

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT CA1213B-CM-N

San Francisco, California

Introduction

NOAA Coastal Mapping Program (CMP) Project CA1213B-CM-N provides a highly accurate dataset of coastal feature data of the city of San Francisco from Seal Rocks and Point Lobos on the ocean side, around to Brisbane, about a mile south of Candlestick Point on the bay side. Project CA1213B-CM-N is a subproject of a larger project, CA1213-CM-N, which covers the southern and eastern portions of San Francisco Bay from the Golden Gate to Carquinez Strait. 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

Photographic mission instructions for CA1213-CM-N were formulated by the Requirements Branch (RB) of the Remote Sensing Division (RSD) following the guidelines of RSD's Photo Mission Standard Operating Procedures. The instructions discussed the project's purpose, geographic area of coverage, scope and priority, image requirements, Global Positioning System (GPS) data collection procedures and guidelines, instructions for data recording and handling, and mission communication protocols. RB created a Project Layout Diagram, flight maps and input files for the aircraft flight management system.

Field Operations

Field operations for CA1213-CM-N consisted of the collection of static and kinematic GPS data and Inertial Measurement Unit (IMU) data, and the acquisition of digital aerial imagery. Aerial survey operations were conducted in April and August, 2013 with the NOAA King Air aircraft (N68RF). Thirty-four (34) flight lines each of natural color and near-infrared (NIR) imagery were acquired concurrently using an Applanix DSS-439 dual head digital camera system (two 60 mm lenses) in coordination with both the MLLW and MHW tide levels, for a total of 136 lines of images. All imagery was acquired at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 meters.

GPS Data Reduction

GPS/IMU data was collected and processed by RSD personnel to yield precise positions and orientations of camera centers for application as photogrammetric control in the aerotriangulation phase of project completion. 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 airborne kinematic data was processed in May and November 2013 using Applanix POSPac MMS (ver. 6.1.0) software. For further information refer to the Airborne Positioning and Orientation Report (APOR) that is on file with

other project data within the RSD Electronic Data Library.

Aerotriangulation

Routine softcopy aerotriangulation 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 RSD Applications Branch (AB) personnel in January 2016 utilizing a Digital Photogrammetric Workstation (DPW), which is a configuration of computer hardware, modular software components, and other associated peripheral devices. For project CA1213B-CM-N, a subset of imagery from six flight lines each of MLLW color, MLLW NIR, and MHW NIR (for a total of 18 lines of images) were measured and adjusted as a single block using the Multi-Sensor Triangulation (MST) module of BAE Systems SOCET SET (v5.6.0) software. Upon successful completion of this process, the MST module provided the standard deviations for each aerotriangulated ground point, which were used to compute a predicted horizontal circular error of 0.43 meters based on a 95% confidence level. An Aerotriangulation 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 accomplished by RSD Applications Branch (AB) personnel in March 2016. Digital mapping was performed using the Feature Extraction software module within SOCET SET (ver. 5.6.0). Feature identification and attribution within the GC were based on image analysis of the aerial imagery and information extracted from the largest scale NOAA nautical charts 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 CA1213B-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 0.9 meters at the 95% confidence level. This predicted accuracy of well-defined points measured during the compilation phase was derived by doubling the circular error computed from the aerotriangulation statistics.

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

Date	Time (UTC)	Color Imagery		NIR Imagery		Tide Level*
		Roll	Images	Roll	Images	
04/17/2013	19:10 – 19:12	13NC13	2586 – 2603	13NR09	1816 – 1833	0.0
04/17/2013	19:17 – 19:20	13NC13	2604 – 2622	13NR09	1834 – 1852	0.0
04/17/2013	20:08 – 20:09	13NC13	2749 – 2755	13NR09	1979 – 1985	0.1
04/17/2013	20:14 – 20:15	13NC13	2756 – 2763	13NR09	1986 – 1993	0.2 – 0.1
04/18/2013	19:59 – 20:02	13NC14	2913 – 2932	13NR10	2143 – 2162	0.1
04/18/2013	20:17 – 20:20	13NC14	2946 – 2967	13NR10	2176 – 2197	0.1

04/23/2013	17:43 – 17:46	MHW Color not used	13NR13	2743 – 2762	1.6 – 1.4
04/23/2013	17:50 – 17:53	MHW Color not used	13NR13	2763 – 2784	1.4 – 1.6
08/24/2013	23:28 – 23:30	MHW Color not used	13NR51	11196 – 11213	1.8 – 2.0
08/24/2013	23:34 – 23:36	MHW Color not used	13NR51	11214 – 11232	2.0 – 1.7
08/26/2013	23:14 – 23:15	MHW Color not used	13NR53	11457 – 11464	2.0 – 2.1
08/26/2013	23:23 – 23:24	MHW Color not used	13NR53	11494 – 11500	2.1

* Tide levels are given in meters above MLLW and were calculated using Pydro software with a TCARI grid referenced to verified water level observations at the time of photography from NOS gauges in the vicinity of the project. The elevation of the MHW tidal datum in the project area varies between 1.47 – 1.97 m. 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 April 2016. 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 10.4 software. All project data was evaluated for compliance to CMP requirements.

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

- 18649, Entrance to San Francisco Bay, 1:40,000, 68th Ed., Dec. 2013
- 18650, San Francisco Bay, 1:20,000, 57th Ed., Dec. 2013
- 18651, San Francisco Bay, 1:40,000, 45th 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

- Project database
- Airborne Positioning and Orientation Reports (APOR)
- Aerotriangulation Report
- GC11192 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

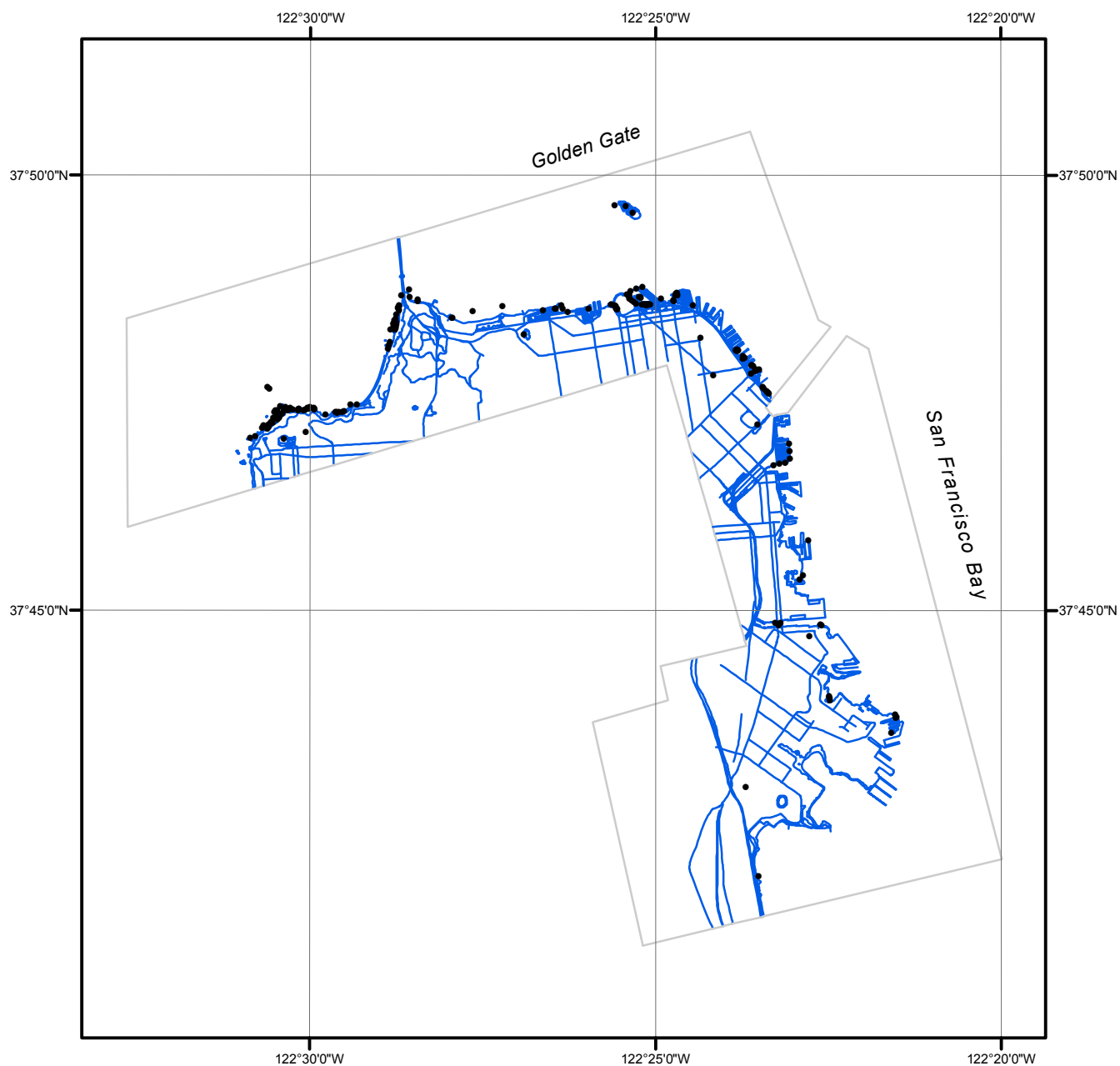
NOAA Shoreline Data Explorer

- GC11192 in shapefile format
- Metadata file for GC11192
- Digital copy of the PCR in Adobe PDF format

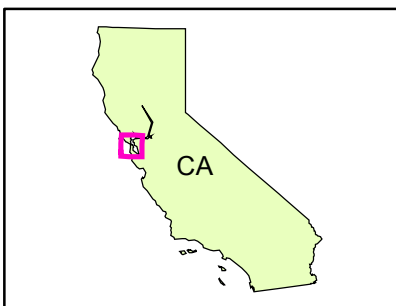
End of Report

SAN FRANCISCO

CALIFORNIA



Overview



CA1213B-CM-N

GC11192