Shoreline

FLORIDA SHORE & BEACH PRESERVATION ASSOCIATION

A League of Cities and Counties on Beach and Coastal Issues

*news from the Florida Shore and Beach Preservation Association* **March 2018**

# University of North Florida's Forensic Study on Hurricane Matthew

*By: Dorukhan Ardag, Patrick Cooper, Abdallah El Safty, Sergio Pena, Amanda Tritinger, and Nikole Ward*

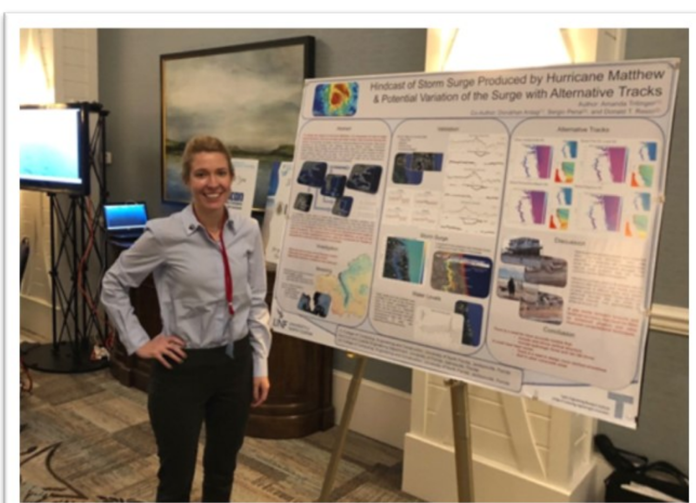
The students at the University of North Florida (UNF) completed an academic forensic study of Hurricane Matthew for Northeast Florida which included Flagler, St. Johns, and Duval County. This summary of that study is broken up into two parts. The first part is the Modeling portion, where the storm was hindcast using state of the art surge and wave models. The second part is the Field portion where damages along the coastline were analyzed in areas throughout these three counties. Ultimately, the goal of this work is to identify methods to make Northeast Florida more resilient to future storm events.

***continued on next page***

## Inside this Edition



**Mark your Calendar**

### 2018 Scholarship Top Award

**Student Poster Presented by Amanda Tritinger**

*"Hindcast of Storm Surge Produced by Hurricane Matthew and Simulation of Potential Tracks for UNF Forensics Study"*

## Modeling - Introduction

Hindcasting offers comprehensive insight into the consequences of a hurricane by demonstrating wind and wave conditions during the storm. It is crucial to create these circumstances to reenact what happened in detail. Furthermore, by manipulating the existing data to create alternate scenarios, a method for comprehending the level of potential risks on coastal regions can be provided. A combination of these findings enhances the coastal resilience perspective, modifies the design criteria, and clarifies what could be done for improved protection against future storms.

## Modeling - Method

A nested approach was used beginning with larger scale modeling that provided input to smaller scale models. The large-scale models used were ADCIRC and WAVAD which simulated the east coast of Florida with incorporated high and low-resolution wind and pressure fields. Then, regional-scale modeling was used at higher resolution for smaller domains with STWAVE for both Northeast Florida and the St. John's River, with the corresponding wind field input for each area. To capture the accuracy in the desired wave parameters, a finer grid was applied to the St. John's River, where a coarser grid was sufficient for the coastline. At each nest level, additional resolution was employed to maximize accuracy and to treat the important physical processes, such as depth effects, as accurately as models are capable of while maintaining reasonable computation time.

These models produced directional spectra, spectral period and direction, significant wave height, water levels, and surge information that was then applied where no measurements were available. The focus of these findings was on the maximum levels which would define the extent of the impact on the coastal features and structures. To confirm model accuracy, comparisons between the model findings and field measurements were made using an offshore buoy and water level stations.

To further investigate Florida's ability to recover from Matthew-strength hurricane conditions, four alternative storm tracks were developed; a direct hit on Jacksonville, tracks that made landfall south and north of Duval county, and one direct strike on Port St. Lucie. The results from these runs show what the response of shorelines, rivers, and estuaries would be from a storm of this magnitude. The consequences of Hurricane Matthew, as well as the outcome of similar hypothetical storms, must be considered for Florida to maximize the resilience of its coastal communities.

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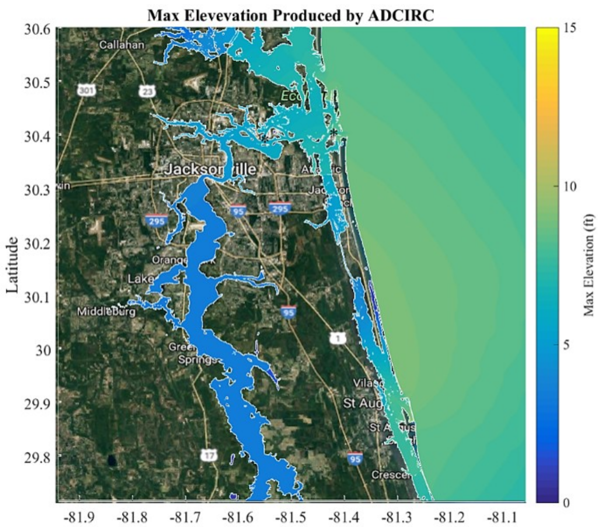

**Figure 1: Maximum Storm Surge Produced by Hindcast of Hurricane Matthew**

## Modeling - Conclusions

Based on validation methods, it can be concluded that the models preformed reasonably well for the purposes of this study. Forecasts and observed data were not readily available for all aspects of riverine applications however, in the coastal application of the study, forecasts predicted a range from 1.8 to 3.4 meters of surge. Figure 1 shows simulated values of surge that range from 0.6 to 2.5 meters, with the larger values occurring at the mouth of the St. John's River due to increased velocities that develop in inlet areas due to contracted flow. It is important to consider the social implications of these gross over predictions moving forward in the future.

This regional scale data can inform localized studies (field investigation). Water levels from this hindcast were provided to the rest of the forensics team for further investigation into forces on structures (i.e. residential docks, and the Jacksonville Pier) as well as to provide the beach team with a better understanding of what was happening during the hurricane.

Spatial and temporal variations were observed when Hurricane Matthew's track was adjusted. Estimated storm surge produced by alternative scenarios is shown in Figure 2. In general, these results show the areas where increased water levels would result in increased damages. This could be used to focus efforts on developing more resilient shorelines.

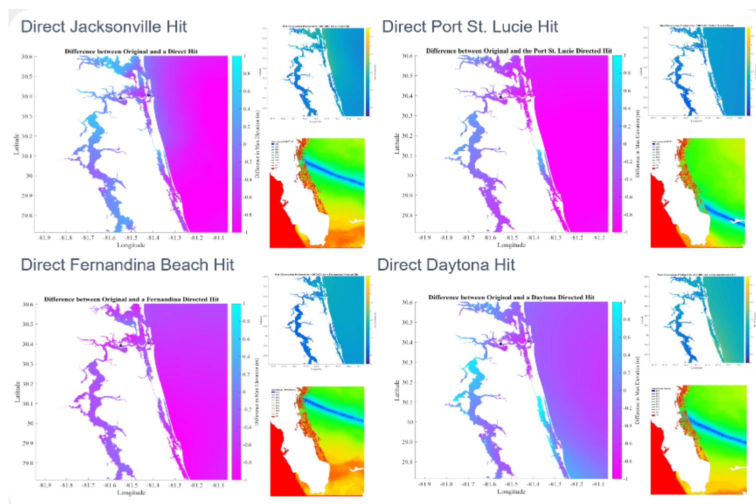

**Figure 2: Maximum Storm Surge and Currents Produced by Alternative Tracks**

Maximum significant wave heights were produced using STWAVE along the coast of the study area at a water depth of approximately 12 meters. Flagler County, the southernmost portion of the study area, shows about a 0.5-meter higher significant wave height than Duval County (6.23 m and 5.69 m respectively). As Matthew moved north along the coast, the track moved further east from the coastline, resulting in the lower significant wave height values in the northern portion of the study area.

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Maximum wind speeds along the St. John's River during Matthew reached approximately 15 m/s, with varying wind speeds as the hurricane passed offshore along Jacksonville's coastline, causing maximum significant wave heights to reach as much as 0.6 m in sections of the river. It is important to note that no localized coefficients were included, or post production alterations made to the numerical models, to provide improved results. All results applied for the examinations of affected areas were based on the physics intended in the production of the models.

The accuracy of these hindcast results exposes the limitations in forecast models. This deficiency in forecasts has led to a degradation in public trust. The forecasting accuracy **must be improved with enhanced physics and other improved computational techniques to ensure accurate reporting and ultimately public safety.**

## Field - Introduction

The damage from Hurricane Matthew on the NE Florida coast was extensive and varying. From the Volusia-Flagler County line to the St. Johns River Inlet, the full spectrum of damage was observed. However, no stretch of beach was left unscathed.

The goal of this groups work was to provide recommendations to help residents, homeowners, and governments in N.E. Florida be better prepared and more informed in their decision making before, during, and after future storm events. We accomplished this by first comparing the damage observed with the information provided by modeling the storm, to determine various weak points and failure mechanisms within existing beach protection system. Finally, by reviewing the recovery efforts with a clear understanding of the processes that lead to the damage, we developed several recommendations.

## Field - Method

The first approach taken to evaluating the damage from Hurricane Matthew was focused on accumulating as much information as possible. This took the form of a database of each structure in the three counties (Flagler, St. Johns, and Duval).

The database was developed utilizing primarily open source information where we focused on pre-and post-storm observations. The main inputs to the database were post storm aerial photographs and video, Google Earth (GE) images, property appraisal information, Light Detection and Ranging (LiDAR) information, and site visits.

Aerial photographs and video were taken just after the storm. On 13 October 2016, UNF personnel chartered a helicopter to fly from the Volusia-Flagler County line to the mouth of the St. Johns River. During the hour flight, one passenger took continuous video of the beach while the other took still photos. The GE platform made historical overhead photography available. Overall the GE aerial photography is limited in the detail that can be observed but was immensely beneficial in providing time-specific images. Each of the county's property appraisal information provided the location, type, and use of each structure. By linking directly to the individual property record card on the appraiser's website, we could quickly gather more detailed information about a parcel.

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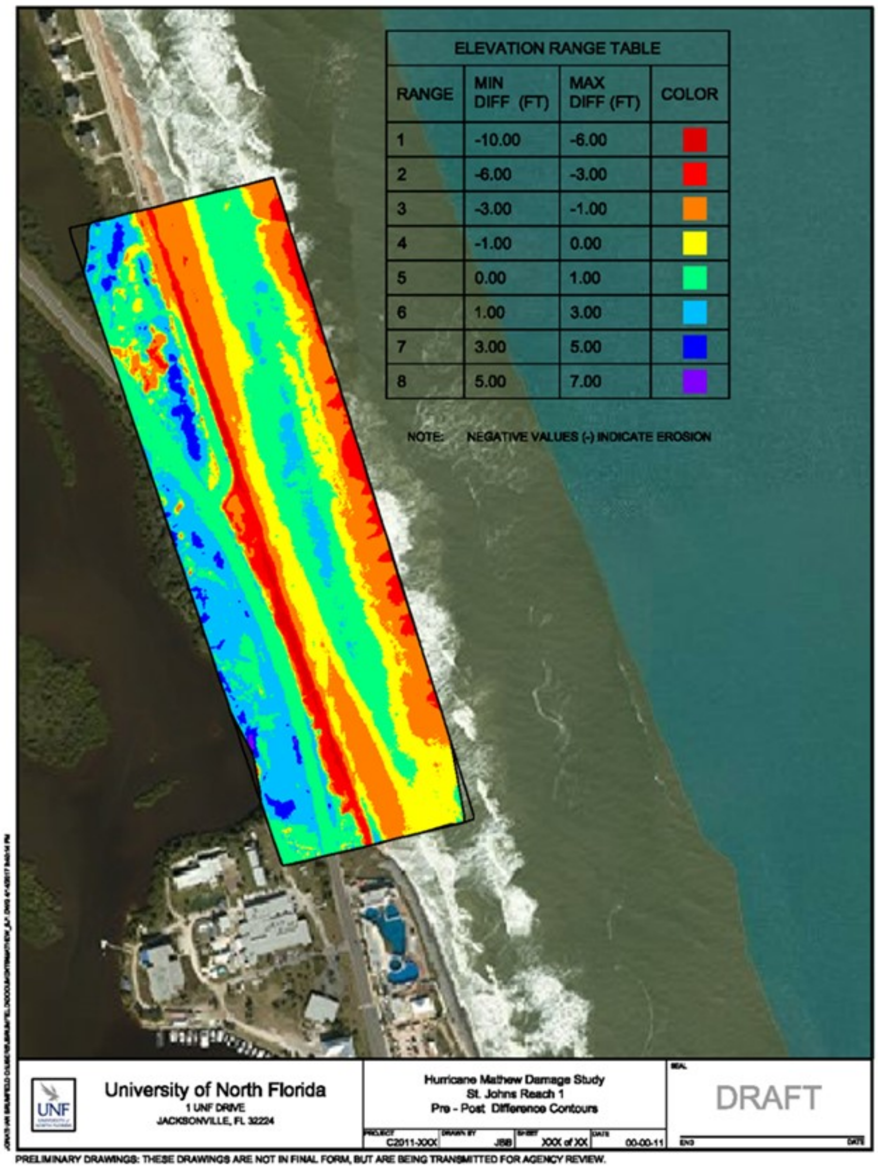
The Joint Airborne LiDAR Bathymetry Technical Center of Expertise (JALBTCX) of the United States Army Corps of Engineers (USACE) performed LiDAR surveys pre-and post-Hurricane Mathew to assess damages for the east coast of Florida. The pre-condition and post-condition survey data sets were collected in Summer 2016 and November 2016 respectively.




With a large database to draw from it became apparent that to provide specific recommendations, detailed examples from within the data were required. Additionally, analyzing a large amount of LiDAR data and follow -on site visits would be too lengthy. This led to our final approach which relied on twelve sites. Being intimately familiar with the coast and damages, sites were chosen that either provided an experiment of opportunity or demonstrated a clear vulnerability. In total twelve sites were chosen, four in Flagler County, five in St. Johns County, and three in Duval County.

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## Field - Conclusions

Our work, although in depth, did not provide definitive answers. We developed three questions and provided some preliminary thoughts that require much more effort within the coastal engineering community.
First was how do we update our beach nourishment process to improve protection? By reviewing damages on either side of the beach nourishment, that was ongoing during Hurricane Matthew, we saw clearly that berm nourishment provided limited protection from the waves at the elevated water levels. A more robust discussion and balance is required when determining the benefits in recreation (berm nourishment) to protection (dune development).

Second is how do we better prepare by assessing an area prior to a storm. Many homeowners and residents we interviewed were poorly informed and did not expect damages to the extent we saw. A concerted effort is required by personnel at all levels in the coastal community to better communicate the risks and vulnerabilities property owners have.

Third is how do we ensure appropriate recovery efforts take place after a storm? In many cases property owners relied on poor advice and recovery methods that were clearly exploited by Hurricane Irma.
In addressing these three areas we have not set out to answer the questions definitively. **Our goal is to spark a much larger conversation.**

## Contact

For more information on the University of North Florida's Hurricane Matthew forensic study, please contact Amanda Tritinger, at atritinger@gmail.com.

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## 2018 Planning Committee

### Executive Committee

**Chris Creed, P.E.,**
**Olsen Associates, Inc.**

**Lauren Floyd**
**APTIM**

**Michael Poff, P.E.,**
**Coastal Engineering Consultants, Inc.**

**Cliff Truitt, Ph.D., P.E.**
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**Scott Douglass, Ph.D., P.E.**
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**North Carolina Sea Grant**
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**Nicole Sharp, P.E.**
**Broward County, Florida**

**Lee Weisher, Ph.D., PWS**
**Woods Hole Group**

**and**

**Lisa Armbruster**
**FSBPA**

# 2018 Tech Conference

## Thank you Attendees, Speakers, Sponsors, Exhibitors and Volunteers

FSBPA would like to thank all who attended the 31st annual Tech Conference in Panama City Beach. Your attendance and support are appreciated, especially to those who traveled so far to join the event.

Following a warm welcome from Panama City Beach's Mayor Mike Thomas, attendees participated in 18 hours of presentations and dialogue about the most interesting and innovative beach and coastal projects and research being conducted around the U.S., Caribbean, and as far as South Korea. Congratulations to the Planning Committee led by Lisa Armbruster for developing this outstanding program and enlisting an incredible group of speakers! Special thanks are also in order to each speaker for sharing information about your team's work and accomplishments. Within the next week, conference presentations will be available on the website for speakers who gave permission to post their presentation.

In addition to the presentations, the student scholarship program was held in the exhibit hall and generously sponsored for the 5th year by Michael Poff and Coastal Engineering Consultants. UNF's Amanda Tritinger and UF's Gabriel Campbell received scholarship awards for presenting their remarkable research. Learn more about Amanda's research in this Shoreline edition. We anticipate publishing a piece on Gabriel's dune vegetation and restoration work later this year. The student scholarship program is a great opportunity for the professional community to meet bright young adults who are developing the skills and training needed to join our beach preservation efforts post-graduation. We can all look forward to working with Amanda and Gabriel soon, as well as to inviting new talent to join us at next year's Tech Conference.

FSBPA greatly appreciates the generosity of the Sponsors and Exhibitors who supported the conference this year. Because of your involvement, attendees enjoyed the professional breaks, welcome reception, luncheon buffet, and other amenities. Networking is an essential part of the Tech conference, and the professional exchange breaks offer a venue for attendees to interact with colleagues while also providing an opportunity to learn about available services and products exhibitors have to offer.

Once again, to our planning committee, speakers, attendees, sponsors, exhibitors, and volunteers who assisted us, thank you for contributing to the National Conference on Beach Preservation Technology's success! FSBPA's Board of Directors and staff greatly appreciate your support.

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# Thank you to our Tech Conference Sponsors

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# Candid Shots from the Conference

## Welcome - Opening Session

## Welcome Reception


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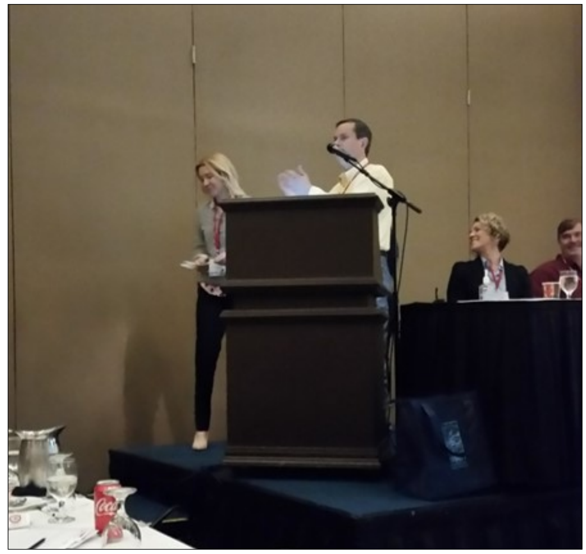
## Student Scholarships


**Gabriel Campbell-Martínez**
"Germination requirements and seed dormancy of sandhill milkweed (*Asclepias humistrata*)"



Michael Poff, Coastal Engineering Consultants, presenting award to Ms. Tritinger

## Exhibits and Professional Exchange Breaks

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## Breakout Sessions

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## Time for Lunch

## And then off to the M&M Challenge...

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## Closing Session


## Thanks for attending!

**We have not finalized the date and venue for the 2019 Tech Conference yet, but we will let you know via *Shoreline*, the website and social media when it is scheduled.**

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# USACE Jacksonville District

## The Testing of Unmanned Aerial Systems for Post-Hurricane Beach Inspections

By Gabriel Todaro
Intern, EN-WC
USACE Jacksonville District

The current method of assessing beach erosion following a hurricane involves coastal engineers taking photographs and hand sketches of eroded beach profiles and then using those sketches to estimate the amount of material lost in the affected area. This is a time-intensive process that involves pacing off or measuring the cross section of the beach every few thousand feet to get a representation of the eroded beach. In addition to being time-intensive, this process can have errors built into it if the beach does not have a consistent shape between the measured points. One method to improve this process that the U.S. Army Corps of Engineers (USACE) is testing is the deployment Unmanned Aerial Systems (UAS), more commonly known as drones.

**Figure 1: Establishing ground control points**

After Hurricane Irma, in late November and early December, a UAS was used in Jacksonville Beach and St. Augustine Beach to collect topographic data and aerial imagery.

The UAS flights were done by establishing a series of ground control points. Ground control points are areas where the GPS coordinates are known that the UAS can reference in order to know its exact location (Figure 1). The ground control points that were established for the Jacksonville Beach test can be seen in Figure 2.

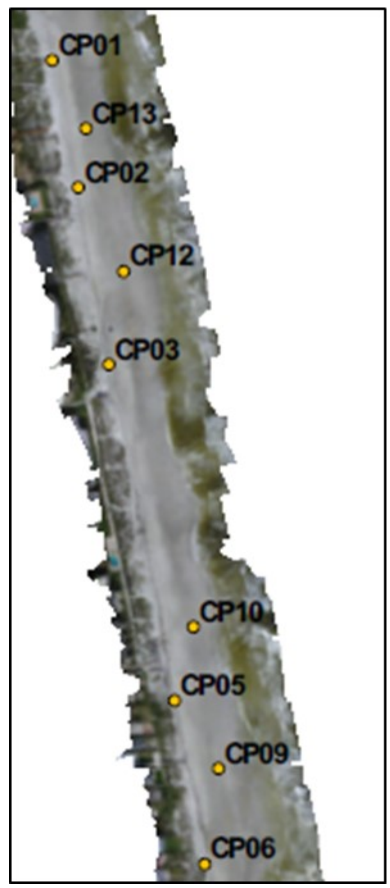


**Figure 2: Ground control point locations for Jacksonville Beach test**

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The results of the UAS trial in Jacksonville Beach are shown in Figure 3 and Figure 4. The UAS surveyed an area of 1000m by 300m and collected 72 vertical check points. Using the vertical check points, USACE was able to plot cross-sectional profiles of the beach.

**Figure 3: UAS flight over Jacksonville Beach (elevations in meters)**

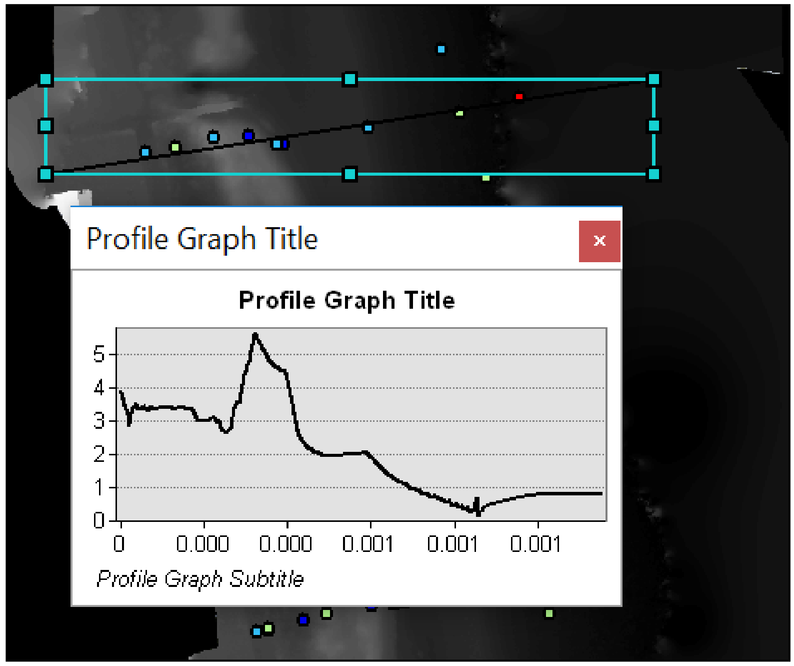


**Figure 4: Cross-section of UAS flight over Jacksonville**

- 0.000000 - 0.030832
- 0.030833 - 0.090410
- 0.090411 - 0.182081
- 0.182082 - 0.329128
- 0.329129 - 0.613281

The UAS was also used at St. Augustine Beach over an area that was 1500x350m. The UAS collected 55 vertical check points. The location of the vertical check points and a sample cross-sectional area can be seen in Figure 5 and Figure 6. The spike in the profile is the result of the drone crossing over a Utility Vehicle which demonstrates one of the disadvantages of using the UAS.

Several disadvantages to using the UAS were highlighted during the testing at St. Augustine Beach and Jacksonville Beach. The first is that the UAS cannot acquire usable data when weather conditions are too poor (wind speeds 11+ meters per second). The second is that the UAS can read obstacles on the ground as part of the elevation. This was shown during the St. Augustine test when the UAS passed over a Utility Vehicle. This issue can be manually corrected but can require added processing time for the data.

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Another issue revolves around the ground control points. The actual flight of the UAS does not take very long but the establishment of the ground control points can take some time to set up. Once the ground control points are set up, they are susceptible to being touched or moved by curious beachgoers. This was the case at both test locations.

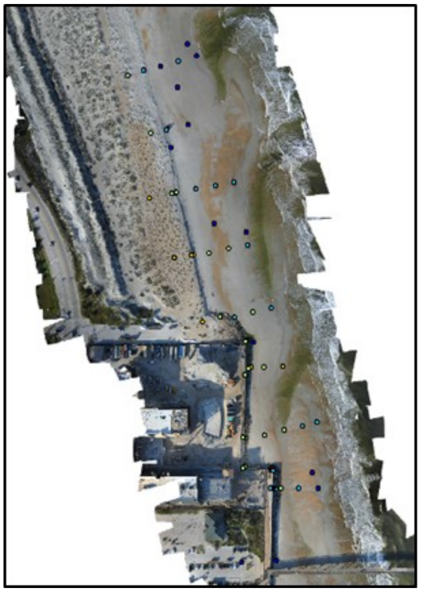

**Figure 5: UAS flight over St. Augustine Beach (elevations in meters)**

- 0.000000 - 0.027174
- 0.027175 - 0.108038
- 0.108039 - 0.185030
- 0.185031 - 0.343047
- 0.343048 - 1.908360

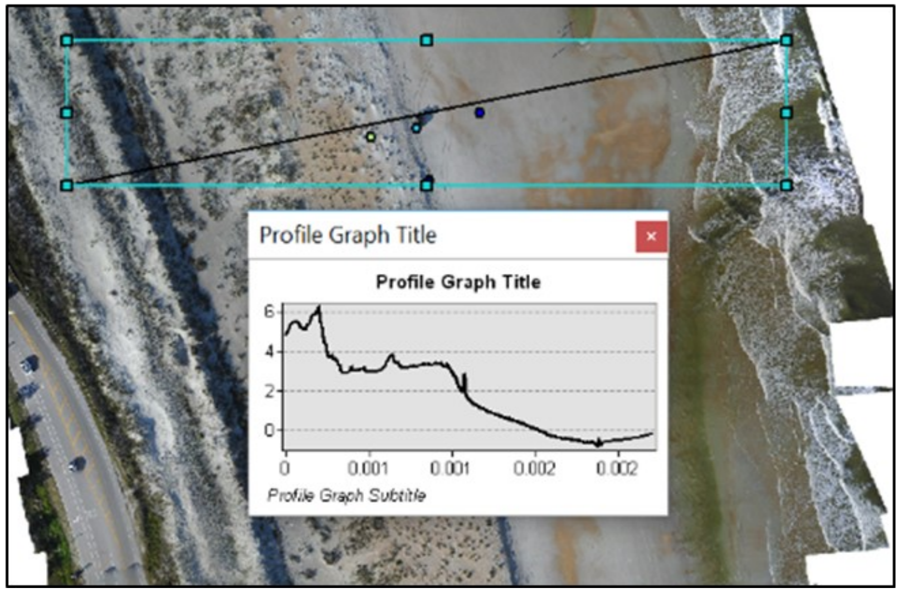


**Figure 6:Cross-section of UAS flight over St. Augustine**

Despite these disadvantages, the UAS has major advantages when regarding the accuracy of the flight compared to the manual beach inspections. When using ground control points, the accuracy of the UAS used is 3 cm horizontally and 5 cm vertically. This increased accuracy makes the UAS a very attractive tool for doing beach inspections. Despite some of the potential limitations of its usage, USACE will continue to test the UASs and potentially deploy them with their inspection teams in the near future.

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# CALENDAR OF EVENTS

## FSBPA Conferences

**September 19-21, 2018**
**61st Annual Conference**
**Hyatt Regency Clearwater Beach Resort**
**Clearwater Beach, Florida**

## OTHER DATES OF INTEREST

**March 9, 2018**
**Last day of the 2018 Legislative Session**
**Tallahassee, FL**

**March 20-22, 2018**
**ASBPA Coastal Summit**
**Washington, DC**

**April 10-13**
**Florida Floodplain Managers Association Conference**
**Orlando, FL**

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