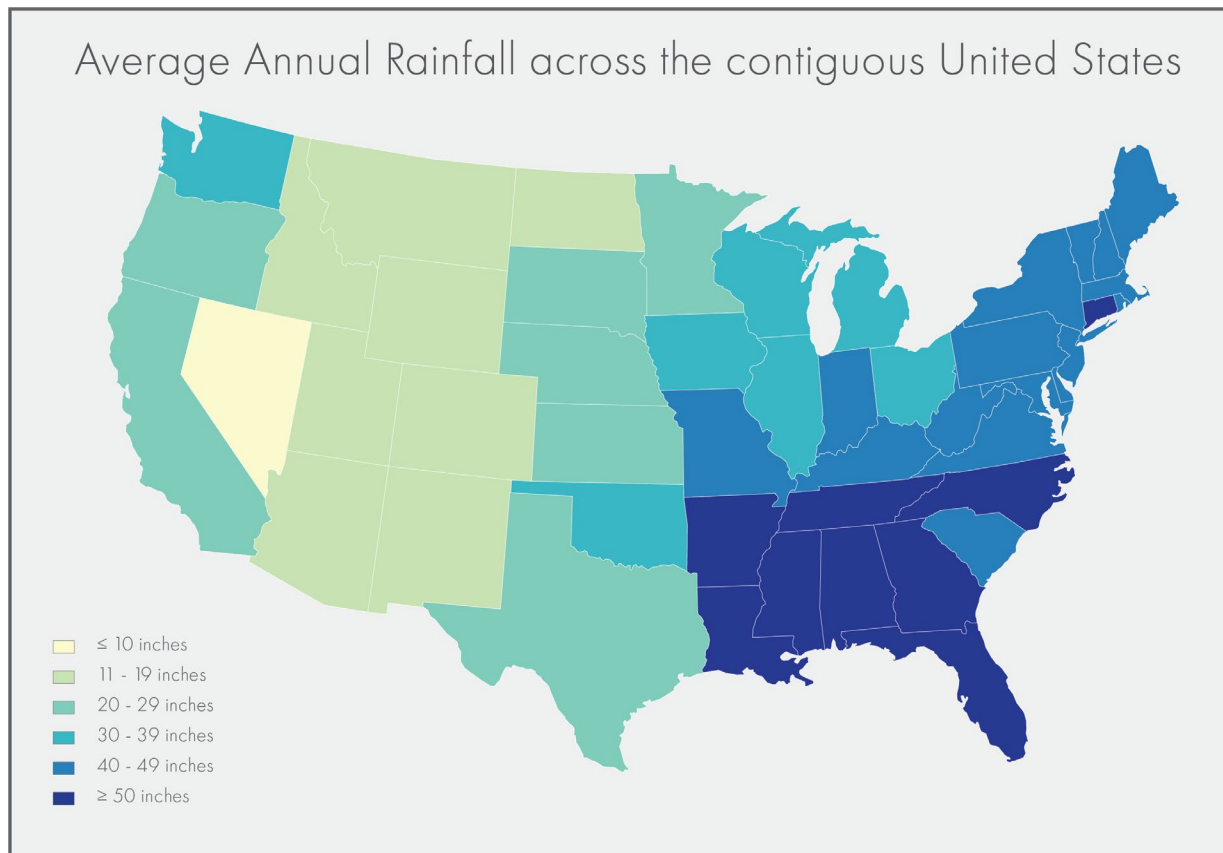
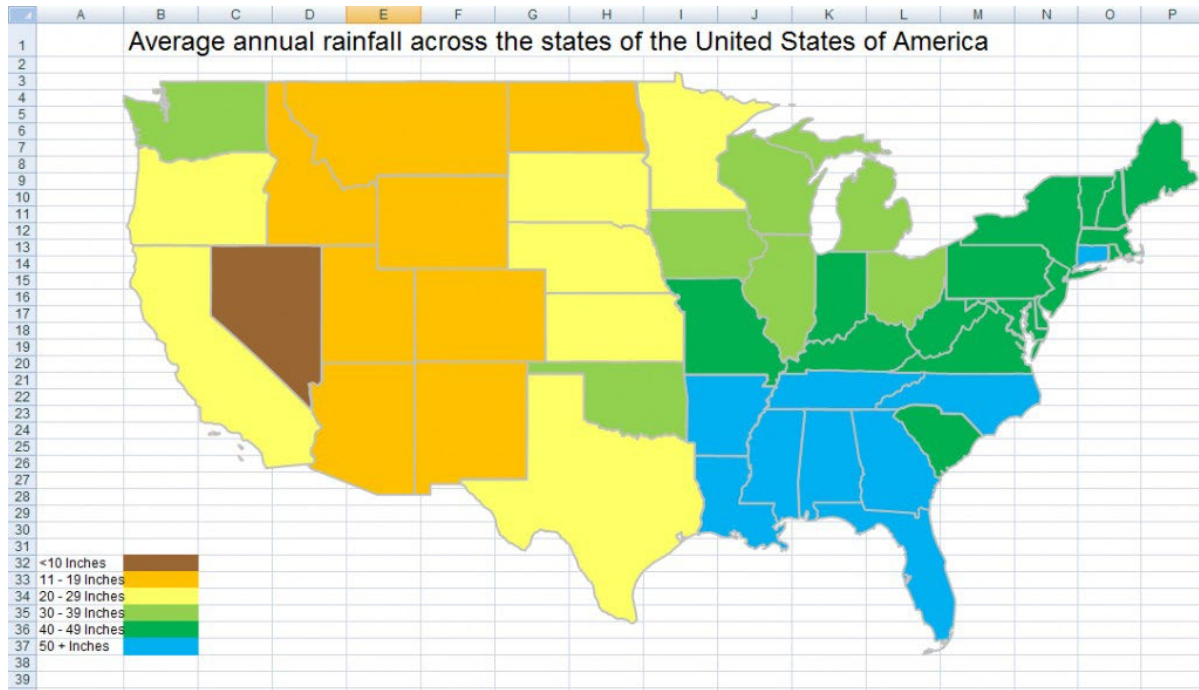


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## TRANSFORMING BAD MAPS

*In a course called Maps & Graphs, I was tasked with transforming a "bad map" using proper cartographic principles. The only requirements were to take a poorly designed choropleth map and use it to create new map that is easy to read, effectively communicates the information, and is aesthetically pleasing. Above is the "bad map", and below is my redesign.*





## Morocco: A Geographical Profile

*This paper was written for the course Geography of Africa, taught by Audrey Smith, in April 2018. The purpose of the project was to create a summary of the more specific research papers written throughout the semester examining the physical and human geography of a chosen nation.*

The most overarching concept taken from the information I have learned in this course and my research done concerning Morocco is that it is an incredibly diverse country. The cultures of the various groups of people who reside there, the jarring differences in landscapes and geographical features across the nation, and the juxtaposition of abandoned villages, protected wildlife reserves, and bustling coastal cities all make Morocco a very interesting place to study.

The country of Morocco can be referred to as a “melting pot”. The coastal areas of Morocco are inhabited by people who come from a spectrum of cultural and ancestral backgrounds. Morocco’s neighbor to the north, separated only by the 8-mile wide Strait of Gibraltar (Wright), is Spain – and the adjacent country of France. Though Morocco achieved independence as a kingdom in 1956 (Barbour, et al), its culture and politics are still deeply intertwined with that of these two former colonizers. As an example, French language is both taught in schools and spoken widely in Morocco, including in “commerce and finance, science and technology, and the media” (Marley 29). Spanish is spoken in some of the northern parts of the country, but is not taught in schools, and is effectively dying out as time goes on (Marley 26). Arabic is the official language of Morocco, along with the neighboring Mediterranean states of Tunisia and Algeria (Marley 29). Additionally, the government of Morocco mandated in 2000 that schools be allowed to teach in Berber (Marley 32). Berber is a term used to describe the people of ancient Sub-Saharan Africa and their language. Today, there are many people across Morocco who still speak the Berber language, especially in “the Rif mountains, the Atlas Mountains, and the semi-desert of the south” (Marley 27). The people of Morocco are predominantly Sunni Muslims, making up about 98% of the population (Benahnia 127). Approximately 1% of the population is Christian, most coming from France or Spain (Benahnia 127). Public schools in Morocco teach Islam as part of the curriculum (Bureau of Democracy, Human Rights, and Labor).

Morocco’s physical geography is quite varied. The country is a total of a little over 172,000 square miles, in which 34.8 million people reside at a rate of 202 people per square mile; but these people are not distributed equally across the land (Bureau of Democracy, Human Rights, and Labor). The north coast borders the Alboran Sea, which is a part of the larger Mediterranean Sea. This coast is covered with vegetation, including forests of pine, fir, and cedar trees (Talasemtane National Park). The west coast is exposed to the Atlantic Ocean, which is a part of the reason why some of the largest cities in Morocco and their ports are located here. The Atlantic coast has a gradient of forests in the north that eventually give way to desert in the southernmost reaches. Morocco is bordered on the east by the nation of Algeria, and to the south by Western Sahara, which Morocco actually claims control over (Central Intelligence Agency). Both neighboring countries are part of the Sahara Desert, and have a mostly arid climate (Peel, et al 1638). The northern coasts of both Morocco and Algeria fall under the Csa – hot/dry summer – climate type, which can also be described as Mediterranean (Peel, et al 1683). The interior of Morocco is home to several mountain ranges: the Rif Mountains, Middle Atlas Mountains, High Atlas Mountains, and Anti-Atlas Mountains. The highest mountain peak, Jebel Toubkal, stands about 4,100 meters or 13,600 feet high (Central Intelligence Agency). The far south and eastern reaches of the country are desert lands, where the Sahara begins, with areas of dunes known as Ergs. Most of this land is severely degraded and cannot support vegetative life apart from pockets of palms surrounding oases. The scenes observed here are very contradictory to those on the coasts and in the high elevations of the mountains.

The contrast of life across Morocco is as large as that between cultures and geography. The capital of Morocco is Rabat, where only a little over half a million people reside (High Commission for Planning). The four largest cities in Morocco are Casablanca, Marrakech, Fes, and Tangier, respectively (High Commission for Planning). Casablanca's population is over 3.3 million people, Marrakech follows with 1.3 million, Fes with 1.1 million, and Tangier with about 1 million (High Commission for Planning). As of 2017, about 61 percent of people in Morocco lived in urban environments (Central Intelligence Agency). Casablanca is located directly on the Atlantic coast, approximately 200 kilometers south of the Strait of Gibraltar. Due to its location, the city has been the principal port of Morocco since the early 1900's (Encyclopedia Britannica). Casablanca is a bustling economic hub, with diverse industries including fishing, beverage and food production, textiles and leather, electronics, banking, tourism, and education (Encyclopedia Britannica). Additionally, over 24,000 of the residents of Casablanca are foreigners, who may be expats, workers from abroad, or long-term tourists (High Commission for Planning). Tangier, Morocco's third most populous city, lies north of Casablanca right along the Strait of Gibraltar, only a little over 7 miles from Spain – making it the largest city in close proximity (Powers 130). Tangier is a free-trade zone, so it is another important port city (Powers 130). In the past couple of decades, Tangier has also become a popular tourist destination, with an architectural model similar to that of Dubai (Powers 134-6). Fes and Marrakech are Morocco's interior cities. Fes lies in the Middle Atlas mountain range and has origins in the Medieval period (UNESCO). The Middle Atlas Mountains are dotted with lakes and reservoirs, which may have been a contributing factor in the settling of this location. Fes – or Fez as it may also be known – is a city that has managed to preserve the history of the Arabian-African culture. The streets in the historic center are unpaved (UNESCO), the world's oldest university operates within its borders, and traditional courtyard houses are still a part of the cityscape (Lobrano). Marrakech is in the High Atlas Mountains, in the southern portion of the country. Marrakech has a distinctively Saharan landscape, has been a trading post since the early 11th century, and still has a bustling market atmosphere (Wickers 494). South and east of Marrakesh, there is little life.

The populations of the towns located in the desert are limited, and there are many Berber villages in the more rural areas, both inhabited and abandoned. The populated villages consist mainly of farming families, who raise crops and livestock animals (Center for Middle Eastern Studies). Women in these families may also weave, sculpt, paint, and otherwise work handicrafts to sell at markets in larger towns (Center for Middle Eastern Studies). Abandoned villages exist in states ranging from almost pristine to crumbling, and some may have been uninhabited since as long ago as the 11th century (Lawless 118). However, there is evidence from records of other cultures including the Phoenicians that the Berber people have existed since ancient times (Amazigh). Aside from the Berber settlements, other areas of Morocco have concentrations of life in seas of barren and craggy land. The many national parks within the country act as wildlife preservations, where hundreds of species of flora and fauna are sheltered from urban sprawl and deforestation. Ifrane National Park is about 30 kilometers south of Fes, in the Middle Atlas range. This park contains forests of coniferous and deciduous trees where animals such as boars and birds take refuge (Williams). On the northern coast, Talassemtane National Park contains protected fir forests and many species of birds (Williams). Far southern Morocco, where the Sahara takes over completely, is still not devoid of life. Khenifiss National Park, which lies on the Atlantic coast at the same latitude as the Canary Islands, is home to flamingos and other seabirds (Williams), and small communities of a few hundred to a few thousand people freckle the surrounding desert. One such community, Zag, lies far into the desert, and is the southeast-most village before the borders of Western Sahara and Algeria meet. Even a couple of hundred kilometers south of Marrakesh and east of the Atlantic coast, this town still manages to support a population of over 12,000 people (High Commission for Planning).

The diversity of Morocco illustrated in part by the distinctiveness of its communities, cultures, and landscapes. Settlements in Morocco range from small villages to large cities. Cities even have large variation, from tens of thousands of people up to multiple millions of people within a municipality. The cultures within these cities and in the countryside are the product of years of blending Arabian, African, French, and Spanish experiences. While Islam is the dominant faith, some indigenous Berber people retain their traditional religion, Spanish and French descendants hold on to Christianity, and others practice Judaism. Morocco's geography includes vast expanses of desert, towering mountain ranges, lush forests, rivers and wild oases, lively metropolitan areas, and beautiful beaches. For all these reasons, and more, Morocco is an incredibly interesting place to study, and possibly one of the most diversified places on Earth.

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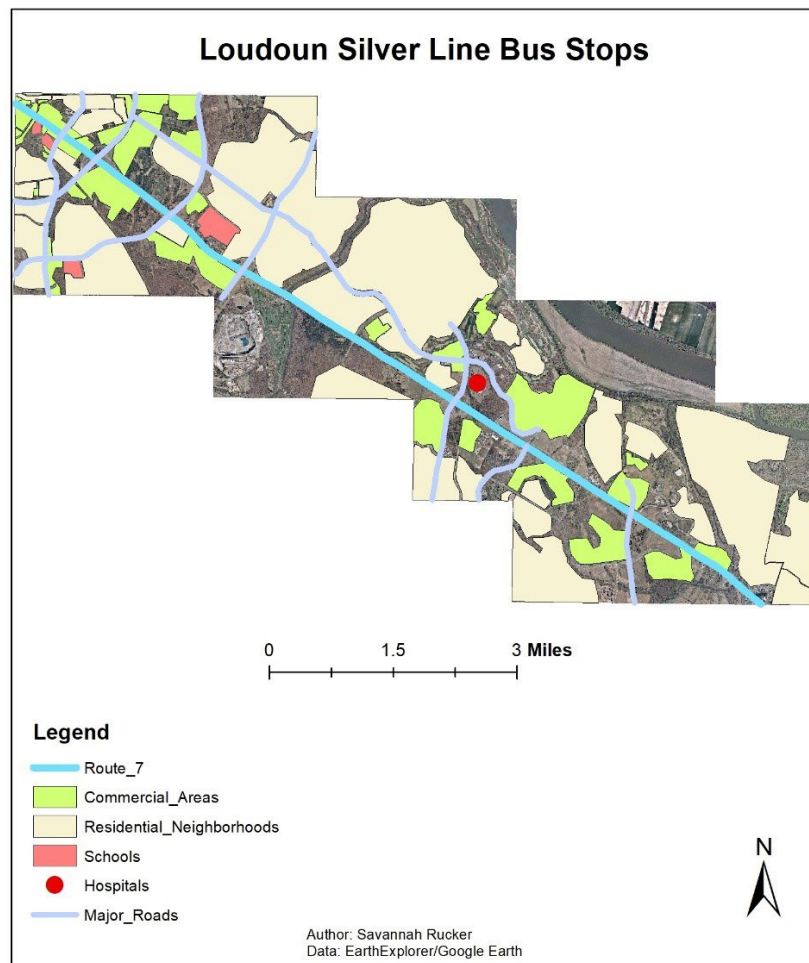
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## PLOTTING SILVER LINE METROBUS STATIONS

This map was created as part of a final project for a course named Aerial Photo Interpretation. In this project, my goal was to find locations for the Silver Line MetroBus stations in Loudoun County, Virginia that would be convenient to major roads while also not being intrusive to school zones and residential communities. I came to the conclusion that the stations needed to be placed along Route 7, because that is the major highway that runs through the middle of the county, connects all of the major towns, and leads directly into Washington DC.

The first step in the analysis was to mosaic 20 orthoimages obtained from EarthExplorer. Next, I selectively digitized the images to highlight Route 7, other major roads, residential areas, school zones, commercial areas, commercial plazas and hospitals. I then buffered out areas less than ½ mile away from public schools, and buffered again to include only areas within 300 ft of a major road. Then, I determined the locations for the stops by choosing areas near large neighborhoods, hospitals, or commercial plazas that did not lie directly on Route 7 and were along major roads. Selected locations are illustrated on the following page.





## Results – Locations

The first location chosen for a MetroBus station is the area to the southeast of the Hospital, which is marked on the map with the red circle. This is an excellent location for a station, because it provides easy access to multiple medical offices and the emergency room, is also adjacent to the Janelia Research Campus (at right) – a large multi-building life science research campus which employs over 500 people, and the Shenandoah University Loudoun Campus (bottom left) – which houses 19 graduate programs.



## Results – Locations

The second location chosen for a MetroBus station is the area to the southeast of the Leesburg Corner Premium Outlet Mall. This is another great spot for a station, because it provides easy access to the mall itself, which employs many and brings consumers from all over the NOVA region. This is also a central location in suburban Leesburg, where the hundreds of residents who work in the D.C. area can park at or walk to in order to take the bus into the city.



## Results – Locations

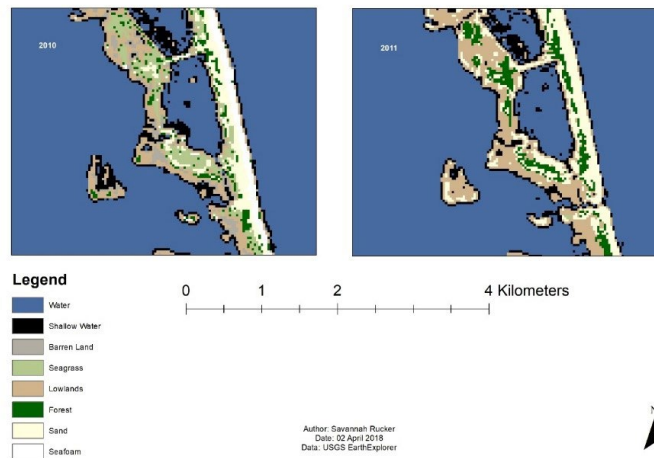
The third location chosen for a MetroBus station is the area to the north of the Lakeview Plaza. This location was selected for several reasons. First, the Lakeview Plaza is in close proximity to multiple very large neighborhoods, as can be seen on the inset map. These large neighborhoods are wealthy, which suggests that homeowners who live here are more likely to work in the D.C. area. Second, the Lakeview Plaza is accessible from a major road, which is connected to Route 7, but is not so close that it would impede traffic. Finally, this location is roughly equidistant from the other two locations.



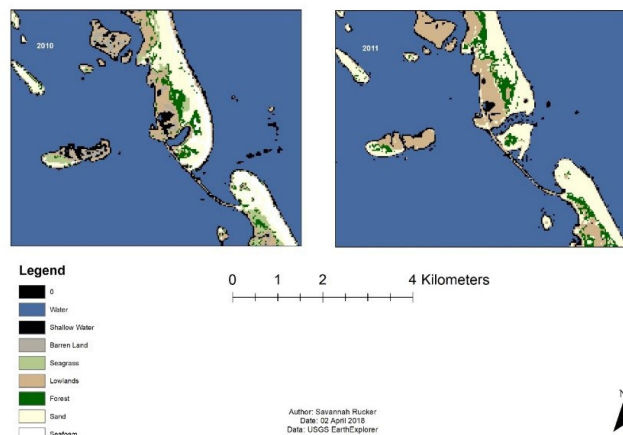
## MAPPING EFFECTS OF HURRICANE IRENE IN THE OUTER BANKS, NORTH CAROLINA

This map was created as part of a final project for a Digital Image Processing course. The goal of this project was to show the devastation suffered by the small island's ecosystem. Pea Island National Wildlife Refuge is a protected habitat for migratory seabirds, where small changes may upset a delicate balance. To illustrate the changes caused by the storm, I first obtained Landsat Thematic Mapper images – one from before the storm, and one from after. The images were taken exactly one year apart, and the second was from two months post-storm. I then assigned an unsupervised Isodata Clustering classification to both images in order to digitize them. I created classes for water, shallow water, barren land, seagrass, lowlands, forest, sand, and seafoam or debris washed up along shore. The most interesting part of this project turned out to be the creation of a new inlet south of the wildlife area, which caused major disruption to the inhabitants of the lower islands in the Outer Banks chain. The road in this area was destroyed, cutting off all access to the upper islands. Another visible change is the destruction of most of the seagrass vegetation – a home to small animals like mice, frogs, nesting birds, and rodents. At another location in the chain, a sound-side lagoon was breached from the Atlantic side, creating a new inlet there as well.

**New Inlet Created South of Pea Island**

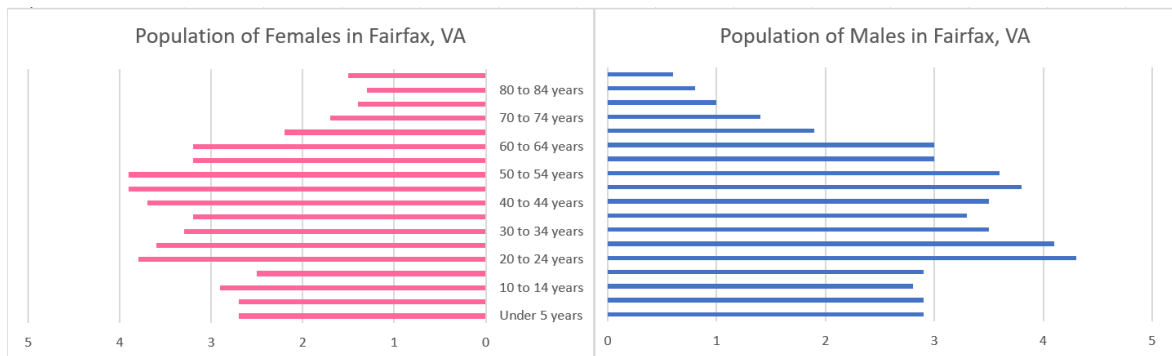


**Breach of Bodie Island**



## GRAPHING THE POPULATION OF FAIRFAX, VA

*In Maps & graphs, I created population pyramid using data from the Census Bureau. I used Excel to create the population pyramid. This graph shows the distribution of the inhabitants of Fairfax, VA by age and gender. The data obtained from the Census Bureau's Factfinder website was based on the 2010 Census.*



This population pyramid illustrates the population of Fairfax, VA segmented by both age and gender. The data was obtained from the Census Bureau's Factfinder website and is based on the 2010 Census. Fairfax is an independent city separate from the surrounding Fairfax County, which borders Washington D.C., Loudoun County, Prince William County, and the Potomac River. Though the population of this city does not appear large initially, it is important to know that the total population of just over 22,500 people is confined to a space of only 6 square miles (City of Fairfax).

When examining the data organized into a pyramid, there appear to be more males than females, but this is only an optical illusion. In fact, the female population is slightly larger than the male, at 50.7 percent and 49.3 percent, respectively. However, there are clear differences in the distribution of male population versus female population in certain age categories. For example, in the 85 years of age and over category, there is a difference of 9 percent between the population of females and males; the female population in that group is larger. Overall, though, the population of both genders appear to contract and expand in the same general age ranges.

The oldest categories contain the smallest percent of the population, as should be expected. The general shape of the pyramid is contracting. The largest population is of people between the ages of 20-24, which would initially be surprising due to the fact that Fairfax is an area with a very high cost of living. According to Sperling's Best Places, the cost of living index for Fairfax is 158.6, compared to the Virginia index of 107 and an overall United States index of 100. Knowing only the cost of living index for the city, it would be assumed that the population would consist mainly of middle-aged and older (but not yet retired) adults, because their careers are usually well established and they therefore have larger incomes. However, the population pyramid shows that the highest percentage of the population actually falls between the ages of 20-24. This is probably because Fairfax is home to a large higher education institution – George Mason University, which has 34,000 students as of 2018 (About Mason).



Otherwise, the next largest age range falls between 40 and 55, where the established professionals lie. Because the college-aged population is likely to stay steady, this would mean that Fairfax will become a city with an older population in the coming decades. To support this population, it would be wise for planners and policymakers to plan for an older population by the year 2030. According to the American Planning Association, shifts that make a better living space for older people include increasing the amount of small housing units such as townhomes, ensuring communities are able to be walked or reached via public transportation, and development of retirement communities (Mooney).

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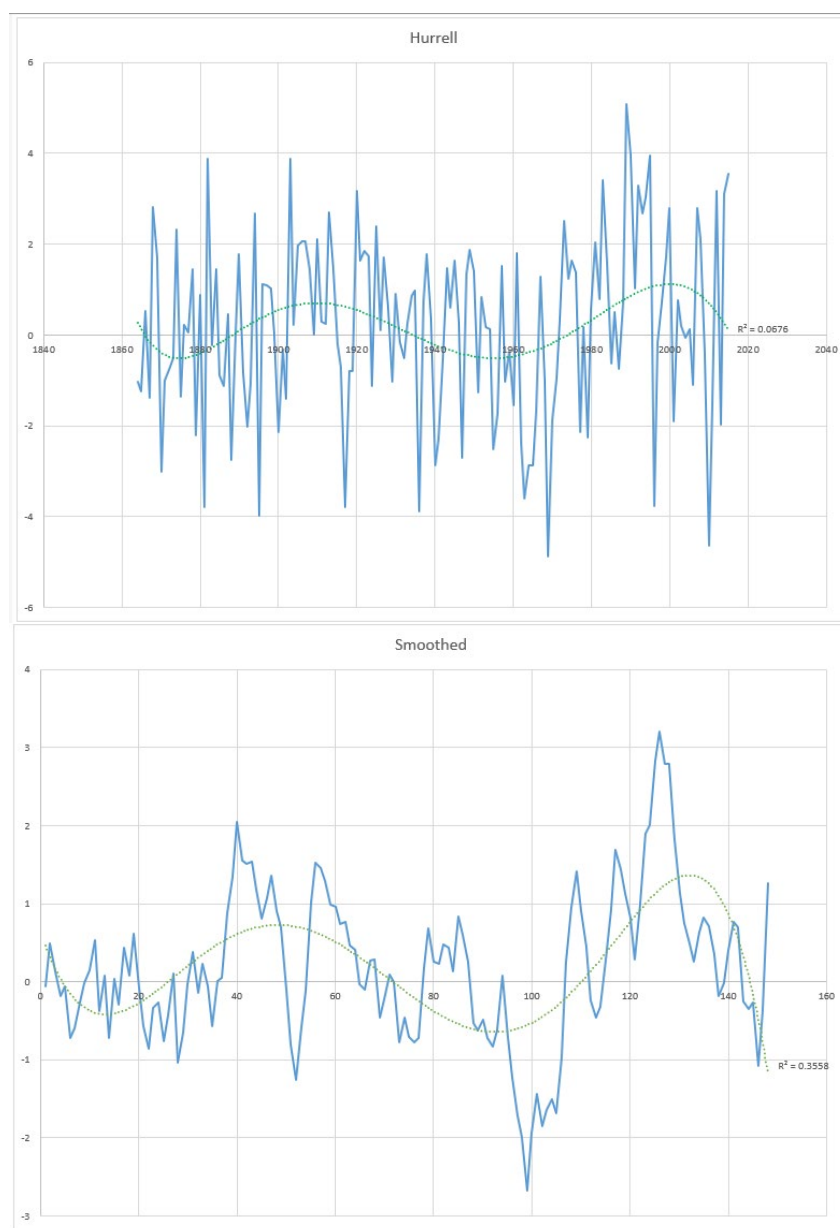
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## MODELING THE NORTH ATLANTIC OSCILLATION PHASES

This project was completed during a meteorology course titled, "Atmospheric Teleconnections". In this activity, I was given raw data in the form of an Excel spreadsheet and was asked to model and analyze it. This model was created in Excel, using one of the XY Scatter Plot options. Then, once the data was plotted onto the graph, I added a trendline. Next, I changed the trendlines to illustrate a linear regression and polynomial regressions in the orders of 2, 3, 4, 5, and 6. After examining the different trendlines, I smoothed the data in order to try to flatten the values better visualize the oscillation. Clearly, the trendline is much more fitting of the smoothed data, as the coefficient of determination ( $R^2$ ) is .3558 using the smoothed data but only .0676 using the original data



## THEMATIC MAP

This map was created to practice creating thematic maps using data made publically available by the local government. The map depicts a large subdivision in the upper Shenandoah Valley of Virginia. Several feature classes were used to create the map, including streets narrowed by SQL definition query, streams, lakes, ponds, and the subdivision parcel boundaries. Additionally, I created a new feature class to illustrate the parks in the neighborhood using digitization.

