NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT TX1105

Ports of Galveston and Texas City, Texas

Introduction

Coastal Mapping Program (CMP) Project TX1105 provides highly accurate digital shoreline data for key areas of change in the ports of Galveston and Texas City, Texas. 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 design of Project TX1105 was accomplished by the Requirements Branch (RB) of the Remote Sensing Division (RSD) in response to the need for timely updates to the NOAA Electronic Navigational Chart (ENC) series. Project requirements were initially formulated as a result of analysis conducted within the Coast and Shoreline Change Analysis Program (CSCAP), in which NOAA nautical chart products are compared to contemporary high resolution imagery in order to ascertain the need for more current shoreline data. Aerial photography was utilized for the CSCAP analysis. WorldView-2 commercial satellite imagery, later obtained from the National Geospatial-Intelligence Agency (NGA) for other purposes, revealed further shoreline changes within the project area, and was therefore used to augment this project. A Chart Evaluation File (CEF) was forwarded to the Applications Branch (AB) of RSD once the change analysis was complete. Refer to the RB CSCAP memorandum of June 20, 2011 for details of the chart comparison process.

Field Operations

Field operations consisted of the collection of static and kinematic Global Positioning System (GPS) data and Inertial Measurement Unit (IMU) data, and the acquisition of aerial imagery. Aerial survey operations were conducted on March 10, 2011 with the NOAA King Air aircraft. Five strips of digital RGB (color) images were acquired with an Applanix DSS-439 medium format digital camera at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 m. Although imagery was not acquired in strict coordination with local tides, the goal was to collect all imagery below Mean High Water (MHW).

GPS Data Reduction

GPS and IMU data was collected and processed to yield precise positions and orientations of camera centers for use in the aerotriangulation phase. The airborne kinematic data were collected using an Applanix POS/AV510 GPS/IMU System. This data was processed in April 2011 using POSPac (ver. 5.3.0) software. For further information refer to the Airborne Positioning and Orientation Reports (APOR) on file with other project data within the AB Project Archive.

Aerotriangulation

Routine softcopy aerotriangulation methods were applied to establish the 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 initiated by RSD personnel in January 2013 utilizing a Digital Photogrammetric Workstation (DPW), which is a configuration of computer hardware, modular software components and other associated peripheral devices. The aerial images were measured and adjusted as one block using BAE Systems' Multi-Sensor Triangulation (MST) module within SOCET SET (version 5.6) photogrammetric software. Upon successful completion of the aerotriangulation process, the MST 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 0.5 meters for the block based on a 95% confidence level. An Aerotriangulation Report was written and is on file with other project data within the RSD Applications Branch (AB) Project Archive.

The commercial satellite imagery was not included in the block adjustment described above. It was determined that rigorous refinement of the vendor's georeferencing was not necessary since the imagery compared favorably spatially with sources of control used to check its geolocation, and since the vendor provided an acceptable accuracy assessment for their imagery. The accuracy reported by the vendor is 5.0 m at the 90% confidence level (CE90). The reported accuracy is exclusive of viewing geometry and terrain distortions.

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).

Compilation

The data compilation phase of this project was accomplished by RSD in February 2013. Digital mapping was performed using a DPW in conjunction with the SOCET SET (version 5.6.0) Feature Extraction software module. Feature identification and attribution within the Geographic Cell (GC) were based on image analysis of the digital photographs, satellite 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 TX1105 were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features compiled from the DSS images have a horizontal accuracy of 1.0 meters at the 95% confidence level. This predicted accuracy of compiled, well-defined points is derived by doubling the circular error value computed from the aerotriangulation statistics. Cartographic features extracted from the WorldView-2 images were compiled to meet a horizontal accuracy of 5.7 meters, based on the vendor reported CE90 accuracy converted to the 95% confidence level (CE95).

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

Aerial Imagery					
Date	**Time (UTC)**	**Roll Number**	**Photo Numbers**	**GSD (nominal)**	**Tide Level***
3/10/2011	18:40 – 18:43	11NC05	1747-1762	0.35 m	0.1 m
3/10/2011	18:45 – 18:46	11NC05	1763-1771	0.35 m	0.1 m
3/10/2011	18:50 – 18:51	11NC05	1772-1779	0.35 m	0.1 m
3/10/2011	18:56 – 18:58	11NC05	1780-1793	0.35 m	0.1 m
3/10/2011	19:05 – 19:06	11NC05	1794-1803	0.35 m	0.1 m
Satellite Imagery					
Date	**Time (UTC)**	**Source File Name**		**Resolution**	**Tide Level***
8/4/2012	17:17	WV021200012AUG04171744-P1BS-052767015010_01_P007		0.5 m	0.4 m
11/15/2012	17:20	WV021200012NOV15172023-P1BS-052835405010_04_P007		0.5 m	-0.1 m

* Tide levels are given in meters above MLLW and are based on actual observations recorded by the NOS gauge at Galveston Pier 21, in Galveston, TX at the time of photography. The elevation of the MHW tidal datum at the tide gauge is equal to 0.4 meters above MLLW.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of AB. The final QC review was completed in February 2013. The review process included analysis of the 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 software. The entire suite of project products was evaluated for compliance to CMP requirements.

End Products and Deliverables

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

RSD Applications Branch Archive
- Hardcopy of the Aerotriangulation Report
- Hardcopy of the Project Completion Report (PCR)
- Page size graphic plot of GC10956 file contents, attached to PCR
- Hardcopy of the CSCAP evaluation memorandum

Remote Sensing Division Electronic Data Library
- GC10956 in shapefile format
- Digital copy of the PCR in Adobe PDF format
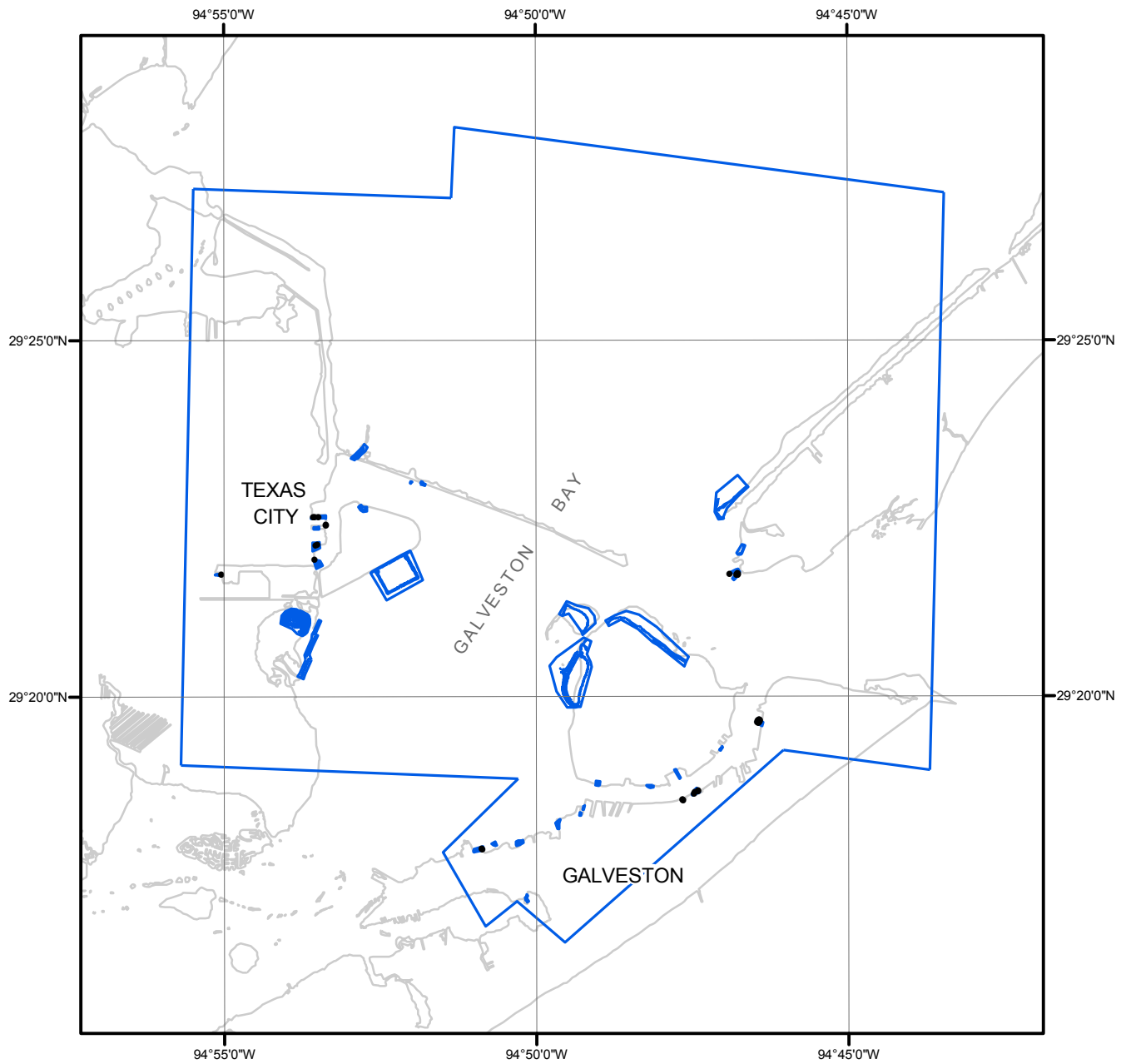- CEF in shapefile format

NOAA Shoreline Data Explorer
- GC10956 in shapefile format
- Metadata file for GC10956
- Digital copy of the PCR in Adobe PDF format

End of Report

PORTS OF GALVESTON AND TEXAS CITY

TEXAS

94°55'0"W 94°50'0"W 94°45'0"W

29°25'0"N 29°25'0"N

TEXAS
CITY

GALVESTON BAY

29°20'0"N 29°20'0"N

GALVESTON

94°55'0"W 94°50'0"W 94°45'0"W

Overview

TX

TX1105

GC10956