NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT ME1102B-CM-N

Casco Bay, Maquoit Bay to Small Point Harbor, Maine

Introduction

NOAA Coastal Mapping Program (CMP) Project ME1102B-CM-N provides highly accurate digital shoreline data for a portion of Casco Bay, extending from Maquoit Bay to Small Point Harbor, in Maine. Project ME1102B-CM-N is a subproject of a larger project ME1102-CM-N, which extends from Cape Elizabeth on Casco Bay to Pemaquid Point, in Maine. 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 the photographic mission instructions for this project following the guidelines of the Photo Mission Standard Operating Procedures. 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 phase, WorldView commercial satellite imagery was obtained in order to provide continuity of compiled features between adjacent projects where a gap in imagery coverage existed. Two orthorectified, pan-sharpened images were adjusted to match the positioning of feature data for ME1102B-CM-N, and a very small number of features extended to the project limit.

Field Operations

The field operations consisted of the collection of static and kinematic GPS data and Inertial Measurement Unit (IMU) data, and the acquisition of digital aerial imagery. The photographic mission operations were conducted in October 2011 and June 2012 with the NOAA King Air (N68RF) aircraft. Project imagery included natural color (RGB) and near-infrared (NIR) imagery acquired concurrently using an Applanix DSS-439 dual-head digital camera system in coordination with both MLLW and MHW tide levels.

Twenty-six flight lines were acquired for ME1102-CM-N, though only eleven flight lines were utilized in full or in part for the completion of subproject ME1102B-CM-N. All imagery covering this subproject was acquired at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 meters.

Direct Georeferencing Data Processing

GPS/IMU data for project ME1102B-CM-N 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 airborne kinematic data was processed between November 2011 and August 2012 using POSPAC (ver. 5.3.3 and 5.4.0) and POSPac MMS (ver. 5.1.0 and 6.1.0) GPS/IMU software. For further information refer to the Airborne Positioning and Orientation Reports (APOR) on file with other project data within the RSD Electronic Data Library.

The processed GPS/IMU data were used to derive precise exterior orientation (EO) values of the camera centers required for digital feature extraction. The predicted horizontal accuracy of the imagery was determined by propagating sensor EO and image measurement uncertainties through the photogrammetric collinearity equations using an Exterior Orientation Total Propagated Uncertainty (EO-TPU) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level was calculated to be 1.4 meters for all the imagery used to compile data for ME1102B-CM-N.

NGS third order geodetic control points were used to test the horizontal integrity of the DG data. All stereo-models were examined and found to have acceptable levels of parallax for mapping purposes.

Compilation

The data compilation phase of this project was accomplished by a member of the Applications Branch (AB) of RSD in June 2020. Digital mapping was performed using the Feature Extraction software module within BAE's SOCET SET (ver. 5.6) photogrammetric software. 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 chart 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 ME1102B-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 2.8 meters at the 95% confidence level. This predicted accuracy of compiled well-defined points is derived by doubling the horizontal uncertainty calculated from the EO-TPU tool.

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

Date	Time (GMT)	Flight Line	Color Imagery		NIR Imagery		Tide Level*
			Roll	Images	Roll	Images	
10/09/2011	13:50 – 13:52	50-005	11NC73	22823 – 22833	11NR50	13450 – 13460	2.8

10/09/2011	14:07 – 14:10	50-006	11NC73	22905 – 22924	11NR50	13532 – 13551	2.8
10/09/2011	14:15 – 14:19	50-007	11NC73	22925 – 22950	11NR50	13552 – 13577	2.8
10/09/2011	14:31 – 14:35	50-008	11NC73	23005 – 23032	11NR50	13632 – 13659	2.8
10/09/2011	14:40 – 14:44	50-009	11NC73	23033 – 23059	11NR50	13660 – 13686	2.7 – 2.8
10/09/2011	14:57 – 15:01	50-010	11NC73	23114 – 23141	11NR50	13741 – 13768	2.6 – 2.7
10/10/2011	13:23 – 13:27	50-011	11NC74	23142 – 23165	11NR40	12851 – 12874	2.6
10/10/2011	13:32 – 13:35	50-012	11NC74	23166 – 23182	11NR40	12875 – 12891	2.6
10/10/2011	13:40 – 13:42	50-013	11NC74	23183 – 23199	11NR40	12892 – 12908	2.6 – 2.7
10/10/2011	13:47 – 13:49	50-014	11NC74	23200 – 23216	11NR40	12909 – 12925	2.7
10/10/2011	13:54 – 13:55	50-015	11NC74	23217 – 23228	11NR40	12926 – 12937	2.7
06/10/2012	13:55 – 13:58	50-011	12NC39	10361 – 10383	12NR24	05549 – 05571	0.1
06/10/2012	14:04 – 14:06	50-012	12NC39	10384 – 10400	12NR24	05572 – 05588	0.1
06/10/2012	14:12 – 14:14	50-013	12NC39	10401 – 10417	12NR24	05589 – 05605	0.1
06/10/2012	14:20 – 14:22	50-014	12NC39	10418 – 10434	12NR24	05606 – 05622	0.1
06/10/2012	14:28 – 14:30	50-015	12NC39	10435 – 10446	12NR24	05623 – 05634	0.1
06/24/2012	12:16 – 12:20	50-010	12NC42	10853 – 10880	12NR27	06041 – 06068	0.2
06/24/2012	12:24 – 12:28	50-009	12NC42	10881 – 10907	12NR27	06069 – 06095	0.1 – 0.2
06/24/2012	12:40 – 12:43	50-008	12NC42	10962 – 10989	12NR27	06150 – 06177	0.1
06/24/2012	12:48 – 12:51	50-007	12NC42	10990 – 11015	12NR27	06178 – 06203	0.1
06/24/2012	13:03 – 13:06	50-006	12NC42	11074 – 11093	12NR27	06262 – 06281	0.1
06/24/2012	13:10 – 13:11	50-005	12NC42	11094 – 11104	12NR27	06282 – 06292	0.1

Satellite Imagery

Date	Time (GMT)	Sensor	Source File ID	Tide Level†
07/07/2014	16:06	WorldView-2	14JUL07160618-S3DS-013274354010_01_P001.TIF	0.5
10/21/2019	15:44	WorldView-3	20191021_WV03_ORI_R1C1.jp2	0.7

* 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 2.79 – 2.85 m. above MLLW.

† Tide levels are given in meters above MLLW and are based on actual observations at the NOS gauge at Portland ME at the time of image acquisition, with offsets applied to the project area.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by senior CMP personnel. The final QC review was completed in July 2020. The review process included analysis of the DG 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 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:

13290, Casco Bay, 40th Ed., Feb. 2016
13293, Damariscotta, Sheepscot and Kennebec Rivers, 36th Ed., Mar. 2016

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 Reports (APOR)
- Project database
- GC11413 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

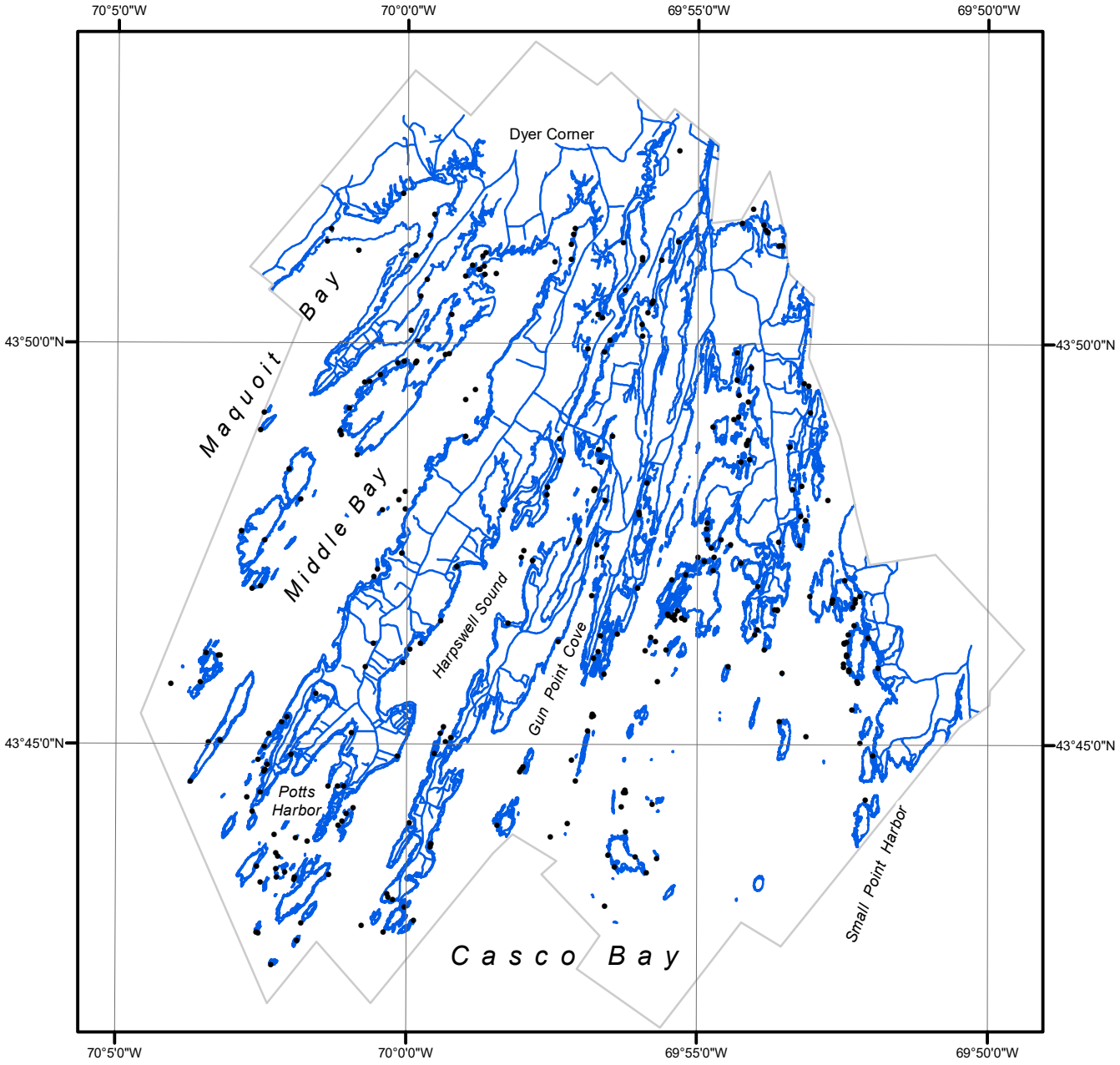
NOAA Shoreline Data Explorer

- GC11413 in shapefile format
- Metadata file for GC11413
- Copy of PCR in Adobe PDF format

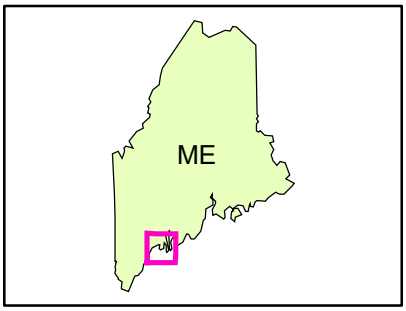
End of Report

CASCO BAY, MAQUOIT BAY TO SMALL POINT HARBOR

MAINE



Overview



ME1102B-CM-N

GC11413