

# **NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT**

## **PROJECT NC0301**

### **OREGON INLET, NORTH CAROLINA**

#### **Introduction**

Coastal Mapping Program (CMP) Project NC0301 provides coastal zone mapping data for the Oregon Inlet vicinity. Digital cartographic feature file (DCFF) GC10552 covers the area around the Oregon Inlet vicinity from approximately three miles north on Bodie Island to approximately two and a third miles south on Hatteras Island. The DCFF may be utilized in support of the NOAA's Nautical Charting Program (NCP) and coastal zone management activities.

#### **Project Design**

This project was designed as a Response and Restoration effort within the Remote Sensing Division Research and Design Group, which assist in providing timely and accurate shorelines. The primary objective of this project was to help support safe navigation through the ever-changing inlet. Congress assigned NOAA the responsibility of helping with navigation after the United States Army Corps of Engineers' proposal for a dual jetty system was abandoned. The project goal is to provide contemporary digital cartographic data in support of a variety of applications within the NCP as well as supporting research and design initiatives. Based on an analysis of project requirements, it was determined that CMP procedures for multiple source projects would apply for this project. A one-meter ground sample distance lidar point cloud, later used to produce a five-meter ground sample distance Digital Elevation Model (DEM), acquired on June 22, 2003 was deemed appropriate to meet project requirements. Overlaying the shoreline contoured from a high resolution lidar derived DEM on a NOAA digital raster nautical chart allows for analysis of discrepancies between data sources. This effort allows the Remote Sensing Division to focus its shoreline compilation efforts where they can provide the greatest assistance to areas of need, importance, and high variability. The DEM was supplemented with 0.125 meter ground sample distance North Carolina Department Transportation (NCDOT) Orthophoto Imagery acquired March 23, 2002 and July 12, 2002. The orthophoto imagery was used for a visual comparison of stable features for a horizontal accuracy assesment. North Carolina FEMA lidar acquired January through March 2001 was also used for an inter-comparison of vertical accuracy.

## Field Operations

On June 22, 2003 the NOAA citation equipped with an Optech ALTM 2050 flew a lidar data acquisition mission over the Oregon Inlet, North Carolina vicinity. Operating at an altitude of 4,000 feet from approximately 14:52:35 to 16:07:39 (UTC), 10 strips of lidar returns were collected. The swath of the lidar was approximately 400 meters in width. Two Ashtech Z-Xtreme Global Positioning System base stations were operating during the lidar collection to assure an acceptable trajectory for accurate lidar post-processing. The acquisition of the NGS lidar elevation data occurred while the water level was near mean sea level, approximately 0.40m above Mean Lower Low Water (MLLW), see Table 1.

Table 1: Source Data for Extraction

Date	Time (GMT)	Altitude (ft)	LIDAR	Swath Width (m)	Water Level Above MLLW (m)
06/22/03	14:52:35-16:07:39	4000	Derived Digital Elevation Models (NC0301_ss1 and NC0301_ss2)	400	0.40

## Data Processing

The lidar data were processed using the Optech REALM Survey Suite version 3.1. The airborne navigation data (airborne GPS and inertial measurement unit (IMU)) were processed using Applanix's POSPAC software. Lidar point cloud editing was performed using the TerraScan Viewer software package.

In preparation for shoreline extraction the lidar point cloud was converted through VDatum from ellipsoid to orthometric heights utilizing Geoid99. Since tide model and sea surface topography fields were not currently available for VDatum in this area a local tidal datum relationship was derived. This tidal datum was calculated utilizing two outside (barrier island system) tide gauges and one inside (barrier island system) tide gauge. The outside tide gauges consisted of Duck FRF Pier, NC (Station # 8651370) and Cape Hatteras Fishing Pier, NC (Station # 8654400). The inside tide gauge that was used is Oregon Inlet Marina, Pamlico Sound, NC (Station # 8652587). A NAVD88 height of 0.24 meters was used for Mean High Water (MHW), giving a greater weight to the outside tide station gauges. The one meter post spacing of lidar returns were interpolated using an inverse distance weighting algorithm in Surfer version 8, into a DEM with a horizontal resolution of 5 meters.

## Extraction

A MHW contour was derived from the lidar derived DEM using the ESRI ArcMap software package. A high-resolution orthophoto created by the North Carolina Department of Transportation was used to help in performing the classification of the vector. Many charted discrete point features (such as aids to navigation, piles, dolphins) could not be clearly

distinguished, confidently identified, or positioned accurately, and therefore were not compiled. Also, linear features other than a MHW line were not included. Without concurrent digital imagery or intensity, lidar alone does not allow for the features to be extracted. The DCFF attribution conforms to the Coastal Cartographic Object Attribute Source Table (C-COAST), the NOAA National Geodetic Survey's attribution schema for coastal data.

Cartographic features were extracted to meet a horizontal accuracy of 3.0 meters at a 95% confidence level. This predicted accuracy of the extracted shoreline vector is a deductive estimate based on the ALTM 2050 specifications and published research of topographic lidar accuracy. Optech states an accuracy of 15 centimeters in the vertical component if lidar is acquired at an altitude of 1,200 meters. The horizontal accuracy is stated to be better than  $1/2,000 \times \text{altitude}$ . Brock et al., 2002; Brock et al., 1999; Hodgson et al., 2004; Hofton et al., 2000; Huising et al., 1998; Krabill et al., 2000; Krabill et al., 1995; Wright et al., 1997 have depicted vertical elevation accuracies of 15-30 centimeters with topographic lidar sensors.

## **Final Review**

Final office review operations were conducted after completion of the compilation phase. The process included review of the identification and attribution of cartographic features based on image analysis and criteria defined in C-COAST. Visual inspection indicated that the charted and newly compiled shorelines matched in some areas. However, there were many areas where the differences were significant enough to indicate that the new compilation provides a better representation of the shoreline than is depicted on the chart. The following NOAA nautical chart was used for chart comparison:

12205, 28<sup>th</sup> Edition; Cape Henry To Pamlico Sound Including Albemarle Sound

The last step in the quality control process was the evaluation of the DCFF contents focusing on the integrity of topology.

## **Project Products**

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

### **RSD Applications Branch Archive**

- Hard copy of the Project Completion Report (PCR)
- Hard copy graphic plot of GC10552 file contents

### **RSD Electronic Data Library**

- DCFF for GC10552 in ESRI Shapefile format
- Digital copy of the PCR in Adobe Acrobat PDF format
- Digital copy of NC0301\_ss1 and NC0301\_ss2 in ESRI Grid format

- Digital copy of NC0301\_strip01-strip10 in ascii format

#### NOAA Shoreline Data Explorer

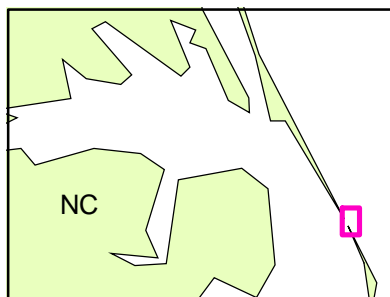
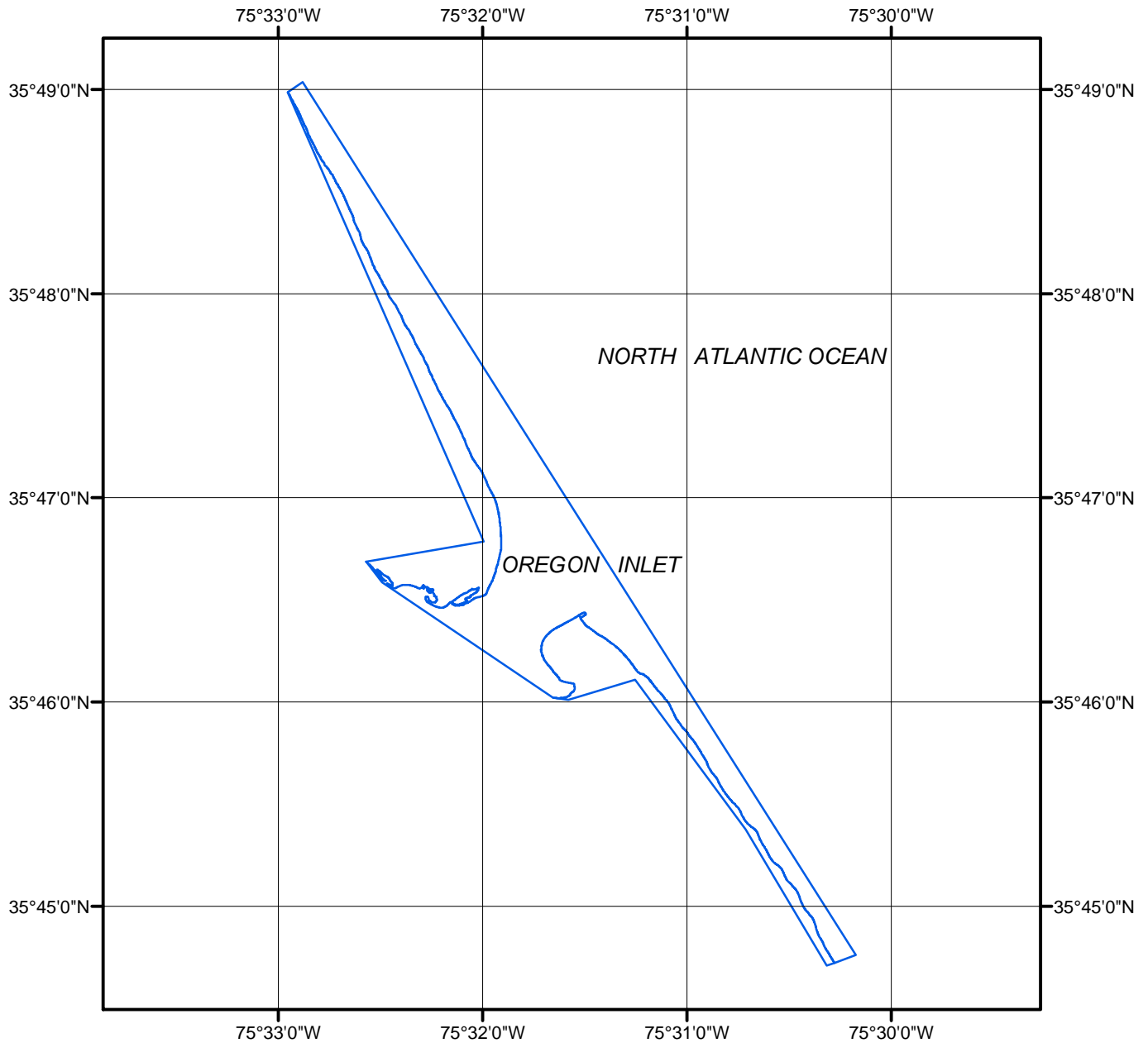
- DCFF for GC10552 in ESRI Shapefile format
- Metadata file for GC10552
- Digital copy of the PCR in Adobe Acrobat PDF format

#### References:

- Brock, J.C., Wright, C.W., Sallenger, A.H., Krabill, W.B., and Swift, R.N., 2002, Basis and Methods of NASA Airborne Topographic Mapper LIDAR Survey for Coastal Studies. *Journal of Coastal Research*, 18(1): 1-13.
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- Huising, E.J. and Pereira, L.M., 1998, Errors and accuracy estimates of laser data acquired by various laser scanning systems for topographic applications. *Photogrammetry and Remote Sensing*. 53(5): 245-261.
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- Krabill, W., 1995, Accuracy of airborne laser altimetry over the Greenland ice sheet. *International Journal of Remote Sensing*. 16(7): 1211-1222.
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End of Report

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