

# Bathymetric Digital Elevation Model of Eastern Canada: Procedures, Data Sources, and Analysis

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## Summary

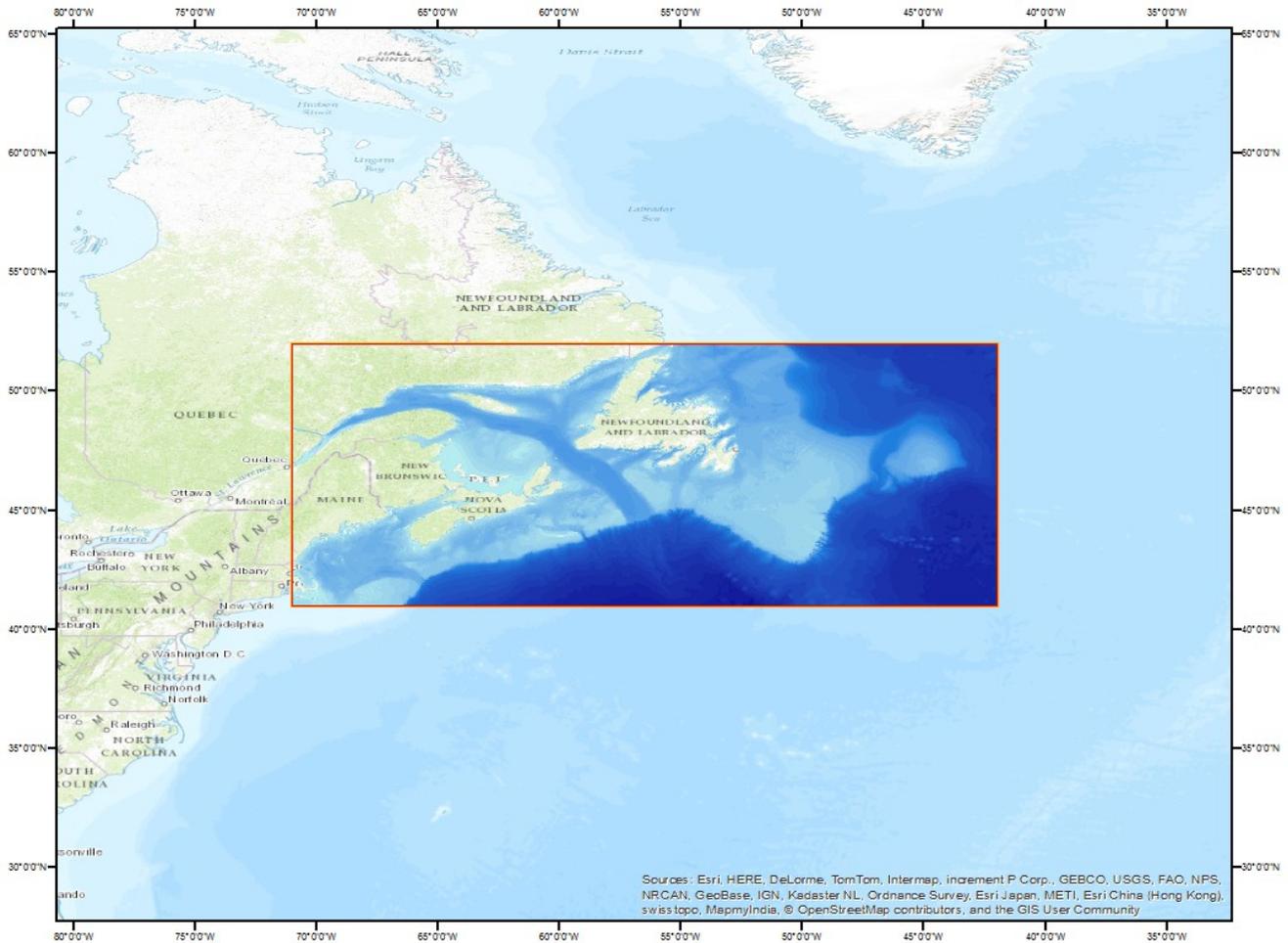
In May of 2015, NOAA's National Geophysical Data Center (NGDC) developed a bathymetric digital elevation model (DEM) of Eastern Canada for NOAA's Pacific Marine Environmental Laboratory (PMEL). The 3 arc-second DEM will be used to support improving the coastal tsunami inundation forecasts. This DEM covers the coastal area offshore Eastern Canada and North-east United States, including the Canadian Provinces of Quebec, Newfoundland & Labrador, New Brunswick and Nova Scotia, and well as the U.S. State of Maine. The extents of this DEM, procedures, data sources, and analysis are described below.

## DEM Specifications

The Eastern Canada bathymetric DEM was built to the specifications listed in Table 1. Figure 1 shows the 3 arc-second boundary in red.

**Table 1. Specifications for the Eastern Canada bathymetric DEM.**

Grid Area	Eastern Canada
Coverage Area	-71° to -42° W, 41° to 52° N
Coordinate System	Geographic decimal degrees
Horizontal Datum	World Geodetic System 1984 (WGS 84)
Vertical Datum	Mean Sea Level (MSL)
Vertical Units	Meters
Cell Size	3 arc-seconds
Grid Format	ASCII raster grid



**Figure 1. Map image of the DEM boundary for the Eastern Canada bathymetric DEM in red.**

## Data Sources and Processing

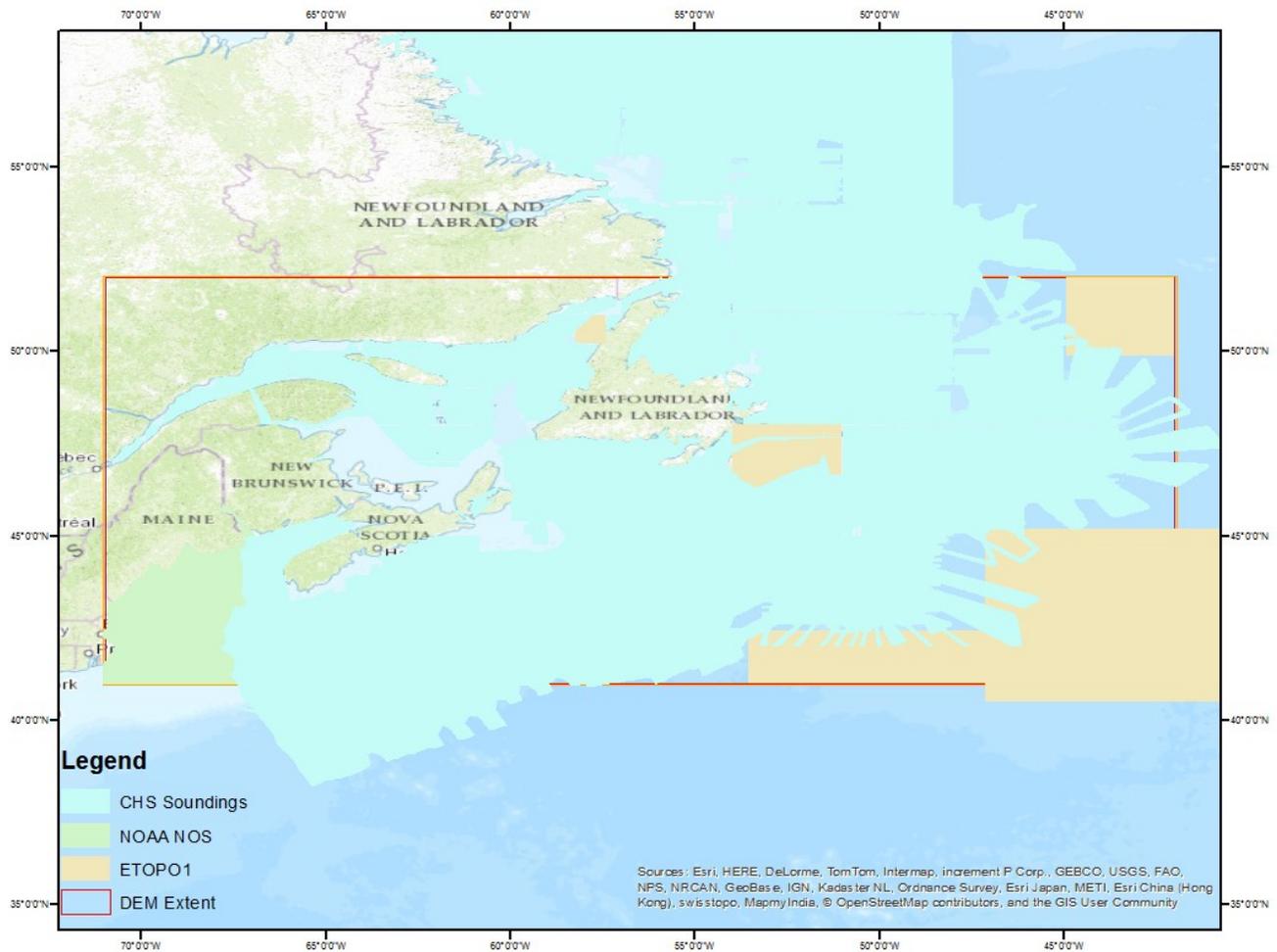
The digital coastline used in developing the Eastern Canada DEM was generated by editing the Global Self-consistent, Hierarchical, High-resolution Geography Database (GSHHG) shoreline based on the ESRI world imagery layer. The digital coastline was converted into a polygon for use in masking topography and eliminating interpolated data.

Bathymetry data used in the compilation of the Eastern Canada DEM included sounding data from NOAA agencies and the Canadian Hydrographic Service (CHS) and completed datasets from NGDC (Table 2 and Figure 2).

The bathymetric data were transformed to WGS 84 and retained their original vertical datum of mean lower low water (MLLW) or mean sea level (MSL) prior to DEM development. Source elevation data were not converted to a common vertical datum due to the large cell size of the DEM (3 arc-second; ~90 meters). This means that the vertical uncertainty of the DEM elevations for a grid cell exceeds the differences between vertical datums (less than 3 meters).

**Table 2: Bathymetric Data Sources used in compiling the Eastern Canada DEM.**

<i>Source</i>	<i>Date</i>	<i>Data Type</i>	<i>Spatial Resolution</i>	<i>Horizontal Datum</i>	<i>Vertical Datum</i>
NGDC	2008	ETOPO1 Global DEM	1 arc-minute	WGS 84 Geographic	MSL
Canadian Hydrographic Service (CHS)	N/A	Multibeam Swath Sonar	1 meter to 3 arc-seconds	WGS 84 Geographic	MSL
NOAA NOS	1887 - 2013	Hydrographic Survey Soundings	1 meter to several kilometers	NAD 1983 Geographic	Mean Lower Low Water



**Figure 2. Source and coverage datasets used to compile the Eastern Canada DEM.**

## **DEM Development**

After the data were transformed to common horizontal datums, the data were reviewed for consistency and errors using ESRI ArcMap and Applied Imagery QT Modeler. Where more recent, higher resolution data existed, older data were superseded. In some areas, older multibeam data were retained as newer overlapping data contained errors during data acquisition. The edited and evaluated data were then converted to ASCII xyz format using GDAL then gridded at 3 arc-second using GMT's 'surface' tool to generate a bathymetric surface which provided full data coverage of the DEM area. The surface was then clipped using the digital coastline to create the final bathymetric DEM.

## **DEM Analysis**

Recommendations to improve the Eastern Canada 3 arc-second DEM are listed below:

- Integrate near shore hydrographic survey data for coastal areas in the DEM.
- Conduct deep-water multibeam surveys to replace global datasets.

## **Acknowledgment**

The authors would like to thank Jonathan Griffin, Frederic Lavoie, Carrie Brayall and René-Claude Bérubé of the Canadian Hydrographic Service for providing data used in developing the Eastern Canada bathymetric DEM.

## **Reference**

Amante, C. and B. W. Eakins, ETOPO1 1 Arc-Minute Global Relief Model: Procedures, Data Sources and Analysis. NOAA Technical Memorandum NESDIS NGDC-24, 19 pp, March 2009.

Wessel, P., and W. H. F. Smith, A Global Self-consistent, Hierarchical, High-resolution Shoreline Database, *J. Geophys. Res.*, 101, #B4, pp. 8741-8743, 1996.