

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT ME1102C-CM-N

Gulf of Maine, Cape Small to Pemaquid Point, Maine

Introduction

NOAA Coastal Mapping Program (CMP) Project ME1102C-CM-N provides highly accurate digital shoreline data for a portion of the Gulf of Maine coast from Cape Small to Pemaquid Point, including Sheepscot Bay, Booth Bay, and Johns Bay. Project ME1102C-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 Procedure. 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.

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-four flight lines were acquired for ME1102-CM-N, though only eight flight lines were utilized in full or in part for the completion of subproject ME1102C-CM-N. All imagery 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 ME1102C-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 ME1102-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 April 2019. 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 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 ME1102C-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 (UTC)	Flight Line	Color Imagery		NIR Imagery		Tide Level*
			Roll	Images	Roll	Images	
10/10/2011	14:01 – 14:05	50-016	11NC74	23229 – 23260	11NR40	12938 – 12969	2.7
10/10/2011	14:10 – 14:14	50-017	11NC74	23261 – 23291	11NR40	12970 – 13000	2.7 – 2.8
10/10/2011	14:20 – 14:25	50-018	11NC74	23292 – 23325	11NR40	13001 – 13034	2.7 – 2.8
10/10/2011	14:31 – 14:37	50-019	11NC74	23326 – 23367	11NR40	13035 – 13076	2.8
10/10/2011	14:42 – 14:48	50-020	11NC74	23368 – 23412	11NR40	13077 – 13121	2.7 – 2.8

10/10/2011	14:54 – 14:57	50-021	11NC74	23413 – 23441	11NR40	13122 – 13150	2.7
10/10/2011	15:03 – 15:06	50-022	11NC74	23442 – 23464	11NR40	13151 – 13173	2.7
10/10/2011	15:12 – 15:15	50-023	11NC74	23465 – 23490	11NR40	13174 – 13199	2.7
10/10/2011	15:20 – 15:23	50-024	11NC74	23491 – 23513	11NR40	13200 – 13222	2.7
06/10/2012	14:37 – 14:42	50-016	12NC39	10447 – 10478	12NR24	05635 – 05666	0.1
06/10/2012	14:48 – 14:52	50-017	12NC39	10479 – 10509	12NR24	05667 – 05697	0.1
06/10/2012	14:58 – 15:03	50-018	12NC39	10510 – 10543	12NR24	05698 – 05731	0.1
06/10/2012	15:09 – 15:14	50-019	12NC39	10544 – 10585	12NR24	05732 – 05773	0.1 – 0.2
06/10/2012	15:19 – 15:25	50-020	12NC39	10586 – 10630	12NR24	05774 – 05818	0.2
06/30/2012	17:38 – 17:42	50-021	12NC43	11285 – 11313	12NR28	06473 – 06501	0.2
06/30/2012	17:48 – 17:51	50-022	12NC43	11314 – 11336	12NR28	06502 – 06524	0.2
06/30/2012	17:57 – 18:01	50-023	12NC43	11337 – 11362	12NR28	06525 – 06550	0.2
06/30/2012	18:07 – 18:10	50-024	12NC43	11363 – 11385	12NR28	06551 – 06573	0.2

* 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 2.74 – 2.83 m. above MLLW.

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 April 2019. 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. 10.6.1) 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
- 13295, Kennebec and Sheepscot River Entrances, 12th Ed., May 2013
- 13296, Boothbay Harbor to Bath, 26th Ed., Jan. 2012
- 13301, Muscongus Bay, 21st Ed., Aug. 2011

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

- GC11414 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

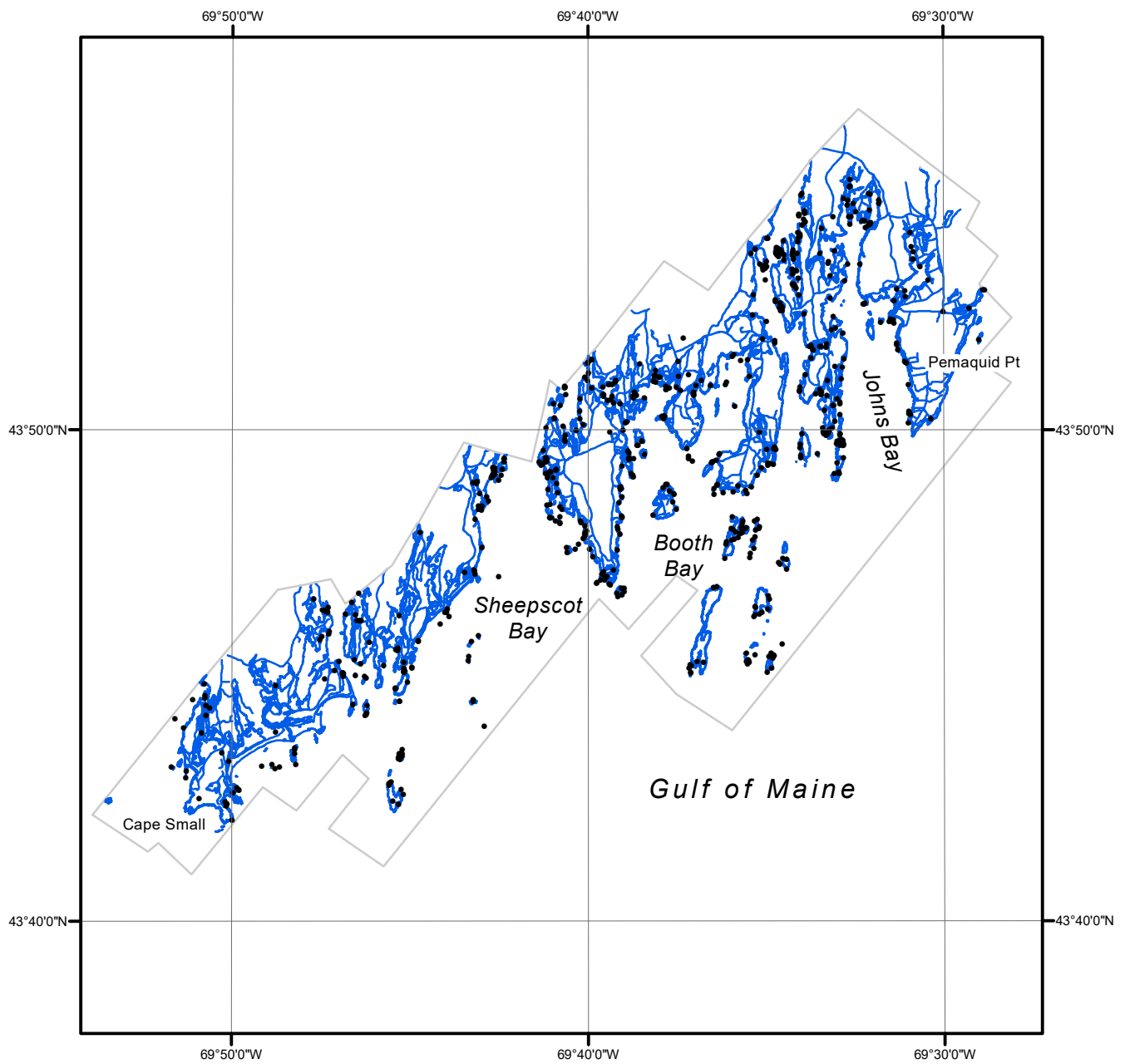
NOAA Shoreline Data Explorer

- GC11414 in shapefile format
- Metadata file for GC11414
- Copy of PCR in Adobe PDF format

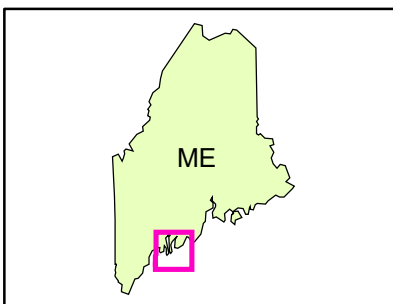
End of Report

GULF OF MAINE, CAPE SMALL TO PEMAQUID POINT

MAINE



Overview



ME1102C-CM-N

GC11414