Positioning Systems

CASE STUDY | Florida Public Archaeology Network

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*Emily Jane Murray maps the Florida coastline so the Florida Public Archaeology Network (FPAN) can track erosion over time.* ***Left:*** *The blue line shows how far a shoreline has eroded in just 14 months.* ***Right:*** *Murray uses an Arrow Gold® to obtain centimeter-level accuracy in her mapping. Having highly accurate shoreline maps increases the accuracy of models used to help predict future erosion.*

**Customer**
Florida Public Archaeology Network (FPAN)

**Industry**
Archaeology, Not-for-Profit

**Challenge**
As sea levels rise faster than predicted, FPAN needed better erosion models and a survey of coastal historic sites to plan future work.

**Solution**
Eos Arrow 100® and Arrow Gold® GNSS receivers, ArcGIS® Field Maps, ArcGIS Online, FARO® laser scanner

**Results**
FPAN can now visualize and measure 3D erosion volumes accurately, enabling them to better prioritize work at at-risk sites.

# Slipping Seaside: Preserving Florida's Past by Mapping Erosion with Eos GNSS

By some estimates, Florida's sea levels have risen by six times the global average in recent years. Preserving the state's approximately 35,000 known at-risk cultural resources along the coastline has become urgent. These resources often include Indigenous items such as pottery, stone tools, and the structures of historic buildings, cemeteries, and other important artifacts.

The Florida Public Archaeology Network (FPAN) is a not-for-profit that promotes the conservation, study, and public understanding of Florida's archaeological heritage. Their work, funded by state legislation and grants, relies on both staff and volunteer contributions to archaeological projects.

In 2016, FPAN established the Heritage Management Scouts (HMS), a citizen-science program aimed at training volunteers to help survey 5,000-6,000 of the state's most at-risk sites. These volunteers help document site changes, such as fallen trees and newly visible above-ground artifacts, which help FPAN know which areas require further study.

"We map anywhere these changes occur because this can help us pinpoint areas to go back to and complete more work," said Emily Jane Murray, FPAN Public Archaeologist for the Northeast Region.

## THE CHALLENGE: PREDICTING AND PLANNING FOR EROSION

As sea level rises faster than predicted, FPAN faces a growing challenge to prioritize which sites to excavate first and also to build more accurate predictive models. "We've got models, which are limited, that say, 'If you add five feet of water there, then a certain site will be wet,'" Murray said. "Unfortunately, we know by observation that these sites are already wet. So the real question is, how fast is this happening, and what do we do next?"

> "You can just hand them the GNSS receiver, a phone loaded with Field Maps, and they are almost instantaneously operational. That's a testament to how easy the Arrow GNSS receivers are to use."

— Emily Jane Murray
*Public Archaeologist,*
*Florida Public Archaeology Network - Northeast Region*

Across the pond, archaeologists in Scotland facing the same problems had already begun finding a solution to similar circumstances. FPAN sent archaeologists to study the work of the Scottish Coastal Archaeology and the Problem of Erosion (SCAPE) organization. SCAPE had already mapped at-risk coastal sites and modeled shoreline erosion with high accuracy. FPAN brought SCAPE's recommendations back to Florida and secured funding for a pilot test.

## THE FIRST SOLUTION: MAPPING HISTORICAL SITES

Following SCAPE's lead, FPAN deployed the ArcGIS® platform for geospatial data management. SCAPE also shared their database model, which helped FPAN manage important site data, such as boundaries and artifacts. FPAN deployed ArcGIS Field Maps, a mobile app that standardized data collection and mandated required fields, so that both staff and volunteers could collect and update information during site surveys.

For location accuracy, FPAN deployed the same GNSS receivers SCAPE was using. The Arrow 100® GNSS receiver provides real-time 30-60 centimeter location accuracy using differential corrections from satellite-based augmentation systems (SBAS). Not only did the Arrow 100 work with Field Maps, but out of the box it was easy for FPAN's volunteers to use with minimal training.

Field data appears instantly on an ArcGIS Online web map at the FPAN office, where Database Manager Kassie Kemp performs quality control. Kemp submits verified information to the state's cultural resource database, the Florida Master Site File. With this workflow, FPAN is solving its first challenge: mapping every historical site efficiently, accurately, and resourcefully.

## THE SECOND SOLUTION: MODELING EROSION MORE ACCURATELY

Shorelines can be mapped many ways. FPAN uses the "upland erosional edge," which involves considering this edge the boundary of the intact site. Mapping this edge is easy in some areas (e.g., bluffs), but it can prove trickier in areas with less well-defined boundaries, such as marshes. Indeed, Florida marshes commonly contain deeply rooted palmetto thickets, which slow erosion. Erosion in these areas might be only centimeters at a time. To map erosion along all coastal types, therefore, FPAN needed even higher location accuracy than they used for the site surveys.

"If you can get to within a meter of a site boundary, you can usually see where the site is," Murray said. "But tracking erosion requires a greater degree of accuracy."

For centimeter-level accuracy, FPAN chose the Arrow Gold® GNSS receiver. The Arrow Gold connects to the free local Florida Permanent Reference Network (FPRN) for real-time differential corrections that ensure centimeter-level accuracy. Murray says FPAN can use this to map erosion better in areas where change is detected at the centimeter level.

FPAN's goal is to map the coastline of each historical site in certain areas annually. They can then compare these measurements over time to the Sea Levels Affecting Marshes Models (SLAMM) for the area. SLAMM is the industry-leading model used to predict future sea-level rise and related changes. They also use a FARO® laser scanner to collect highly accurate spatial data that can be processed into point cloud and 3D models, georeferenced with high-accuracy coordinates from the Arrow Gold.

## THE RESULTS: THE MODELS ARE SCARY

The results so far have enabled Murray's team to actually visualize and measure erosion volumes in 3D. "This is one of the coolest things we're doing with the Arrow Golds," Murray said. "We can track more quantifiable shoreline loss by comparing the models through time and get a 3D rendering of all the sediment that has washed away." In short, these models will allow FPAN to better anticipate erosion — and prioritize which historical sites to excavate.

According to Murray, these sites likely contain important information about the past. "We can learn how people moved and reacted to erosion in the past, including which methods worked and which didn't," Murray said. "To understand the past is to understand the present."