NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT FL1607-TB-N

St. Joseph Sound, Florida

Introduction

NOAA Coastal Mapping Program (CMP) Project FL1607-TB-N provides a highly accurate database of new digital shoreline data for St. Joseph Sound, in Florida. The project was conducted using stereo softcopy photogrammetry supplemented with lidar-derived Mean High Water (MHW) and Mean Lower Low Water (MLLW) data. 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 NOAA National Geodetic Survey (NGS) formulated the Project Instructions for this project following the guidelines of the "Scope of Work, Shoreline Mapping for the Coastal Mapping Program" (SOW), Version 14A, dated October 24, 2012. 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.

NGS was responsible for planning, acquisition, and processing of all aerial data to support photogrammetric and lidar processing for feature compilation. This includes the establishment of ground control, and the post-processing of airborne GPS data. In addition, NGS provided shapefiles of the flight lines and exposure centers of the imagery to be used for compilation.

Field Operations

NGS performed field operations that included surveying of ground control points and accuracy assessment checkpoints to support the acquisition and processing of aerial photographs and topographic/bathymetric (topobathy) lidar. A total of fourteen GCPs were established in project FL1607-TB-N using real-time kinematic (RTK) GPS techniques. Ground Survey data are on file with other project data within the RSD Electronic Data Library.

The lidar acquisition was conducted by NOAA in February 2016 and consisted of a total of 163 passes using a DeHavilland Twin Otter aircraft (N57RF) at an altitude of 400 meters (AGL) to complete the entire 107 square mile project area. Topobathy lidar data was collected with a Riegl VQ-880-G lidar system at an aggregate nominal point density of 18 pulses per square meter for both topographic and bathymetric returns, with a nominal swath width of 287 meters and a 50% swath overlap.

The aerial photography phase of the project was conducted by NOAA in February 2016 using the NOAA King Air aircraft (N68RF). A total of eight flight lines of color imagery were acquired and within +/- 2 hours of the predicted MLLW. Imagery was captured with a nominal ground sample distance (GSD) of 0.25 meters through the use of an Applanix DSS 560/580 aerial camera.

GPS Data Processing

For both the lidar and image acquisitions, the airborne GPS data was collected using the Applanix POSAV Model 410 IMU unit along with a dual-frequency Trimble BD960 receiver. Airborne GPS data was processed using the Applanix POSPac MMS software with tightly coupled processing (In-Fusion single Base) to achieve the final image center locations and orientations. Base data for all kinematic processing consisted of a station set up in the survey area collecting ≥ 4 hours of static GPS data with the position derived via NGS Online Positioning Users Service (OPUS). Two base stations were utilized for the lidar acquisition for redundancy purposes. For further information refer to the Airborne Positioning and Orientation Report (APOR) on file with other project data within the RSD Electronic Data Library.

Lidar Data Processing

NOAA collected the raw topobathy lidar data for Project FL1607-TB-N and performed the initial processing and quality control. Lidar point cloud data was processed by Dewberry personnel in October 2017. Riegl RiProcess software was utilized to transform the lidar point cloud into a mapping projection and to check the calibration stability. Terrasolid software was used for assessing relative and absolute accuracies between overlapping lifts and relative with each lift, initial point cloud classification, editing of the lidar point cloud, and for classification of water surface, erroneous returns, bathymetric surface and bare earth points. Refraction correction was performed through Dewberry's lidar Processor. Additional quality control (QC), point classification, and formatting were performed with GeoCue, Terrasolid, and Global Mapper software. NOAA VDatum software was used to convert the vertical datum of the lidar points from NAD83 ellipsoid to local MHW and MLLW tidal datums. QTModeler and custom ArcGIS Scripts were used to produce bare earth MHW and MLLW digital elevation models (DEMs) at a 1-meter grid resolution and to create and format the MHW and MLLW vectors into shapefile format.

The lidar point cloud was compared to higher accuracy ground control points to determine vertical uncertainties of the data set, and then compared to the morphologic slope around the derived shoreline at a large number of sample sites in the project area to determine the uncertainty of the vectors. Based on this assessment the MHW lidar derived shoreline vectors meet a horizontal accuracy of 2.3 meters at the 95% confidence level, and the MLLW lidar derived shoreline vectors meet a horizontal accuracy of 3.3 meters at the 95% confidence level. NOAA supplied the lidar-derived MHW and MLLW shapefiles to be segmented, edited, and attributed by Dewberry.

Aerotriangulation

The aerotriangulation (AT) phase of the project was performed by Dewberry using digital AT methods to establish the network of photogrammetric control required for the compilation phase. Inpho Match-AT software was used to perform automatic point measurements and interactive point measurements of tie points. The Root Mean Square (RMS) of the standard deviations in both X and Y directions were calculated and used to determine a predicted horizontal circular error at the 95% confidence level. The predicted horizontal accuracy for FL1607-TB-N is 0.1 meters. An AT Report is on file with other project data within the RSD Electronic Data Library.

There were 103 image frames that were not adjusted in the AT because they were either open water frames or did not have enough land area to be measured in the adjustment. Therefore, these frames maintained the exterior orientation recorded by the GPSIMU during collection. The horizontal accuracy of these Direct Georeferenced (DG) frames was calculated by NGS staff. The Root Mean Square (RMS) of the standard deviations in both X and Y directions were calculated and used to determine a predicted horizontal circular error at the 95% confidence level. The predicted horizontal accuracy for these frames is 0.7 meters. Positional data is referenced to the North American Datum of 1983 (NAD 83).

Compilation

The data compilation phase of the project was initiated by Dewberry personnel in January 2019. Digital mapping was performed with BAE's SOCET for ArcGIS module of SOCET SET (ver. 5.6). This enabled compilation of features into an Esri Geodatabase, in which topological and attribution relationships could be enforced. Once compilation was complete, the geodatabase features were exported to shapefile format. 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 subproject FL1607-TB-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features compiled from images adjusted via AT were compiled to meet a horizontal accuracy of 0.2 meters at the 95% confidence level. Cartographic features compiled from images that were not adjusted were compiled to meet a horizontal accuracy of 1.4 meters at the 95% confidence level. These predicted accuracies of compiled, well defined points are derived by doubling the circular error calculated from the AT and DG statistics respectively.

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

Date	Time (UTC)	Roll ID	Flight Line / Photo ID	Tide Level*
13-FEB-2016	15:05 – 15:11	16VC17	45-008 / 4949 – 4986	0.1 – 0.2
13-FEB-2016	15:14 – 15:19	16VC17	45-004 / 4987 – 5024	0.2 – 0.3
13-FEB-2016	15:23 – 15:29	16VC17	45-007 / 5025 – 5062	0.1 – 0.3
13-FEB-2016	15:33 – 15:38	16VC17	45-003 / 5063 – 5100	0.2 – 0.3
13-FEB-2016	15:43 – 15:48	16VC17	45-006 / 5101 – 5138	0.2 – 0.3
13-FEB-2016	15:52 – 15:57	16VC17	45-002 / 5139 – 5176	0.2 – 0.3
13-FEB-2016	16:02 – 16:08	16VC17	45-005 / 5177 – 5214	0.2 – 0.3
13-FEB-2016	16:11 – 16:16	16VC17	45-001 / 5215 – 5252	0.2 – 0.4

* Tide levels are given in meters above MLLW and were calculated using the Pydro software tool with a TCARI grid referenced to verified water level observations at NOS gauges. The MHW tidal datum in the project area ranges from 0.77 to 0.93 meters above MLLW.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of Dewberry. The final QC review was completed in June 2019. The review process included analysis of AT results and assessment of the identification and attribution of digital feature data within the GC 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 orthomosaics and compiled project data resulted in creation of the Chart Evaluation File (CEF). The following nautical charts were used in the comparison process:

11411, Intracoastal Waterway, Tampa Bay to Port Richey, 20th Ed., Jan. 2017
11412, Tampa Bay and St. Joseph Sound, 47th Ed., Oct. 2015

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

- Airborne Positioning and Orientation Report (APOR)
- AT Report
- Project Completion Report (PCR)
- Project database
- GC11378 in shapefile format
- CEF in shapefile format

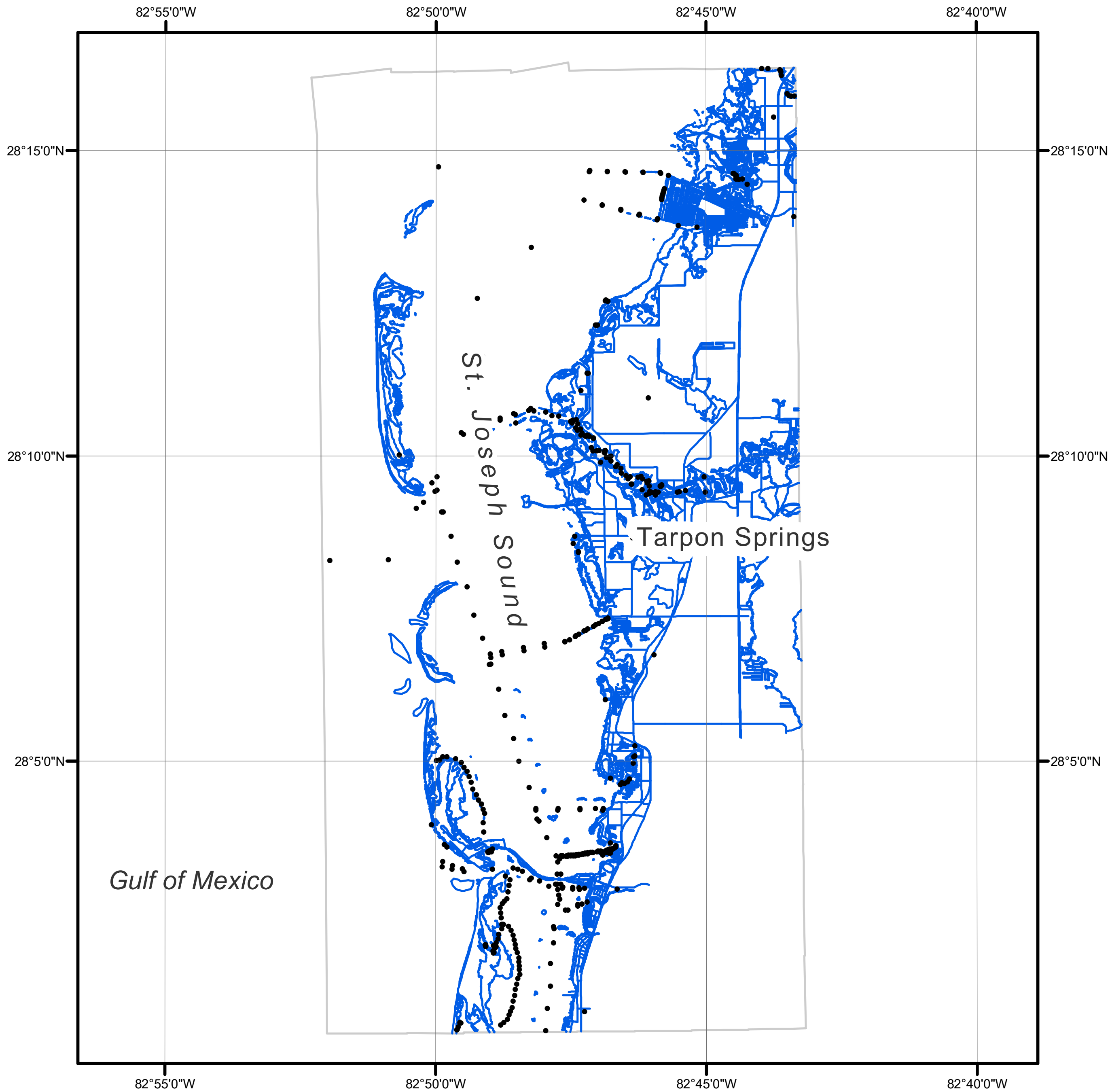
NOAA Shoreline Data Explorer

- GC11378 in shapefile format
- Metadata file for GC11378
- PCR in Adobe PDF format

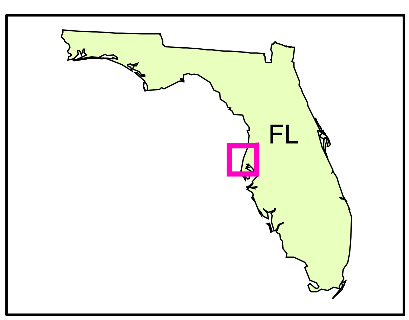
End of Report

ST. JOSEPH SOUND

FLORIDA



Overview



FL1607-TB-N

GC11378