NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT FL1912C-TB-C

St. Andrew Sound to Apalachicola Bay, Florida

Introduction

NOAA Coastal Mapping Program (CMP) Project FL1912C-TB-C provides a highly accurate database of new digital shoreline data for a portion of the Florida Gulf Coast from St. Andrew Sound to Apalachicola Bay. FL1912C-TB-C is a subproject of a larger acquisition project, FL1912-TB-C, which extends from St. Andrew Bay to Ochlockonee Bay, in Florida. Project FL1912-TB-C is also part of a larger project which includes two additional acquisition projects, FL1913-TB-C and FL1914-TB-C, all of which cover areas that were impacted by Hurricane Michael, extending from Mobile Bay, Alabama to Gulf Harbors in New Port Richey, Florida. The Geographic Cell (GC) may be used in support of the NOAA Nautical Charting Program (NCP) as well as geographic information systems (GIS) for a variety of coastal zone management applications.

Project Design

The Requirements Branch (RB) of the NOAA National Geodetic Survey (NGS) Remote Sensing Division (RSD) designed Project FL1912-TB-C and formulated project instructions following the guidelines of the "Scope of Work, Shoreline Mapping for the Coastal Mapping Program" (SOW), Version 14A. The instructions discussed the project's purpose, geographic area of coverage, scope and priority; data acquisition, processing, accuracy, and compilation requirements; product delivery and reporting instructions; and contact and communication information. RSD provided a shapefile and maps of the project area, and tide coordination time windows for data acquisition.

Quantum Spatial Inc. (QSI) was contracted to provide the planning, acquisition, and post-processing of aerial imagery and ground surveys for aerial imagery checkpoints; lidar acquisition, processing, classification; ground survey activities including checkpoints for use in independent vertical accuracy testing; aerotriangulation (AT); feature compilation and quality control.

Field Operations

The field operations for Project FL1912-TB-C consisted of the surveying of ground control and check points, and the acquisition of digital aerial photographs and topographic-bathymetric (topobathy) lidar data. Ground control/check points were established in Project FL1912-TB-C using a combination of fast-static, real-time kinematic, and post-processed kinematic Global Positioning System (GPS) techniques. Survey field work was performed between November 2019 and May 2020 by QSI personnel. This phase of project completion is described in QSI's Ground Survey Reports for lidar and imagery. These are on file in RSD's Electronic Data Library with all of the other project reports.

Lidar acquisition for FL1912-TB-C was performed by QSI and subcontractor Woolpert from November 2019 through July 2020. The topobathy lidar data was captured at a target point density of ≥4 points per square meter using the Riegl VQ-880-GII, VQ-880-G+, and Leica Chiroptera 4X sensor systems. For more information refer to QSI's Lidar, Digital Imagery & Shoreline Mapping report for FL1912, FL1913, & FL1914-TB-C.

Acquisition of digital imagery, kinematic GPS data, and Inertial Measurement Unit (IMU) data was performed by Fugro, a subcontractor of QSI. Aerial survey operations included the acquisition of 77 lines of imagery within +/- 3 hours of low tide using a Leica ADS100 (RGB/NIR) 4-band camera system from December 2019 to May 2020. A subset of eleven flight lines were used for FL1912C-TB-C. All aerial images were acquired at a nominal altitude of 12,500 feet, giving a ground sample distance (GSD) of 0.30 meters. For more information on imagery acquisition refer to QSI's Hurricane Michael FL1912_FL1913_FL1914 Data Acquisition Summary Report.

GPS Data Processing

GPS/IMU data were processed by Fugro personnel to yield precise sensor positions and orientations of the imagery as inputs for the AT phase. The aircraft used to acquire data was equipped with a Novatel SPAN IMU unit to collect ABGPS and IMU data. A combination of three static base stations and five CORS stations were used to calculate the differential (DGPS) solution and final photo center locations. Novatel Inertial Explorer (ver. 8.7) software was used to process the data and obtain a loosely-coupled GNSS/INS solution. The airborne positioning and orientation processing yielded acceptable results for highly-accurate aerotriangulation. For further information refer to the FL1912_FL1913_FL1914 Hurricane Michael Airborne Positioning and Orientation Report (APOR).

Lidar Data Processing

The lidar processing phase of the project was performed by QSI using Riegl's RiProcess or Leica's Lidar Survey Studio (LSS) software to facilitate bathymetric return processing. Once bathymetric points were differentiated, they were spatially corrected for refraction through the water column based on the angle of incidence of the laser. QSI refracted water column points using a combination of Riegl's RiHydro tools, Leica LSS, and proprietary software. The resulting point cloud data were classified using both manual and automated techniques.

RSD received classified lidar tiles covering the project area and used NOAA VDatum software to convert the vertical datum of the lidar points from NAD83 ellipsoid to local MHW and MLLW tidal datums. QT Modeler and custom ArcGIS Scripts were used to produce bare earth MHW and MLLW digital elevation models at a 1-meter grid resolution and to create and format the MHW and MLLW vectors into shapefile format.

The lidar point cloud was first compared to ground control points of a higher accuracy to determine vertical uncertainties for the data set, then compared to the morphologic slope around the derived shoreline at many sample sites in the FL1912-TB-C project area to determine the uncertainty of the derived vectors. Based on this assessment, RSD personnel determined that the MHW lidar-derived shoreline vectors meet horizontal accuracies of 1.9 meters (lidar block 1)

and 5.8 meters (lidar block 3) at the 95% confidence level, and the MLLW lidar-derived shoreline vectors meet horizontal accuracies of 4.8 meters (lidar block 1) and 8.3 meters (lidar block 3) at the 95% confidence level.

Aerotriangulation

The AT phase of the project was accomplished by Fugro personnel in June 2020 using digital AT methods to establish the network of photogrammetric control required for the compilation phase. Leica's XPro (ver. 6.4.2) AT software was used to perform automatic and interactive measurements of tie points. The final adjustment was done in two blocks, one each for UTM Zones 16 and 17, and was accomplished by using a rigorous simultaneous least squares bundle adjustment. Analysis tools within XPro were used to refine the aerotriangulation solution and to evaluate the accuracy of the adjustment. The Root Mean Square (RMS) of the standard deviations in both X and Y directions was calculated and used to determine predicted horizontal circular error at the 95% confidence level of 0.20 meters for the UTM Zone 16 block and 0.19 meters for the UTM Zone 17 block.

The project database consists of project parameters and options, camera calibration data, interior orientation parameters, ground control parameters, adjusted exterior orientation parameters, and positional listing of all measured points. Positional data is referenced to the North American Datum of 1983 (NAD 83). An Aerotriangulation Report was completed and is on file with other project data within the RSD Electronic Data Library.

Compilation

The data compilation phase of the project was initiated by personnel from QSI subcontractor Dewberry in August 2021. This work was accomplished using a Digital Photogrammetric Workstation (DPW), which consists of a stereo-enabled PC-based graphics workstation running the Windows 2010 operating system and SOCET-GXP digital photogrammetric software. Feature identification, segmentation, and attribution within the GC were based on image analysis of the project imagery and information extracted from the appropriate NOAA nautical charts, US Coast Guard Light List and other ancillary sources. Feature attribution was assigned in compliance with the Coastal Cartographic Object Attribute Source Table (C-COAST), which provides the definition and attribution scheme for the full range of cartographic features pertinent to the CMP. Selected features were further modified with additional descriptive information to refine general classification.

Spatial data accuracies for Project FL1912C-TB-C were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features compiled from the stereo imagery were compiled to meet a horizontal accuracy of 0.4 meters at the 95% confidence level, a predicted accuracy of compiled, well-defined points derived by doubling the circular error calculated from the AT statistics. A limited number of features were extracted from orthoimagery using Automatic Feature Extraction methods, and were conservatively estimated to meet a horizontal accuracy of 5.0 meters. The lidar-derived features had horizontal accuracies that varied based on location and shoreline type, ranging from 1.9 to 8.3 meters as described above.

The following table provides information on the imagery used to complete this project:

Date	Time (UTC)	Flight Line	Photo IDs	Tide Level*
12/31/2019	17:52 – 17:54	930017	BL001/NL001	0.0 m
12/31/2019	17:58 – 18:01	930018	BL001/NL001	0.0 m
12/31/2019	18:05 – 18:11	930019	BL001/NL001	0.0 m
12/31/2019	18:17 – 18:24	930020	BL001/NL001	0.0 m
12/31/2019	18:29 – 18:35	930021	BL001/NL001	0.0 m
12/31/2019	18:41 – 18:49	930022	BL001/NL001	0.0 – 0.1 m
12/31/2019	18:54 – 19:01	930023	BL001/NL001	0.0 – 0.1 m
12/31/2019	19:06 – 19:19	930024	BL001/NL001	0.0 – 0.1 m
12/31/2019	19:35 – 19:55	930025	BL001/NL001	0.0 – 0.1 m
12/31/2019	20:00 – 20:23	930026	BL001/NL001	0.0 – 0.1 m
12/31/2019	20:28 – 20:47	930027	BL001/NL001	0.1 m

***** Tide levels are given in meters above MLLW and are based on verified observations recorded by NOAA gauges 8728690 at Apalachicola, FL and 8729108 at Panama City, FL. The elevation of the MHW tidal datum in the project area ranges between 0.37 – 0.53 meters above MLLW.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of QSI. The final QC review was completed in September 2021. The review process included analysis of AT results and assessment of the identification and attribution of digital feature data within the subproject according to image analysis and criteria defined in C-COAST. The quality control process concluded with an inspection of topological connectivity within the GC using ArcGIS (ver. 10.8.1) software. All project data was evaluated for compliance to CMP requirements.

Comparisons of the largest scale NOAA nautical charts with natural color images and compiled project data resulted in creation of the Chart Evaluation File (CEF). The following nautical charts were used in the comparison process:

- 11389, St. Joseph and St. Andrew Bays, 36th Ed., May 2019
- 11391, St. Andrew Bay, 26th Ed., Sep. 2015
- 11393, Lake Wimico to East Bay, 23rd Ed., Jan. 2017
- 11401, Apalachicola Bay to Cape San Blas, 33rd Ed., Jun. 2019
- 11402, Apalachicola Bay to Lake Wimico, 24th Ed., Feb. 2020
- 11404, Carrabelle to Apalachicola Bay, 26th Ed., Feb. 2020

End Products and Deliverables

The following specifies the location and identification of the products generated during the completion of this project:

Remote Sensing Division Electronic Data Library

- Preliminary Ground Survey Reports for Lidar and Imagery
- Airborne Positioning and Orientation Report (APOR)
- Aerotriangulation Report
- Project Completion Report (PCR)
- GC11615 in shapefile format
- CEF in shapefile format

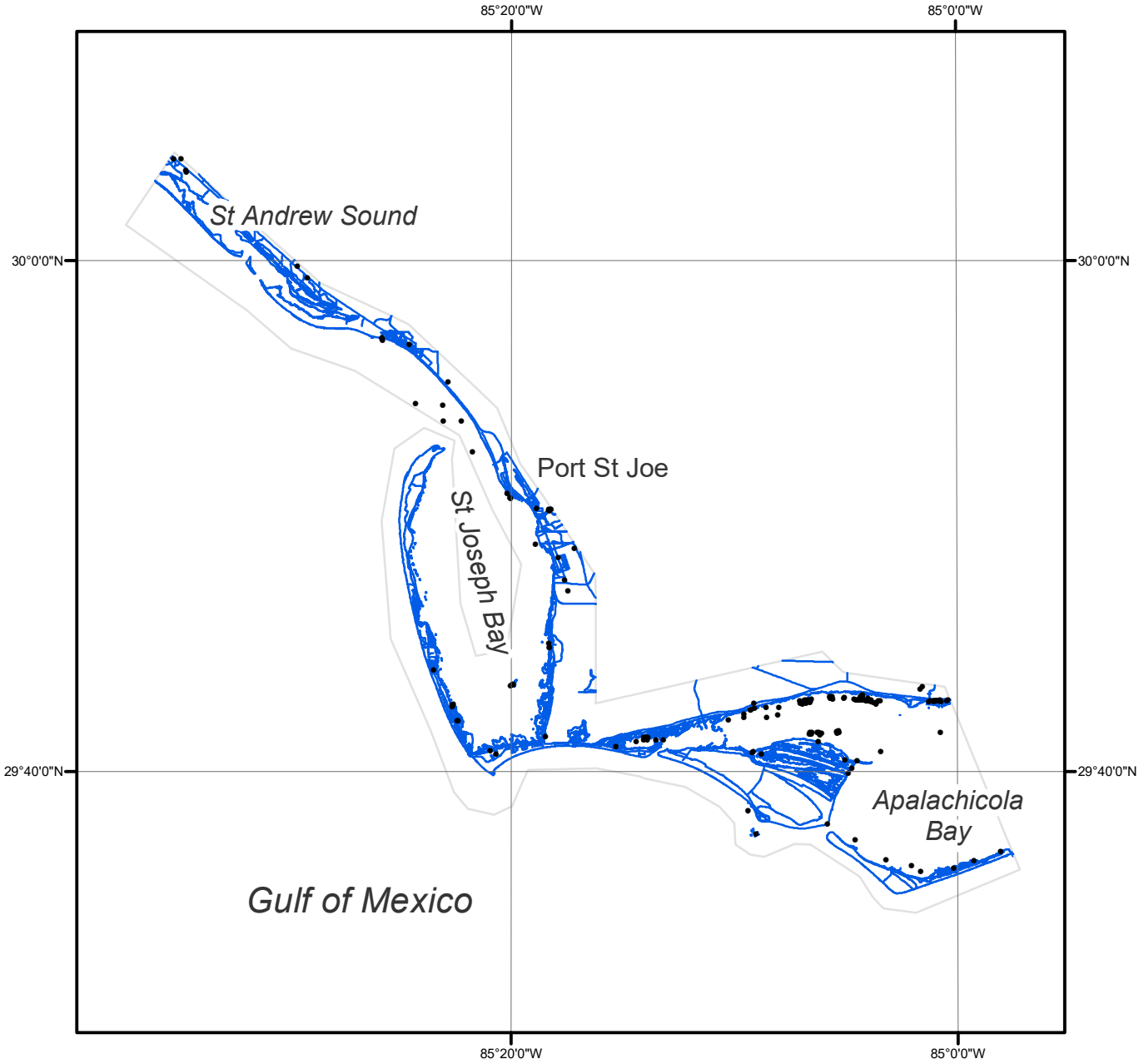
NOAA Shoreline Data Explorer

- GC11615 in shapefile format
- Metadata file for GC11615
- PCR in Adobe PDF format

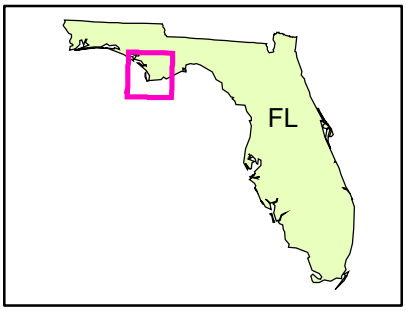
End of Report

ST ANDREW SOUND TO APALACHICOLA BAY

FLORIDA



Overview



FL1912C-TB-C

GC11615