

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT SC1601B-TB-C

Wright River to Port Royal Sound, South Carolina

Introduction

NOAA Coastal Mapping Program (CMP) Project SC1601B-TB-C provides a highly accurate database of new digital shoreline data for the outer coast of South Carolina extending from Wright River to Port Royal Sound. Project SC1601B-TB-C is a subproject of the larger project SC1601-TB-C, which extends from Wassaw Sound, Georgia to Winyah Bay, South Carolina. 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) Remote Sensing Division (RSD) 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. NOAA also provided shapefiles depicting the shoreline to be mapped and the boundaries of the main project area.

Field Operations

All of the field operations for SC1601B-TB-C were conducted by Quantum Spatial Inc., (QSI) which included the planning, acquisition and post-processing of aerial imagery and LIDAR data to support photogrammetric processing and feature compilation, as well as the establishment of ground control, the post-processing of airborne GPS data and calibration of the LIDAR data.

A total of 280 ground control points (GCPs) were established in project SC1601-TB-C using a combination of traditional static, fast-static, rapid-static, real-time kinematic, and post-processed kinematic GPS techniques. Six additional photo-identifiable check points were also occupied at well-defined, discrete locations. Survey field work was performed between July 2016 and February 2017. A Ground Survey Report is on file with other project data within the RSD Electronic Data Library.

The aerial photography acquisition phase of the project was conducted by QSI’s subcontractor Richard Crouse and Associates (RCA) between December 2016 and March 2017. A total of 27 flight lines of natural color imagery were acquired within a tolerance of 25% of the Mean Lower Low Water (MLLW) tide stage. Of the 27 flight lines acquired, six were used in project SC1601B-TB-C. Imagery was captured with an approximate nominal ground sample distance (GSD) of 0.30 meters through the use of a large format Intergraph Z/I Digital Mapping Camera (DMC) with a focal length of 92 mm.

The LIDAR acquisition was conducted between December 2016 and March 2017 and consisted of a total of 988 lines flown over 46 LIDAR acquisition missions with an average point density of 14 pulses per square meter and a nominal swath width of 291 meters and a 30% swath overlap. Topo-bathy Green LIDAR and topographic Near-Infrared (NIR) LIDAR were captured in tandem through the use of a Riegl VQ-880-G sensor. The topo-bathy data was used to derive the Mean High Water (MHW) and MLLW shorelines, while the NIR data was used as an aid to developing the water surface model necessary for applying refraction corrections to the topo-bathy data. The flight lines were required to be collected within 20% of the mean range of MLLW. For further information about all field operations see the Topobathymetric LiDAR and Shoreline Mapping Report on file within the RSD Electronic Data Library.

GPS Data Processing

Each acquisition aircraft used by QSI was equipped with either a POSAV Applanix Model 510 IMU or a dual frequency Trimble BD960 to collect the Airborne Global Positioning System (ABGPS) and Inertial Measurement Unit (IMU) data. NGS Continuously Operated Reference Stations (CORS) and several cooperative CORS stations were used for base stations on the project, with at least two of these CORS stations being used to process each POSAV dataset to achieve the final image center locations. 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

LIDAR point cloud data for all of the areas were processed from January 2017 to June 2018. 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. QSI refracted water column points using Riegl's RiHydro tool as well as QSI's proprietary software Las Monkey. 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.

Aerotriangulation

The aerotriangulation (AT) phase of the project was performed by QSI using digital AT methods to establish the network of photogrammetric control required for the compilation phase. The Bingo automated aerotriangulation system (version 6.9) was used to perform automatic point measurements and interactive point measurements of tie points. Upon successful completion of the aerotriangulation process, the Bingo software provided the RMS of the standard deviations of the residuals for each aerotriangulated ground point which were used to compute a predicted horizontal circular error of 0.4 meters based on a 95% confidence level. For further information see the Aerotriangulation Report on file with other project data within the RSD Electronic Data Library.

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) and the North American Vertical Datum of 1988 (NAVD88).

Compilation

The data compilation phase of project SC1601B-TB-C was initiated by QSI personnel in September 2017. NGS supplied the LIDAR derived MHW and MLLW shapefiles to be edited, attributed and generalized by QSI. Additional features were then manually compiled using stereo imagery. 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 a suite of digital photogrammetric software known as DAT/EM Summit Evolution (version 7.5). Feature identification, segmentation, and attribution were based on imagery analysis of the processed digital images and information extracted from the appropriate NOAA Nautical Charts, the U.S. 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 SC1601B-TB-C were determined according to standard Federal Geographic Data Committee (FGDC) practices. Stereo compiled cartographic features were compiled to meet a horizontal accuracy of 0.8 meters at the 95% confidence level. This predicted accuracy of compiled, well defined points is derived by doubling the circular error calculated from the aerotriangulation statistics. The LIDAR derived features had horizontal accuracies that varied depending on location and shoreline type ranging from 1.4 to 1.9 meters.

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

| Date | Time (UTC) | Strip ID | AT Frame #s | Index Frame ID | GSD | Tide Level* |
|------------|---------------|----------|-------------|----------------|-------|-------------|
| 01/08/2017 | 15:36 – 15:41 | 17 | 013 – 031 | 102 – 088 | 0.3 m | 0.1 m |
| 01/08/2017 | 15:51 – 15:56 | 18 | 013 – 031 | 131 – 149 | 0.3 m | 0.1 m |
| 01/08/2017 | 16:01 – 16:06 | 19 | 012 – 030 | 178 – 160 | 0.3 m | 0.2 m |
| 01/08/2017 | 16:15 – 16:19 | 20 | 012 – 030 | 201 – 219 | 0.3 m | 0.2 m |
| 01/08/2017 | 16:24 – 16:29 | 21 | 011 – 030 | 246 – 227 | 0.3 m | 0.3 m |
| 01/08/2017 | 16:37 – 16:42 | 22 | 011 – 030 | 267 – 286 | 0.3 m | 0.4 m |

* Tide levels given in meters above MLLW and are based on verified observations recorded by the NOS tide gauge at Fort Pulaski, GA. The height of the MHW tidal datum in the project area ranges from 1.92 to 2.35 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 October 2018. The review process included analysis of aerotriangulation 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 10.4 software. All project data was evaluated for compliance to CMP requirements.

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

11507, Beaufort River to St. Simons Sound, SC, 36th Ed., Jun. 2015
11513, St. Helena Sound to Savannah River, SC, GA, 28th Ed., Jul. 2018
11516, Port Royal Sound, SC, 32nd Ed., Dec. 2013

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)
- Ground Survey Report
- Topobathymetric LiDAR and Shoreline Mapping Report
- Aerotriangulation Report
- Project Completion Report (PCR)
- Project database
- GC11258 in shapefile format
- CEF in shapefile format

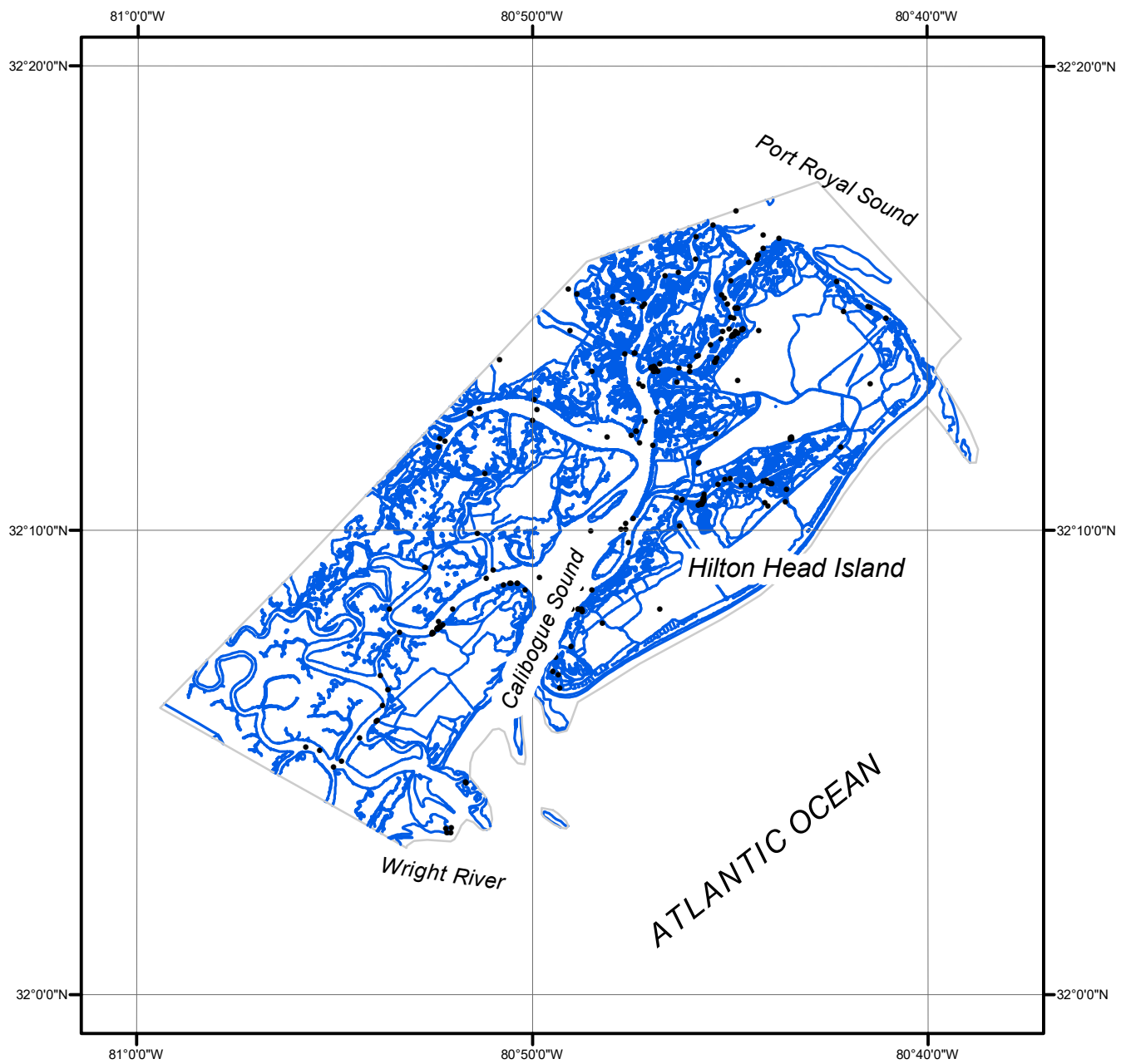
NOAA Shoreline Data Explorer

- GC11258 in shapefile format
- Metadata file for GC11258
- PCR in Adobe PDF format

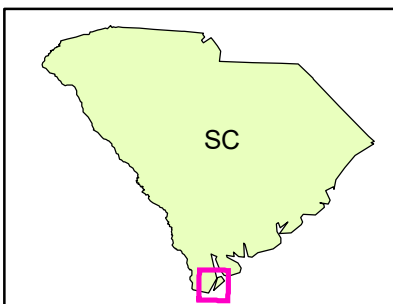
End of Report

WRIGHT RIVER TO PORT ROYAL SOUND

SOUTH CAROLINA



Overview



SC1601B-TB-C

GC11258