NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT NJ1302-TB-N

Little Egg Inlet, New Jersey

Introduction

NOAA Coastal Mapping Program (CMP) Project NJ1302-TB-N provides a highly accurate database of new digital shoreline data for Little Egg Inlet, New Jersey. The project area includes Little Egg Inlet as well as small tributaries surrounding it. 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, imagery and lidar data acquisition requirements, orthophoto creation, tide-coordination, Global Positioning System (GPS) and Inertial Measurement Unit (IMU) 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

The field operations consisted of acquisition of topobathy lidar data, digital aerial imagery, static GPS data, and kinematic GPS and IMU data. Static GPS data were collected to support aerial data acquisition and processing operations, as well as to assess the accuracy of post-processed lidar data.

Seventy Three (73) lines of Topographic/Bathymetric (topobathy) lidar were acquired on September 19th and 20th of 2013 using a Riegl VQ820G LIDAR system on board the NOAA Twin Otter aircraft (N46RF). The topobathy lidar data were collected within a two hour time window of the Mean Lower Low Water (MLLW) tide stage at a nominal altitude of 1,000 feet with a 50% swath overlap resulting in a single swath point density of eighteen points per square meter.

Seventy Three (73) lines of natural color digital aerial imagery (5136 images) were collected on September 19th and 20th of 2013 using the single cam Applanix Digital Sensor System 439 (DSS439) onboard the Twin Otter aircraft (N46RF). The imagery was collected within a two hour time window of the MLLW tide stage at a nominal altitude of 1,000 feet with a ground

sample distance (GSD) of 0.04m. Due to camera shutter cycle time restrictions at this low altitude, the endlap for the imagery was set to 20%, thus stereo-photo coverage was not possible.

For both acquisitions base stations were established at the Atlantic City airport (KACY) and within the project site using static GPS. Airborne kinematic GPS/IMU data were collected to determine precise sensor positions for both the lidar and camera systems.

Check points were collected within the project area by NGS Observation and Analysis Division (OAD) personnel to validate the vertical accuracy of the lidar. Twenty-nine (29) check points were collected which yielded a vertical accuracy of 0.065 cm root mean square error (RMSE) with a standard deviation of 0.016 cm.

GPS/IMU Data Processing

GPS and IMU data were processed by RSD personnel to derive precise exterior orientation (EO) values of the camera centers required for orthorectification 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 using Applanix POSPAC (ver. 5.4) software in October of 2013.

LIDAR Data Processing

LIDAR point cloud data were processed in September 2013. Riegl RiProcess software was utilized to transform the lidar point cloud into a mapping projection, check the calibration stability, and perform refraction corrections to bathymetric returns. Terrasolid software was utilized for editing of the lidar point cloud, and for classification of water surface, erroneous returns, bathymetric surface and bare earth points. NOAA VDatum software was used to convert the vertical datum of the lidar points from NAD83 ellipsoid to local Mean High Water (MHW) and local MLLW tidal datums. GeoCue lidar processing software was used to produce bare earth MHW and MLLW digital elevation models (DEMs) at 1 meter grid resolution.

To determine accuracy the lidar point cloud was compared to higher accuracy ground control points and the morphologic slope around the derived shoreline for 785,557 sample sites in the project area (767,490 for the MHW line and 18,067 for MLLW line). Based on this assessment the MHW lidar derived shoreline vectors are tested to have a circular error at the 95% confidence level (CE95) of 2.22 meters, and the MLLW lidar derived shoreline vectors are tested to have a CE95 of 4.43 meters. The journal article “Lidar-Derived National Shoreline: Empirical and Stochastic Uncertainty Analyses” published in the Journal of Coastal Research in 2010 contains more detailed information and is on file in the RSD Project Archive.

Ortho-image Processing

The aerial images were orthorectified by RSD personnel in October 2013 using Applanix RapidOrtho software in conjunction with the EO data and a standard 30-meter United States Geological Survey (USGS) National Elevation Dataset (NED) DEM. A mosaic of the entire block of orthoimages was later created using INPHO OrthoVista software, with a GSD of 0.15 meter, and divided into 2.5 km square tiles. The horizontal accuracy of the orthomosaic image is conservatively estimated to be 0.5 meters, based on the software and methodology used.

Compilation

The data compilation phase of this project was completed in June 2015 by RSD personnel and consisted of three different methods. The MHW and MLLW shoreline vectors were delineated using the DEMs discussed above with a Raster-to-Vector script implemented within ESRI ArcGIS 10.1 software. Features which were not significantly elevated above the water level were compiled from the orthomosaics using ArcMap 10.2.2. The remaining elevated features such as bridges, landmarks and navigational aids were compiled directly from the lidar point cloud data within ArcMap 10.2.2 using the LP360 extension. Feature identification and the assignment of cartographic codes were based on image analysis of the project digital orthomosaics 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). Selected features were further modified with additional descriptive information to refine general classification.

Spatial data accuracies for Project NJ1302-TB-N were determined using the methods described above. The lidar derived MHW and MLLW features are tested to have horizontal accuracies of 2.2 meters and 4.4 meters respectively at the 95% confidence level. Cartographic features compiled from the orthomosaic image and from the lidar point cloud meet a horizontal accuracy of 1.0 meters at the 95% confidence level.

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 July 2015. The review process included 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 10.2.2 software. All project data was evaluated for compliance to CMP requirements.

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

12316, Little Egg Harbor to Cape May, 1:40,000 scale, 35th edition

End Products and Deliverables

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

RSD Applications Branch Archive

- Hardcopy of the Project Completion Report (PCR)
- Page-size graphic plot of GC11118 file contents, attached to PCR

Remote Sensing Division Electronic Data Library

- Project database
- GC11118 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

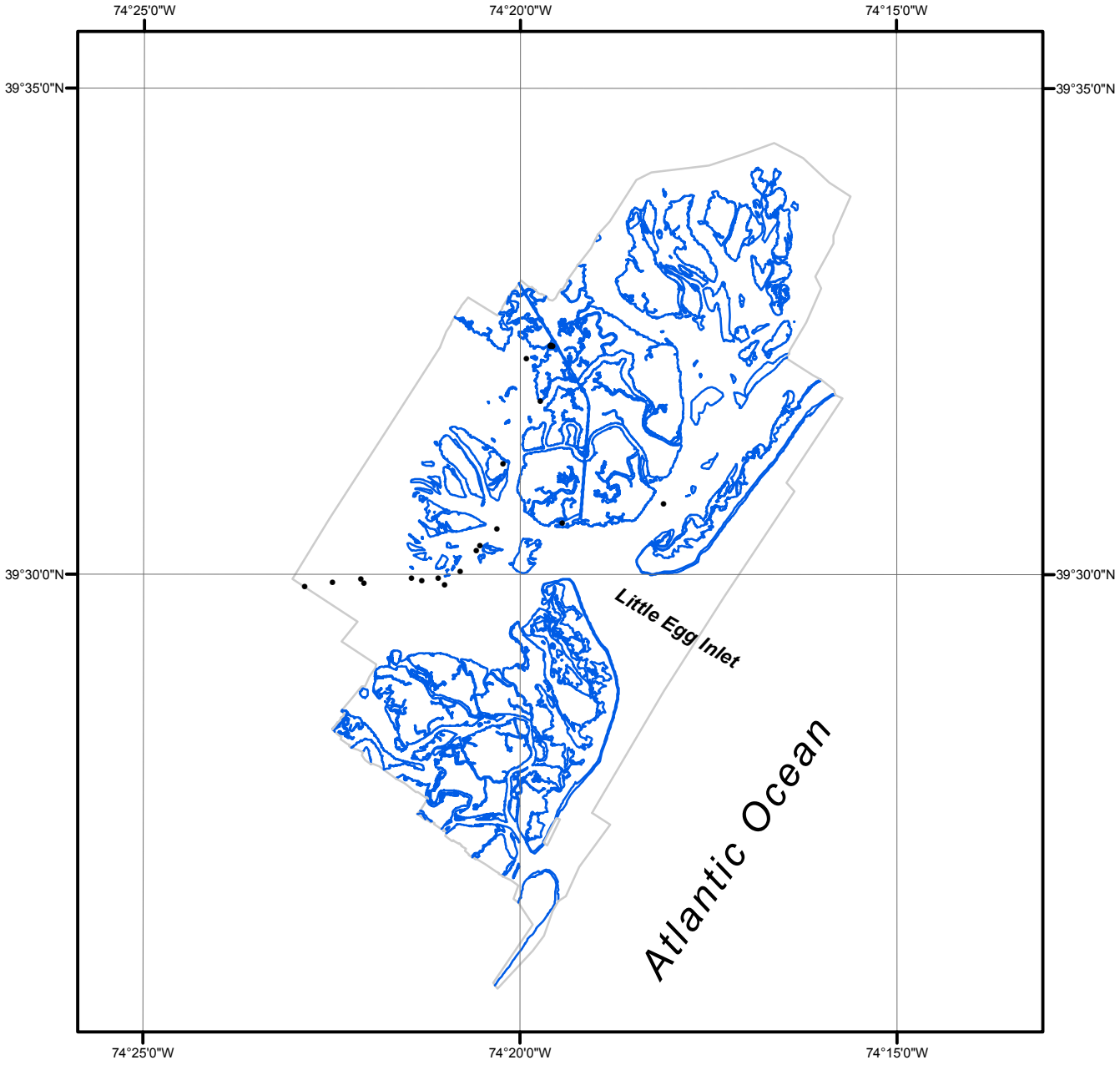
NOAA Shoreline Data Explorer

- GC11118 in shapefile format
- Metadata file for GC11118
- Digital copy of the PCR in Adobe PDF format

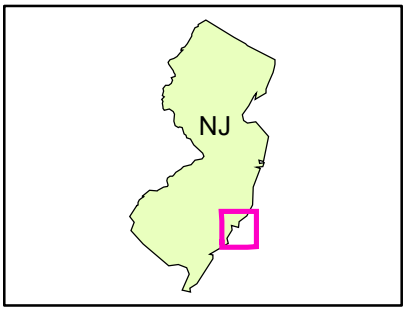
End of Report

LITTLE EGG INLET

NEW JERSEY



Overview



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