

# Mapping Mangroves in LP360

## A Pennsylvania State University Student Project



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January 15, 2018  
Revision 1.0

### Introduction

Mangroves fulfill an important niche in wetland ecology and play a significant role in modifying the global carbon budget. They harbor and provide shelter for the offspring of many species of water birds, fish, and reptiles, and sequester close to five times the amount of carbon that terrestrial tropical forests do while aiding in sediment deposition and preventing coastal erosion.

While much research has been conducted assessing the use of LIDAR in the application of monitoring terrestrial forests, very little has been done with respect to monitoring mangroves and other wetland features. The aim of this project was to begin delving into this void and to develop techniques and best practices that will be applied to my graduate research on the use of geospatial technologies to assess and quantify biometric data on American Mangroves for monitoring “blue carbon” sequestration and net primary productivity.

Goals for the project include:

- The production of Canopy Height Models (CHMs) for Mangroves within the two Areas of Interest (AOI).
- Quantification of the above ground biomass volume of Mangrove canopies utilizing differing approaches to address the unique geographic factors in each AOI.
- Methods for addressing the surrounding and inclusive water bodies within the areas of the AOIs containing Mangroves.

### Study Areas

Two separate study areas have been used for this project, one in coastal Louisiana and one in the Florida Keys. Each study area is unique in its climate, types of mangrove species, surrounding water bodies, and data types available. For Louisiana, a portion of the Terrebonne Parish immediately surrounding the Barrier Island Refuge (BIR) at Isle Dernieres was selected, as it is rich in Black Mangroves (*Avicennia germinans*) and small in area. For the Florida Keys, Long Key was chosen as a suitable site for the same reasons as the Terrebonne BIR. While both sites contain high concentrations of mangroves, the heights and structure of the Mangroves at each location vary greatly. The mangrove species in the Terrebonne province are restricted to the Black Mangrove that will only grow to a few meters tall due to lower temperatures in the winter, while the Florida Keys contain a mix of Red Mangroves (*Rhizophora mangle*)

and Black Mangroves that grow to 30 meters or more in height. The LIDAR data quality was also very different, with the BIR dataset almost entirely consisting of first returns while the Long Key dataset had a lower point density (~5 pts/m<sup>2</sup> at BIR vs ~2.5 pts/m<sup>2</sup> at Long Key) with multiple returns per pulse.



Figure 1: NAIP imagery of Isles Dernieres Barrier Island Refuge (BIR) with mangroves classified in green.



Figure 2: NAIP imagery of Long Key, Florida with mangroves classified in green.

### Methods

The unique properties of each study area and corresponding LIDAR data called for different methods for extracting the mangrove CHMs. An unsupervised classification of the NAIP imagery was applied to isolate mangrove polygons as a shapefile for later use in LP360 in both cases, but the methods in LP360 that followed would differ.

Because the BIR site LIDAR data only contained first returns, I would need to create a synthetic ground class to export a useable DEM. This was done using the 'Classify by Statistics' Point Cloud Task (PCT) to classify the minimum height value within each 10-meter square as synthetic ground. The 'Classify by Feature' PCT then was applied to classify the mangrove vegetation points and export a mangrove-only DSM. From there an nDSM could be derived to assess the above ground biomass volume of the mangrove CHM.

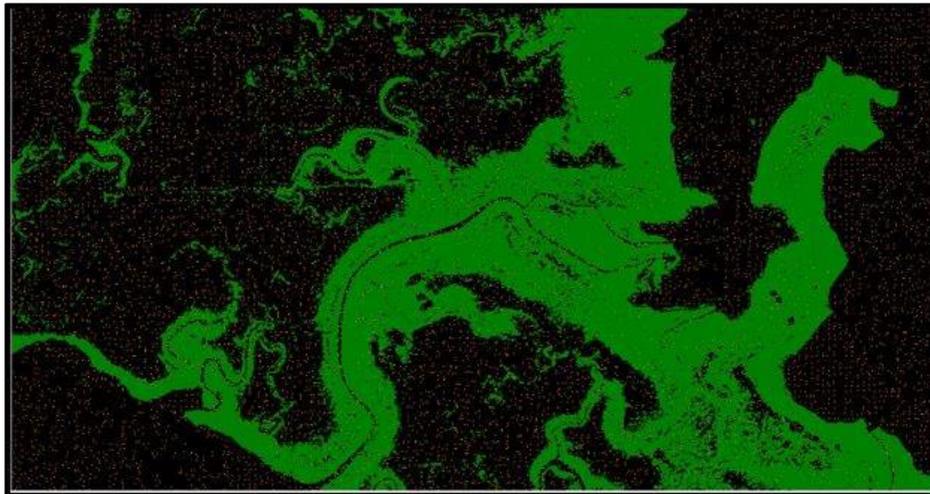


Figure 3: Synthetic ground points (orange) and classified mangrove points (green) in LP360.

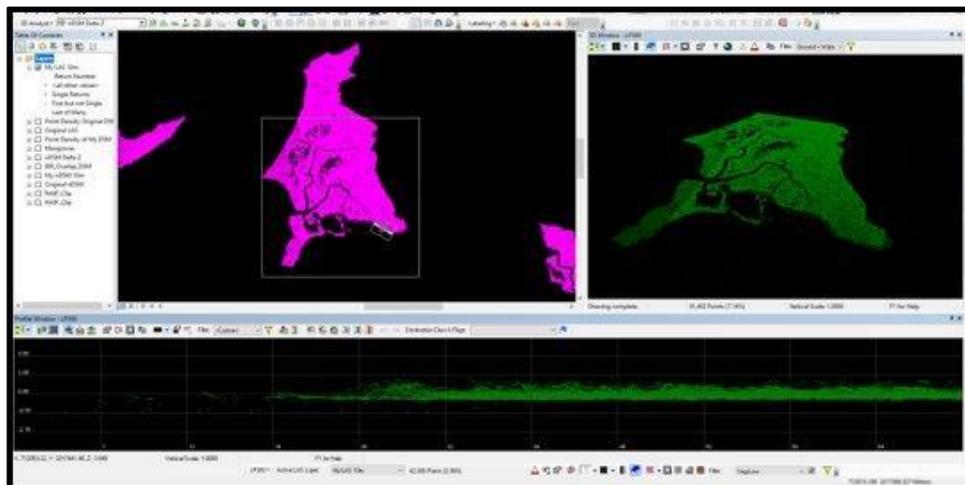


Figure 4: Mangrove canopy at BIR, LA in 3D view and profile view in LP360.

The Long Key site contained numerous discrete returns per pulse, therefore a synthetic ground class was not necessary. However, the presence of mangroves over waterbodies required hydro-flattening of the lagoon water and the water body surrounding the island. 3D breaklines were created and hydro-flattened in LP360, and the minimum height value of the water was applied to all water points during conflation. The 'Classify by Feature' was used to classify all first return points within the mangrove polygons and place them into the mangrove class. A DEM and mangrove-only DSM were exported to derive the CHM for above-ground biomass volumetric calculations.

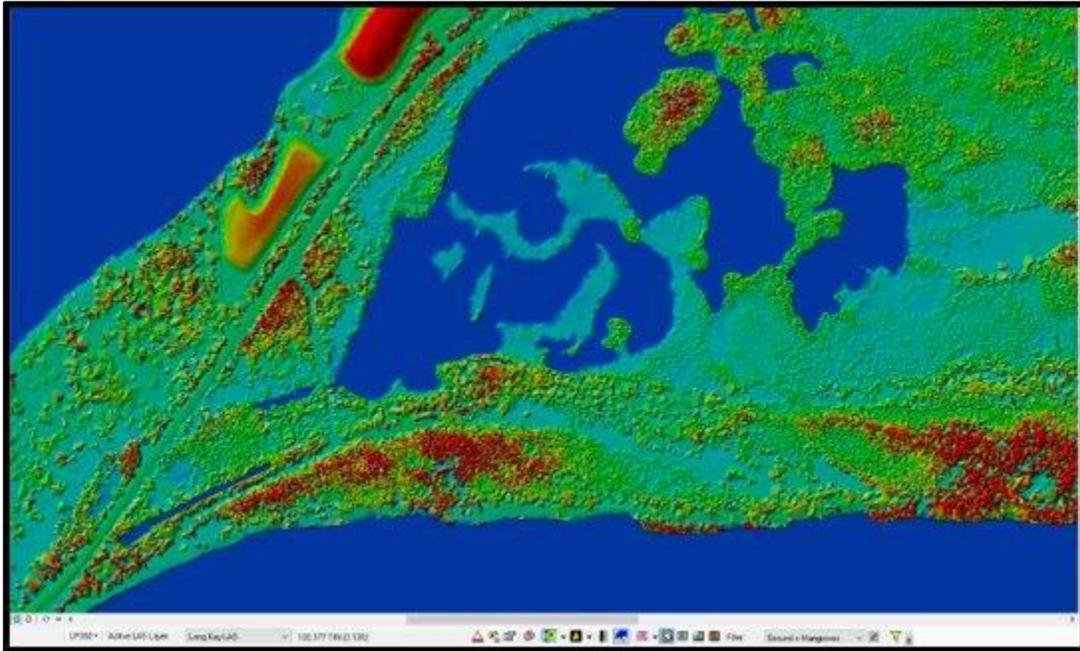


Figure 5: DSM TIN colored by elevation value at Long Key, FL.

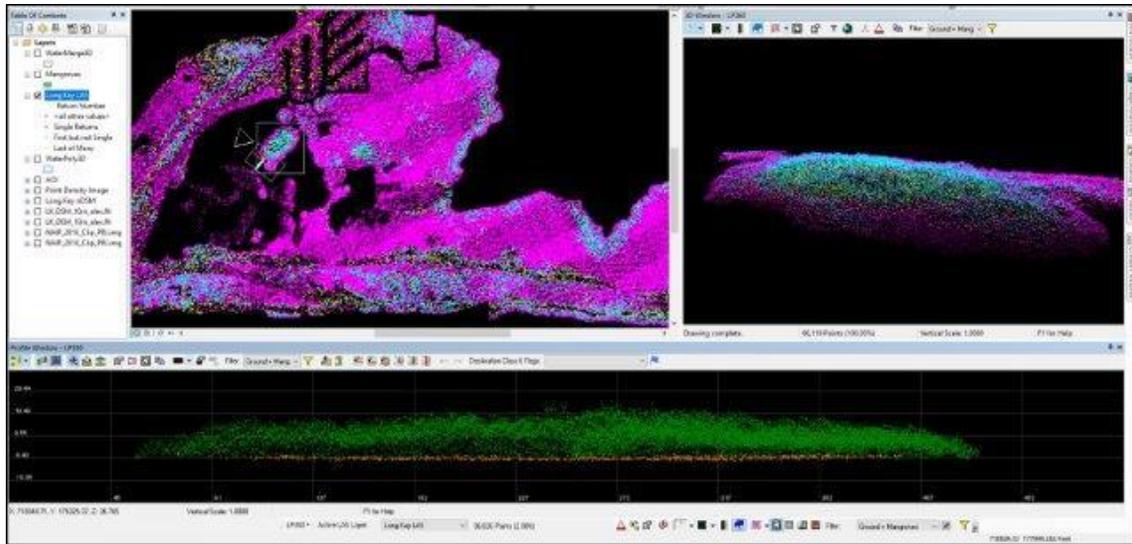


Figure 6: Mangrove canopy points at Long Key, FL in 3D and profile view.

**Results**

The derived CHMs for both study areas were successfully produced using 10-meter cells and Inverse Distance Weighed (IDW) interpolation methods. The CHMs were then used to approximate the above-ground biomass volume using surface volume calculations in ArcGIS.

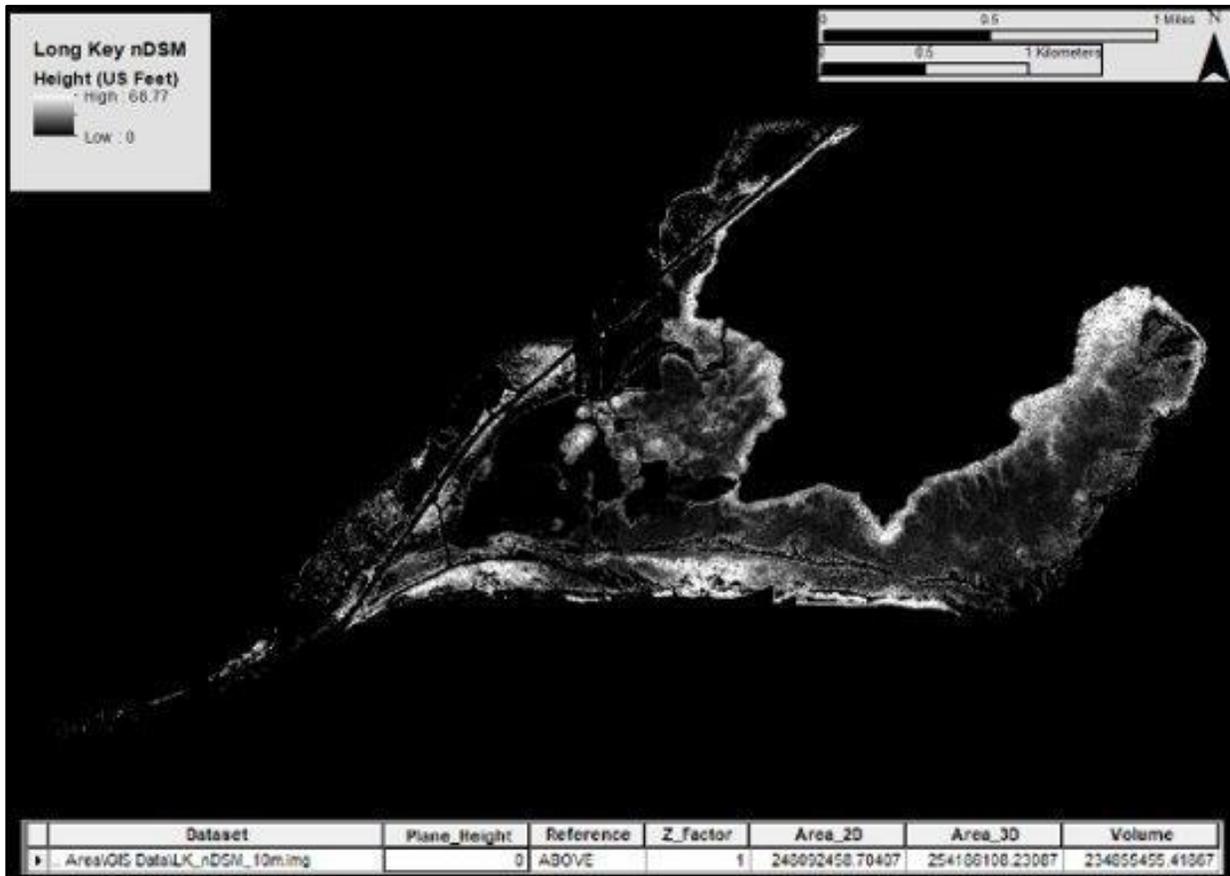


Figure 7: Canopy Height Model (CHM) of mangroves in Long Key, FL.

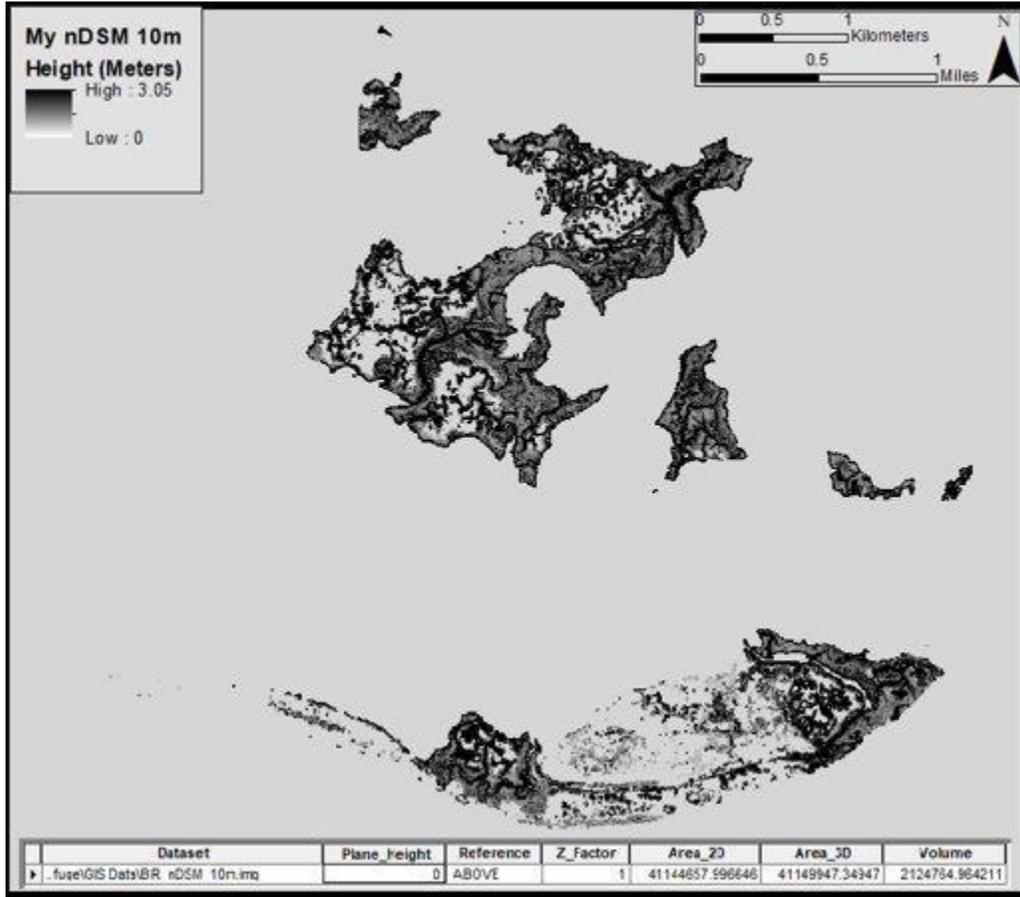


Figure 8: CHM of mangroves in the Isles Dernieres BIR, LA