

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT SC0801B

Coosaw River, Lucy Point Creek to Whale Branch, South Carolina

Introduction

NOAA Coastal Mapping Program (CMP) Project SC0801B provides highly accurate digital shoreline data for the Coosaw River and nearby tributaries near the coast of South Carolina. SC0801B is a subproject of the larger project SC0801 which extends from St. Helena Sound inland to Huspa Creek and south from Port Royal Sound inland to Coosawhatchie River. 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 Remote Sensing Division (RSD) formulated photographic mission instructions for this project following standard mission guidelines. The instructions discussed the project's purpose, geographic area of coverage, scope and priority; photographic requirements; flight line priority; Global Positioning System (GPS) data collection procedures and guidelines for both kinematic and static surveys; data recording and handling instructions; and contact and communication information. RB created a Project Layout Diagram, flight maps and input files for the aircraft's flight management system.

Subsequent to the compilation and review phases of project completion, a commercial satellite image was obtained and incorporated into the project in order to meet a request from the Marine Chart Division (MCD) of NOAA's Office of Coast Survey for feature data more recent than the project aerial imagery. In response to the request, one pan sharpened natural color WorldView-2 image was obtained from Maxar (Digital Globe, Inc.) via the NextView government contract. The image has a ground sample distance (GSD) of 0.5 meters. This image was spatially adjusted to the aerial imagery using the Georeferencing tool within Esri's ArcGIS (ver. 10.6.1) desktop GIS software. Comparison of at least twenty check points from the aerial imagery to their measured locations within the adjusted satellite image yielded an additional uncertainty of 1.06 meters, calculated at the 95% confidence level. This figure was doubled and added to the accuracy of the aerial imagery from which the check points were derived, in order to conservatively predict the accuracy of well-defined points compiled from the satellite image.

Field Operations

The field operations consisted of the collection of static and kinematic GPS data, Inertial Measurement Unit (IMU) data, and the acquisition of aerial imagery. The photographic mission operations were conducted between October 25th, 2009 through February 27th, 2013 with the NOAA Citation II (N52RF) and King Air (N68RF) aircraft. Twenty-six flight lines of color and near-infrared (NIR) digital images were acquired concurrently with an Applanix Digital Sensor

System (DSS) 439 aerial camera system with one set of color and NIR digital images acquired within tolerance of Mean High Water (MHW) and another set of color and NIR digital images acquired within tolerance of the Mean Lower Low Water (MLLW). All imagery was acquired at a nominal altitude of 10,000 feet, resulting in an approximate GSD of 0.35 meters.

Quantum Spatial, Inc. (QSI) was contracted by RSD to survey ground control points (GCPs). Two GCPs were established within subproject SC0801B using static GPS techniques. Survey field work was performed between August and October 2017. A Ground Photo Control Report was written and is on file with other project data within the RSD Electronic Data Library.

GPS Data Processing

GPS/IMU data were processed by RSD personnel to yield precise camera positions and orientations for direct georeferencing (DG) of the imagery. A local GPS base station was established for use as a reference station for kinematic GPS processing operations. The position of the base station was determined using the NGS Online Processing User Service (OPUS), which computed fixed baseline solutions from nearby CORS stations. The final processing of kinematic GPS data using Applanix POSPAC MMS (ver. 6.1) was in performed March 2013. For more information refer to the Airborne Positioning and Orientation Reports (APOR) on file in the RSD Electronic Data Library.

Aerotriangulation

Routine softcopy aerotriangulation (AT) methods were applied to establish a network of precise camera positions and other control for mapping, and to provide model parameters and orientation elements required for digital compilation. This work was performed by QSI personnel in January 2018 utilizing a digital photogrammetric workstation (DPW), which consists of a stereo-enabled PC-based graphics workstation running the Windows 7 operating system and a suite of digital photogrammetric software known as DAT/EM Summit Evolution (ver. 7.5). The DAT/EM software was used to import the photo measurements, while the Match AT software system (ver. 5.6) was used to perform tie point measurements, both automatic and interactive, and to perform the final block adjustment. Color and NIR images were measured and adjusted as two separate blocks. The final adjustment of the blocks was accomplished by using a rigorous simultaneous least squares bundle adjustment, and analysis tools within Match AT were used to refine the AT solution and to evaluate the accuracy of the adjustment. Upon successful completion of this process, Match AT provided the standard deviations for each aerotriangulated ground point, which were used to compute a predicted horizontal circular error of 0.47 meters for the color images and 1.54 meters for the NIR images. Both of these values are based on a 95% confidence level. An AT Report was written and is on file with other project data within the RSD Electronic Data Library. Positional data is referenced to the North American Datum of 1983 (NAD83).

Compilation

The data compilation phase of this project was initiated by QSI personnel in February 2018. DAT/EM Summit Evolution Professional (ver. 7.5) photogrammetric software was used to extract feature data from stereo imagery, and feature identification, capture, segmentation, and attribution occurred within an ArcMap (ver. 10.4.1) file geodatabase using DAT/EM's stereo module. Feature identification and the assignment of cartographic codes were based on image analysis of the project digital images and information extracted from the appropriate NOAA

Nautical Charts, 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 SC0801B were determined according to standard Federal Geographic Data Committee (FGDC) practices. Most cartographic features were compiled to meet a horizontal accuracy of 0.9 meters. The MLLW depth contour features extracted from the NIR imagery were compiled to meet a horizontal accuracy of 3.1 meters. These predicted accuracies of compiled well-defined points, computed at the 95% confidence level, are derived by doubling the horizontal uncertainties calculated from the AT statistics. Additional features compiled from WorldView satellite imagery using Esri's ArcGIS (ver. 10.6.1), were compiled to meet a horizontal accuracy of 2.6 meters, computed at the 95% confidence level. The derivation of this accuracy is described in the Project Design section above.

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

Aerial Imagery						
Date	Time (UTC)	Color		NIR		Tide Level*
		Roll	Frames	Roll	Frames	
11-04-2009	15:56 – 15:58	09NC19	05606 – 05619	09NR20	05450 – 05463	2.1 m – 2.7 m
11-04-2009	16:02 – 16:03	09NC19	05620 – 05631	09NR20	05464 – 05475	2.3 m – 2.6 m
11-06-2009	17:33 – 17:34	09NC12	04093 – 04101	09NR13	03937 – 03945	2.5 m – 2.7 m
11-07-2009	15:33 – 15:37	09NC21	05963 – 05989	09NR22	05807 – 05833	1.7 m – 2.4 m
11-08-2009	17:28 – 17:29	09NC23	06181 – 06188	09NR24	06025 – 06032	2.4 m – 2.5 m
11-08-2009	17:30 – 17:31	09NC23	06193 – 06205	09NR24	06034 – 06049	2.2 m – 2.3 m
11-08-2009	17:45 – 17:49	09NC23	06265 – 06290	09NR24	06109 – 06134	2.1 m – 2.5 m
11-08-2009	17:57 – 18:00	09NC23	06324 – 06346	09NR24	06168 – 06190	2.3 m – 2.6 m
11-08-2009	18:14 – 18:17	09NC23	06415 – 06437	09NR24	06259 – 06281	2.3 m – 2.6 m
11-08-2009	18:25 – 18:26	09NC23	06467 – 06475	09NR24	06311 – 06319	2.6 m – 2.7 m
11-08-2009	18:27 – 18:29	09NC23	06482 – 06492	09NR24	06326 – 06336	2.4 m – 2.5 m
11-08-2009	18:42 – 18:45	09NC23	06553 – 06578	09NR24	06397 – 06422	2.3 m – 2.7 m
11-08-2009	18:55 – 18:58	09NC23	06616 – 06640	09NR24	06460 – 06484	2.1 m – 2.7 m
03-24-2010	13:58 – 13:59	10NC36	16477 – 16488	10NR27	13873 – 13884	0.1 m
03-30-2010	20:14 – 20:17	10NC38	16888 – 16906	10NR29	14284 – 14302	-0.2 m – 0.0 m
03-31-2010	20:21 – 20:23	10NC39	17091 – 17104	10NR30	14487 – 14500	-0.2 m – 0.0 m
03-31-2010	20:54 – 20:58	10NC39	17151 – 17176	10NR30	14547 – 14572	-0.2 m – 0.0 m
03-31-2010	21:08 – 21:12	10NC39	17205 – 17231	10NR30	14601 – 14627	-0.3 m – 0.1 m

04-01-2010	15:04 – 15:05	10NC40	17335 – 17338	10NR31	14731 – 14734	2.2 m
04-01-2010	15:14 – 15:15	10NC40	17366 – 17371	10NR31	14762 – 14767	2.2 m – 2.3 m
04-01-2010	20:42 – 20:43	10NC41	17623 – 17630	10NR32	15019 – 15026	0.1 m – 0.3 m
01-20-2012	17:11 – 17:12	12NC03	00556 – 00561	12NR02	00215 – 00220	0.1 m – 0.2 m
03-06-2012	17:50 – 17:52	12NC19	04992 – 05001	12NR10	02031 – 02040	0.1 m – 0.2 m
03-06-2012	18:00 – 18:02	12NC19	05027 – 05037	12NR10	06917 – 02076	0.1 m – 0.2 m
03-06-2012	18:06 – 18:08	12NC19	05039 – 05049	12NR10	02078 – 02088	0.1 m
03-06-2012	18:16 – 18:17	12NC19	05077 – 05083	12NR10	02116 – 02122	0.1 m – 0.2 m
03-06-2012	18:22 – 18:23	12NC19	05084 – 05090	12NR10	02123 – 02129	0.1 m
03-06-2012	18:52 – 18:54	12NC19	05151 – 05169	12NR10	02190 - 02208	0.2 m
03-06-2012	18:59 – 19:00	12NC19	05171 – 05184	12NR10	02210 - 02223	0.2 m
09-24-2012	14:28 – 14:30	12NC77	28387 – 28402	12NR60	15152 – 15167	0.2 m – 0.5 m
09-24-2012	14:35 – 14:37	12NC77	28403 – 28417	12NR60	15168 – 15182	0.2 m – 0.5 m
02-27-2013	21:19 – 21:21	13NC01	00133 – 00148	13NR01	00133 – 00148	-0.1 m – 0.0 m
Satellite Imagery						
Date	Time (UTC)	Source File (Tile) Name				Tide Level
03-31-2019	16:24	20190331_WV02_ORI_R1C1_NAD83.jp2				n/a

* 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 throughout the project area. The height of the MHW tidal datum in the project area is approximately 1.98 - 2.48 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 December 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 (ver. 10.6.1) software. All project data was evaluated for compliance to CMP requirements.

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

- 11516, Port Royal Sound, 32nd Ed., Dec. 2013
- 11519, Coosaw and Broad Rivers, 13th Ed., May 2014

End Products and Deliverables

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

Remote Sensing Division Electronic Data Library

- Project database
- Ground Photo Control Report
- Airborne Positioning and Orientation Report (APOR)
- Aerotriangulation Report
- GC11321 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

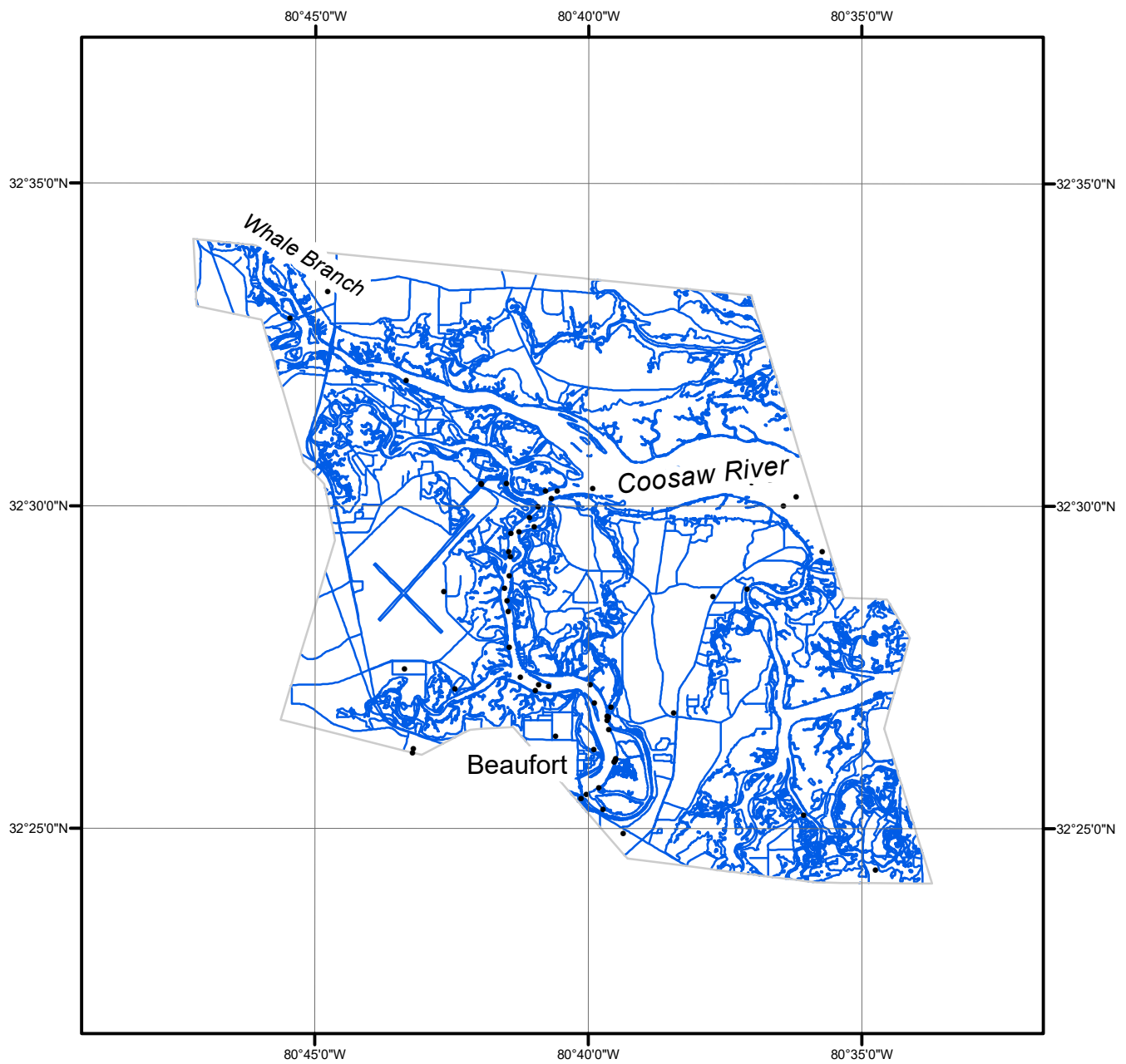
NOAA Shoreline Data Explorer

- GC11321 in shapefile format
- Metadata file for GC11321
- PCR in Adobe PDF format

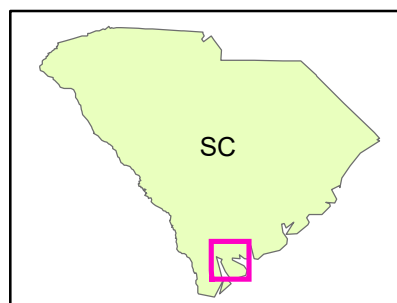
End of Report

COOSAW RIVER, LUCY POINT CREEK TO WHALE BRANCH

SOUTH CAROLINA



Overview



SC0801B

GC11321