Measuring the Shoreline Loss: Salmon Creek Case Study

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Abstract

The effects of sea-level rise are measurable in historic maps and modern aerial imagery. Today, scientists are actively studying these changes along the coast of North Carolina through a variety of multidisciplinary approaches. New technologies such as Unmanned Aerial Systems (U.A.S) are helping provide researchers with a cost effective and site specific platform for collecting remotely sensed data. In the past, multispectral imagery was acquired through expensive satellite and aerial platforms. Today, these data can be obtained through the use of small inexpensive drones equipped with imaging systems that provide current and detailed data sets for very specific locations.

The goal of this project was to identify how much of the shoreline along Salmon Creek in Bertie County, NC has eroded away over the last several hundred years. It was believed that this information will help better understand what it may have looked like in the late 1500's when English explorers first mapped the area. To measure changes since the 16th century we first analyzed the earliest known depiction of the creek made when English explorers intending to settle the region mapped the area. The map produced from these expeditions is both surprisingly accurate and detailed in its representation of the creek. This is made more obvious when it is directly compared with modern 20th century aerial imagery.

To further assess changes since the 16th century, the project turned to the existing expertise at the Center of Excellence in Remote Sensing Education and Research (CERSER) in acquiring and analyzing imagery with U.A.S. CERSER researchers use these new technologies on a variety of problems from creating 3D elevation and model datasets, to detailed analysis of photo-mosaic imagery to locate archaeological sites.

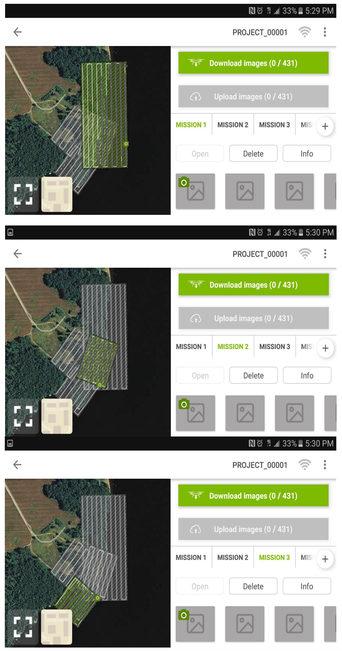
The results of this project demonstrate how dramatic changes to the 16th century shoreline of Salmon Creek are and show that once exposed to a significant rise in sea level, shoreline migration and impacts are permanent. Finally, this project was aimed to further aid in the creation of specialized technologies and methodologies for future studies of shoreline loss at CERSER.

Methodology

The team used a DJI Phantom 2 Vision in order to create an image of the Salmon Creek shoreline. The drone is equipped with a mounted camera. Using an app named Pix4D to control the path of the drone wirelessly to take images of the designated area. Pix4D allows the user to draw an outline of the path that they want the drone to take, and controls the drone during the whole process. Controlling the altitude of the drone to make sure it does not come into contact with any trees during the photography of the site.

The fieldwork portion of the project began during the spring of 2017, this project demonstrated how dramatic the changes to the coast line within the transition zone and showed that once exposed to a significant rise in sea level the migration and impacts are permanent. The transition zone is measurable by comparing images from previous years and also allows for future predictions of impacts from rising sea levels.

Once arriving at the site the team connected to the drone using the Pix4D app, on an android device. Once connected the course for the drone was set. Using a grid to pick the method of the imagery. After mapping the course the drone was sent on several trips. Each trip the drone was sent on equates to a different mission. In order to photograph every part of Salmon Creek possible.



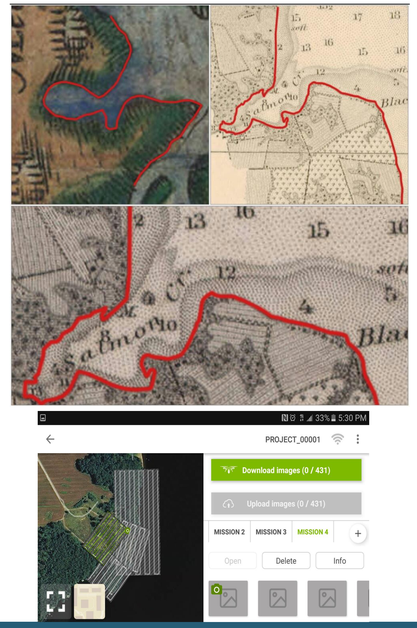
Flight Plan

Pix4d Android application was utilized on a Samsung J7 for the creation of four flight plans. The parameters for the flights taken were 125 x 89 meters, which is large enough to cover the area of interest (Figure 5). A total of four aerial image flights were taken, with the longest flight time recording at 12 minutes. There were a total of 171 pictures taking during the four on-site flights. This overlap is necessary for the creation of the larger mosaic.

Despite the UAS ability to fly missions on its own, it is still necessary to plot the linear transects prior to flight. It is also important to plot out the mission onsite as obstacles such as trees and power lines pose a threat to successful flight operation. Prior to flying, the team chose a location free of obstructions for take-off and oriented the transect grid over the AOI. There was a respectable location for the DJI Phantom 2 to take off and be clear of obstructions. Once transects were mapped, the UAS automatically flew at a constant elevation of 50 meters along the route taking aerial images at every point mapped until completion. This resulted in 171 overlapping images that would later be used to produce a larger mosaic image. The benefit of this automation was that the team did not have to manually fly the UAS.

Area of Interest

The Area of Interest (A.O.I.) is located at the western end of the Albemarle Sound near the conflux of the Roanoke and Chowan Rivers (Fig. 1). Between these two major drainages is a drainage named Salmon Creek. People have used Salmon Creek for millennia but the first time it is drawn is in the late 16th century by English explorers

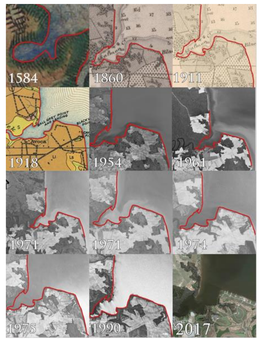


Conclusion

This research was successful in achieving the primary objective that was to test, develop, and acquire the needed technology to make use of the images taken through the U.A.S. platform, and to use aerial photography and satellite imagery to combine them in order to identify changes in the Salmon Creek shoreline. By evaluating the Salmon Creek site in Bertie County, North Carolina with the DJI Phantom 2 Vision+, 171 images were captured and stitched together to compare and contrast with the aerial photography and satellite imagery. Ultimately, the CERSER program at Elizabeth City State University can benefit from this research by applying U.A.S. technology and the methodology produced from this research to aid further remote sensing research.

Future Work

For future investigation the team came to the conclusion that in order to evaluate such a large area, satellite imagery and aerial photography was better suited to observe the shoreline corrosion. The U.A.S while still valuable in site specific locations, where high resolution images needed to be taken over a small area could be used to observe finer details. With more advanced technology including a multispectral camera included with a more efficient drone like the DJI Phantom 4 would allow the team to observe different phenomena that occurred along the shoreline therefore allowing for a better understanding of exactly why the shoreline has changed in the way it has. A multispectral camera would allow the team to view changes in vegetation, salt content, and water temperature, all of which are key factors in understanding shoreline corrosion.



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