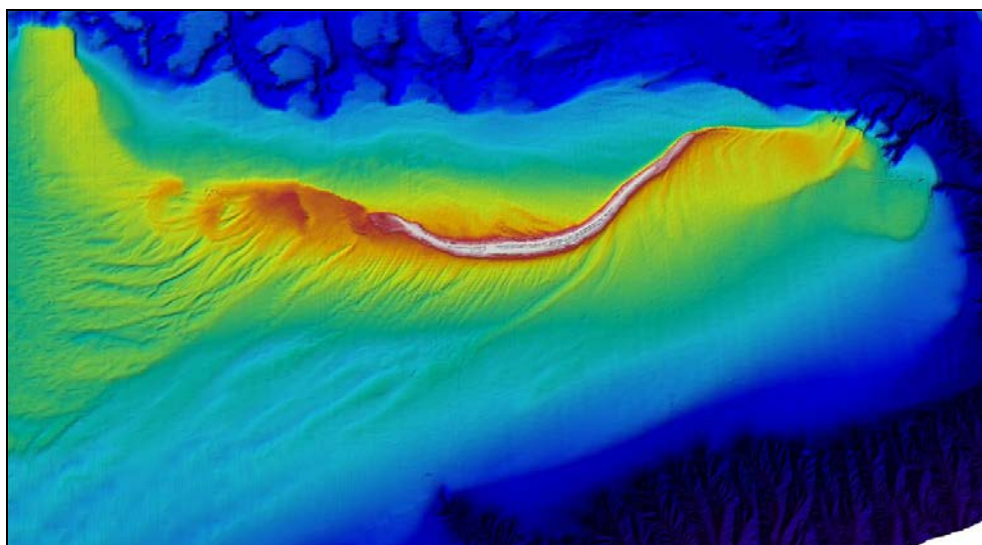




**GEOLOGICAL SURVEY OF CANADA  
OPEN FILE 5348**

**Digital Elevation Model (DEM) of Sable Island Bank  
and adjacent areas**

**K.J. Webb and E.L. King**



**2014**



Natural Resources  
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**K.J. Webb<sup>1</sup> and E.L. King<sup>2</sup>**

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**2014**

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Publications in this series have not been edited; they are released as submitted by the author.

## **Introduction**

This product contains a Digital Elevation Model (DEM) and corresponding bathymetric contours for Sable Island Bank and adjacent continental slope and shelf basins, including The Gully. The goal for this product was to incorporate all possible resolutions that encompass the Sable Island Bank and adjacent areas into one complete multi-resolution DEM. The best, most accessible bathymetry product is foundation data for a wide variety of end-users; it will form part of the foundation data for a surficial geological GSC “A-series” map of the bank.

The digital elevation model consists of a sampled array of depth soundings of irregularly spaced water depth values that have been primarily derived from the Canadian Hydrographic Service (CHS) fieldsheets as well as multibeam bathymetric data gathered by Geological Survey of Canada – Atlantic. Multibeam coverage includes; the continental slope area, The Gully area (Marine Protected Area), and six other smaller surveys (Panuke-Cohasset, South Sable, South Venture, East Bar, West Bar, and Canyon-49 on the west flank of The Gully).

## **Usage Disclaimer**

The gridding and smoothing of both the DEM grid and the contour derivatives DO NOT conform to CHS standards. They are for morphological and illustrative purposes only and are not to be used for navigational purposes.

## **Slope multibeam data collection**

The slope-situated multibeam data were collected during two surveys; a deep water survey using a Simrad EM 300 system and a shallow water survey using a Simrad EM 1002 system which together covered an area of ~22 000 km<sup>2</sup> on the Scotian Slope, from 100 m to 3900 m water depth (Campbell et al., 2006).

### *Deep-water survey (700 m to 3900 m water depth):*

The deep-water multibeam survey was conducted by C&C Technologies during May 18<sup>th</sup> to June 20<sup>th</sup>, 2000. The survey was coordinated by the Geological Survey of Canada in collaboration with several industry partners (Pickrill et al., 2001). It utilized a Simrad EM300 multibeam sonar system installed on the M/V Ocean Alert, a 240 ft former Coast Guard vessel that at the time was owned by Alert Shipping of St. John's NL (Campbell et al., 2006).

### *Shallow-water survey (100 m to 700 m water depth):*

The shallow water multibeam survey was conducted by the Geological Survey of Canada in partnership with Clearwater Fine Foods Inc. during July 18<sup>th</sup> to August 4<sup>th</sup>, 2000. The survey utilized a Simrad EM1002 installed on the Clearwater-operated M/V Anne S. Pierce, a 98 ft vessel. (Campbell et al., 2006).

## **The Gully multibeam data collection**

The Gully multibeam data were collected during three surveys; a deep water survey using a Simrad EM 300 system and a shallow water survey using a Simrad EM 1002 system which together covered an area of ~22 000 km<sup>2</sup> on the Scotian Slope, from 100 m to 3900 m water depth (Campbell et al., 2006).

### *Deep-water survey (700 m to 3900 m water depth):*

The deep-water multibeam survey was conducted by C&C Technologies during May 18<sup>th</sup> to June 20<sup>th</sup>, 2000. The survey was coordinated by the Geological Survey of Canada in collaboration with several industry partners (Pickrill et al., 2001). It utilized a Simrad EM300 multibeam sonar system installed on the M/V Ocean Alert, a 240 ft former Coast Guard vessel that at the time was owned by Alert Shipping of St. John's NL (Campbell et al., 2006).

### *Shallow-water surveys (100 m to 700 m water depth):*

The shallow water multibeam surveys were coordinated by the Geological Survey of Canada in partnership with Canadian Hydrographic Service. Small areas of the western Upper Gully flank were surveyed in a series from 1997 to 1999. The bulk of The Gully was surveyed between March 19<sup>th</sup> and August 4<sup>th</sup>, 2000. The survey utilized a Simrad EM1000 installed on the M/V F.G. Creed, a 20 m SWATH (Small Water Area Twin Hull) vessel operated by the Canadian Coast Guard (Campbell et al., 2006).

## **Sable Island Bank multibeam data collection**

The five smaller GSC multibeam datasets for Sable Island Bank were acquired from the following Geological Survey of Canada – Atlantic cruises;

Cohasset: (CREED96-501, CREED97-090, CREED98-100, CREED2000-100)

South Venture: (CREED2000-100, CREED2001-100)

South Sable Area: (CREED97-090, CREED98-100, CREED2000-100)

West Bar: (CREED98-090, CREED2001-100)

East Bar: (CREED2001-100)

## Data Display

The final product is a 25 m digital elevation model; a digital representation of cartographic information in a raster form. A sun-illuminated relief grid was also generated from the 25 m DEM. It is important to note that the horizontal spacing of depth soundings in certain areas varies greatly; it is not necessarily compatible with the final 25 m grid cell size. Original grid resolutions for some areas were as coarse as 500 m (West - Northwest of Northern Spur) or as fine as 20 m (Slope), 15m (The Gully) and 5 m spatial resolution (Sable Island Bank multibeam surveys). The Southwest area of Banquereau {UTM Zone 20; upper left corner (823850.00,4895898.00) bottom right corner (864441.00,4885890.00)} is particularly noted as having spacing up to 7000 metres; the DEM is visually degraded accordingly.

Vertical resolution for this DEM is guesstimated to be within a tolerance of 1-2% for CHS depth soundings (Sable Island Bank area) and 1% for all other multibeam soundings. Bathymetric values are colour coded from blues and violets for deeper and reds to whites for shallower depths. Artificial sun-illumination is directed from 315° at 45° above the horizon. The vertical exaggeration is 1. Some data artefacts are visible in the DEM. Parallel ridges oriented along the survey direction for the slope area are present and are due to refraction errors from line to line (Campbell et al., 2006). Also, a linear seam is visible through most of the data where the two surveys (The Gully and Slope) have been merged. It should also be noted that horizontal resolution on the Slope decreases substantially with increased water depth due to the increased area of seabed or “footprint” covered by each beam and, to a lesser extent, the increase in beam spacing. Overall, this results in a smoothing effect in the data with an underestimation of locally steep slopes and an inability to resolve small features (Campbell et al., 2006).

The reliability of the relationships encoded in the data structure of the DEM has been verified using CHS and GSC contour vectors upon completion of the data production cycle. The test verifies full compliance to the DEM specification. The DEM was visually inspected for completeness and intended accuracy for the purpose of quality control. All contour information supplied by the CHS for the Sable Island Bank (excluding The Gully and Slope area) that accompanies this dataset is provided with minor modification from the GSCA. The contributing Canadian Hydrographic Service contours are a product of the National Earth Science Series (NESS) and Natural Resource Maps (NRM).

Individual quadrangle DEM grids were mosaiced together into a single comprehensive raster grid and mosaiced together in ArcView 8.3. A Natural Neighbours weighted average interpolation method was used to create the raster surface, because the sample data points were distributed unevenly.

The DEM is expressed in a Universal Transverse Mercator (UTM) projection coordinate system (Northings / Eastings) and is referenced to NAD83 Zone 20. It has floating point depth values and 32 bit depth.

Approximate file sizes are 313 megabytes for the 25-meter horizontal resolution DEM, 44 megabytes for the sun-illuminated relief grid and 99 megabytes for the bathymetric contour lines.

### **Data Set Citation**

Dataset Creator: Kevin J. Webb

Dataset Title: Sable Island Bank DEM

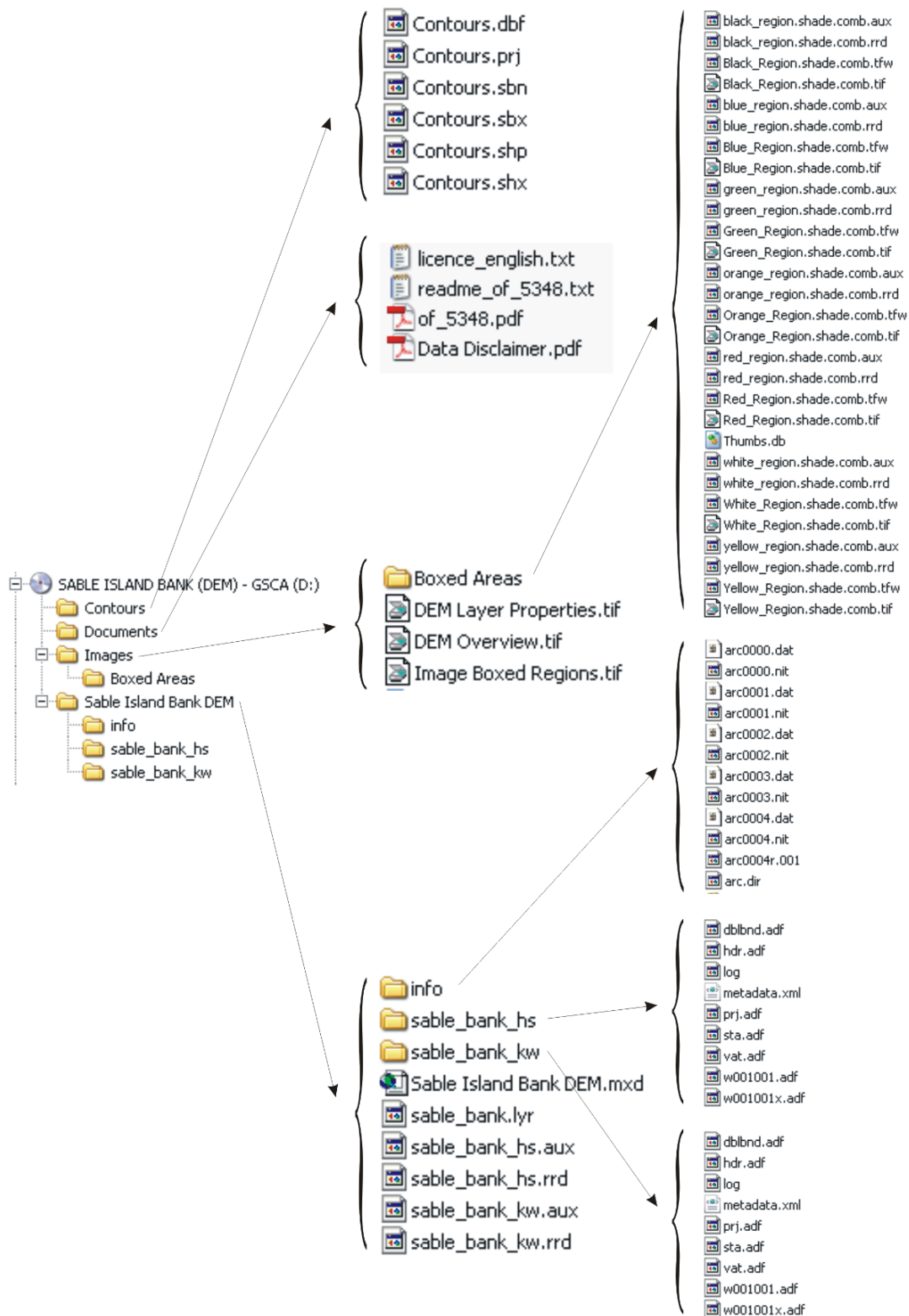
Dataset Release Place: Dartmouth, Nova Scotia

Dataset Publisher: Geological Survey of Canada

Dataset Open File: # 5348

## Data Structure

The folder and file structure are imaged below. In addition the xyz coordinates of the 25 m grid are included in file “sable\_bank\_kw.xyz.gz”.

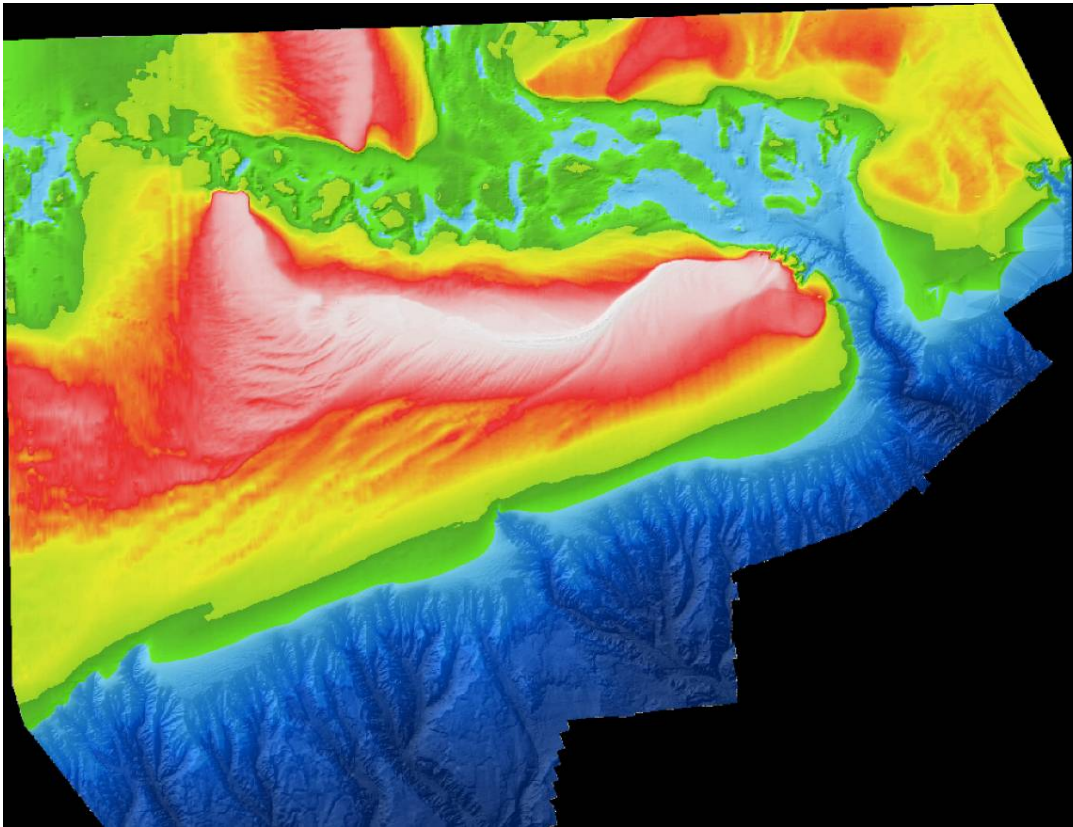


## Selected Bathymetric Images

A major advantage of the GIS dataset is the ability to generate custom images, colour schemes, queries, oblique views, contour maps etc. To this end the grids and contours and original xyz grid are included in this product. In addition, several sample images of the bathymetry and contours are included both in this publication and in this document, to illustrate the scope, range, and detail of the product, especially for readers with limited or no access to GIS software. They are georeferenced images (TIFF-format) with accompanying .tfw files for viewing in most GIS environments. These are shown in Figures 1 to 12. The 3-D views (Figures 3 and 4) are DEM derivatives not included in the publication.

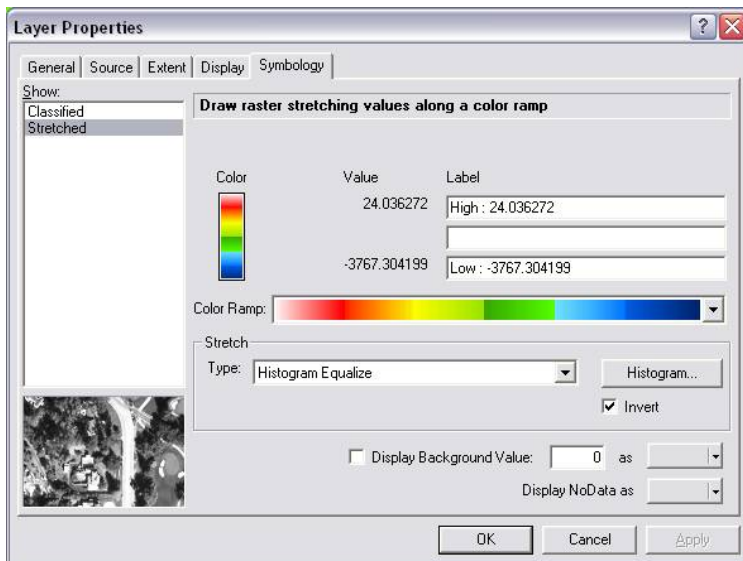
## Bathymetric Contours

The ArcMap project includes bathymetric contours derived from the DEM. Contour interval is 5 m in water depths shallower than 105 m, 10 m between 110 and 300 m water depth and 20 m below. In some areas the data do not warrant such a tight contour interval so they are terminated. Elevation ranges from -5 (on land) to -9908 m. Contours were smoothed to eliminate most artefacts. This results in considerable smoothing over areas of multibeam coverage. Figure 12 shows an example of the contours and Figure 13, an enlarged (smaller scale) display. The water depth attribute assigned to all vectors enables the user to generate any sub-set of the contours for custom map generation.

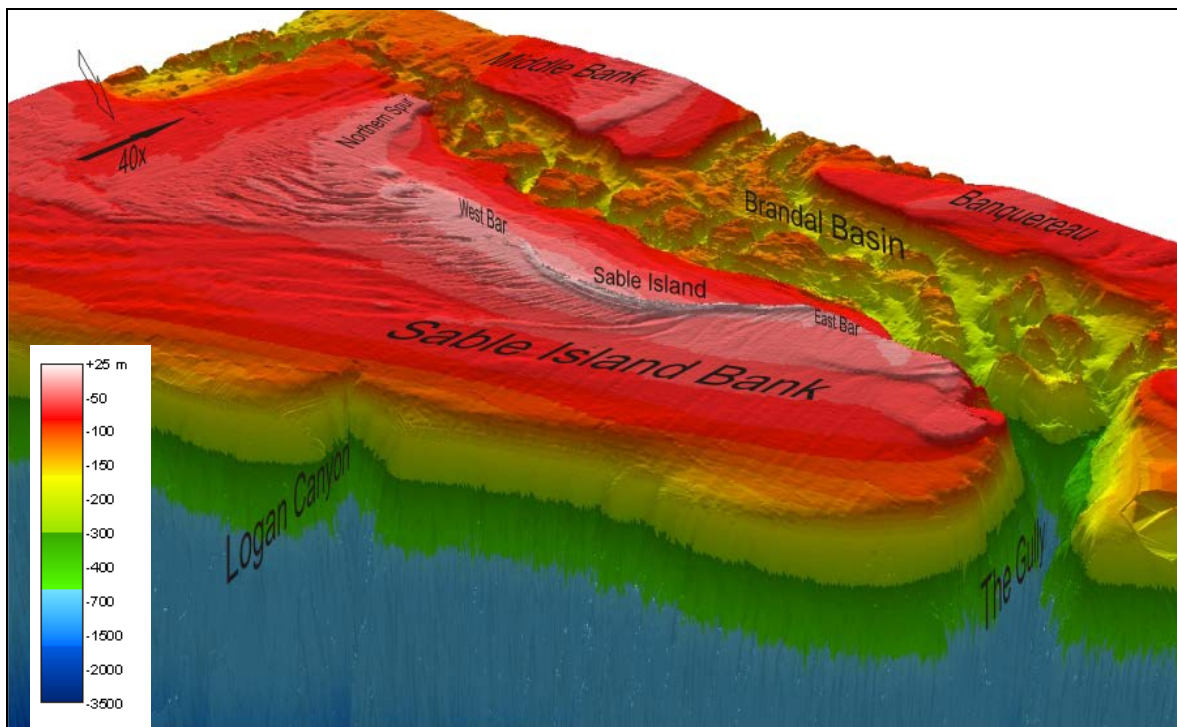


**Figure 1. Overview of DEM area. Depth/colour properties in Fig. 2.**





**Figure 2. Water depth layer colour and range properties.**



**Figure 3. Oblique view of Sable Island Bank with geographic names. This presentation is rendered at 75 m resolution. The filled north arrow and vertical exaggeration are shown while the open arrow is illumination angle and azimuth (applies for Fig. 4 also).**

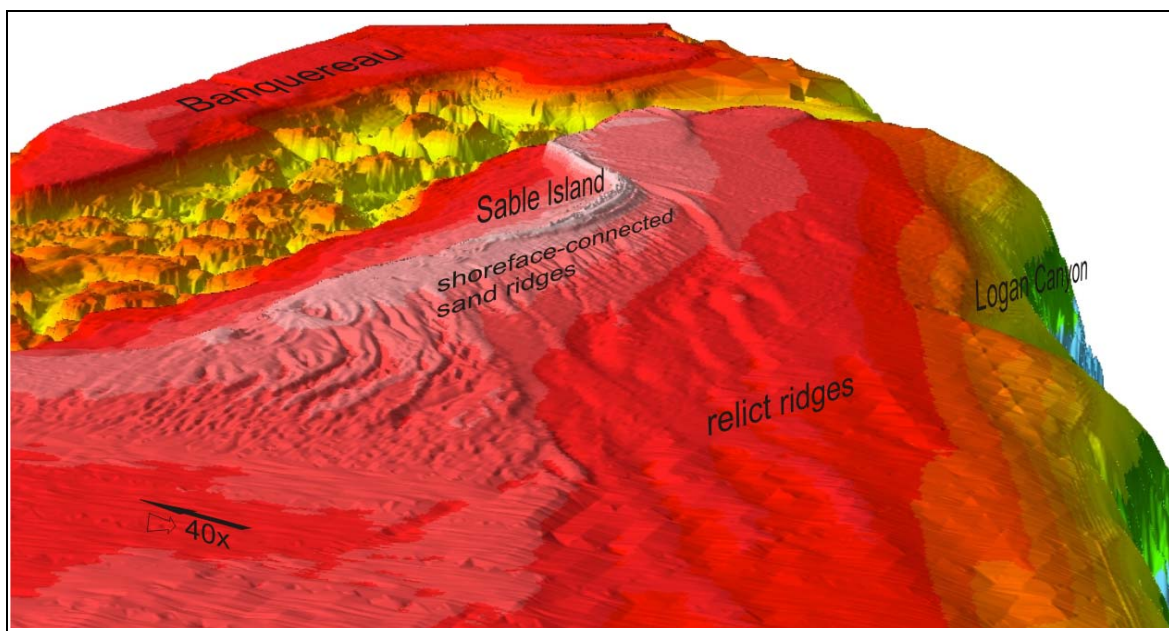


Figure 4. A sand ridge complex on the seaward face of Sable Island.

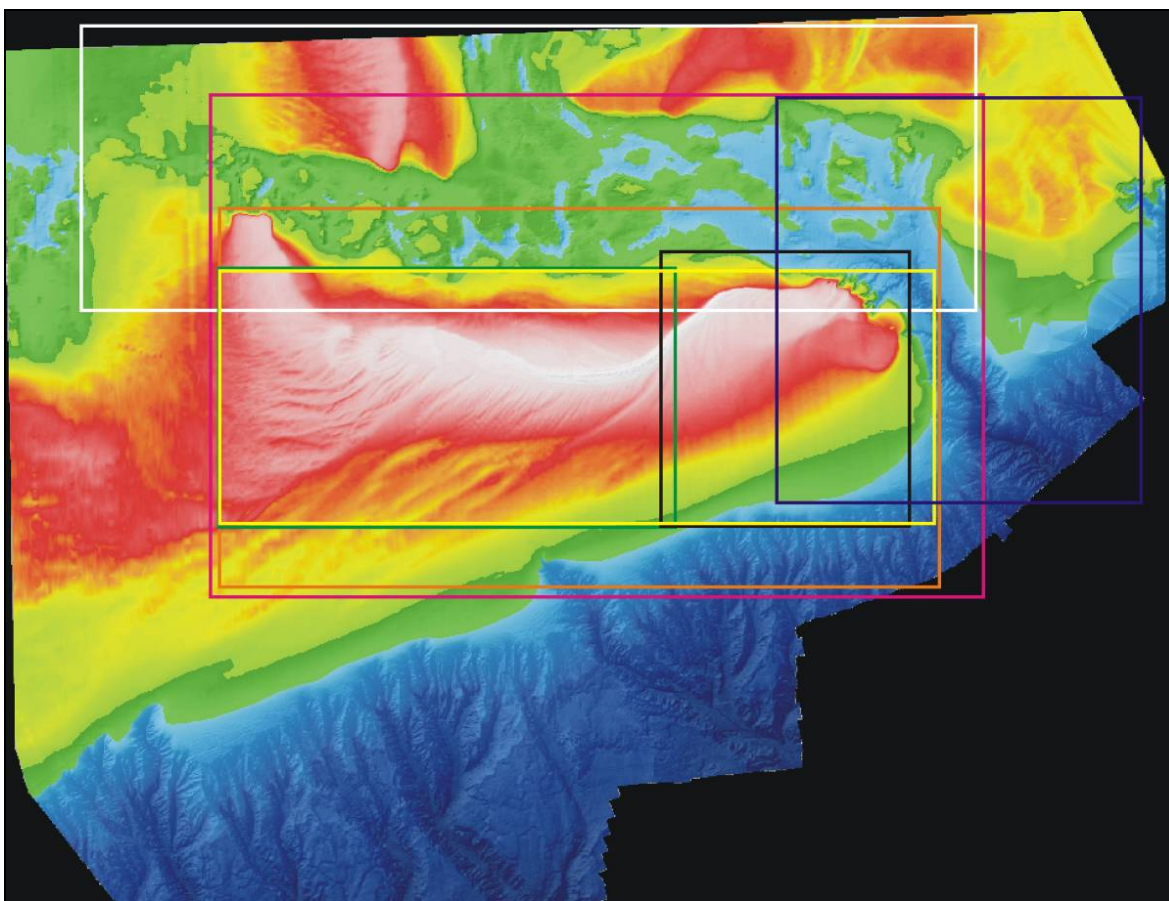
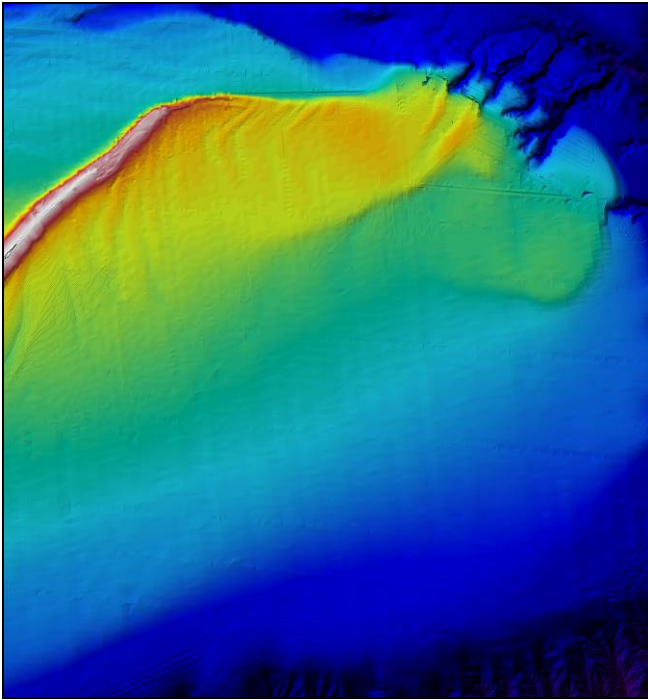
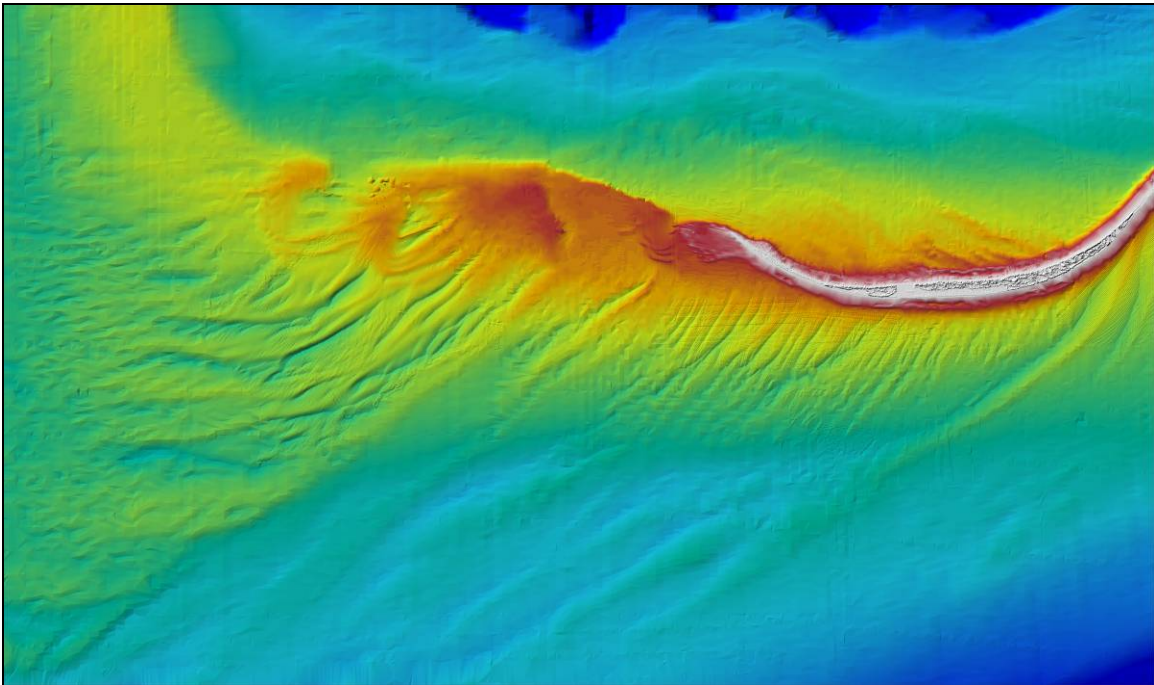


Figure 5. Colour-coded index to the regional images on the DVD. Selected images are also presented in this document.

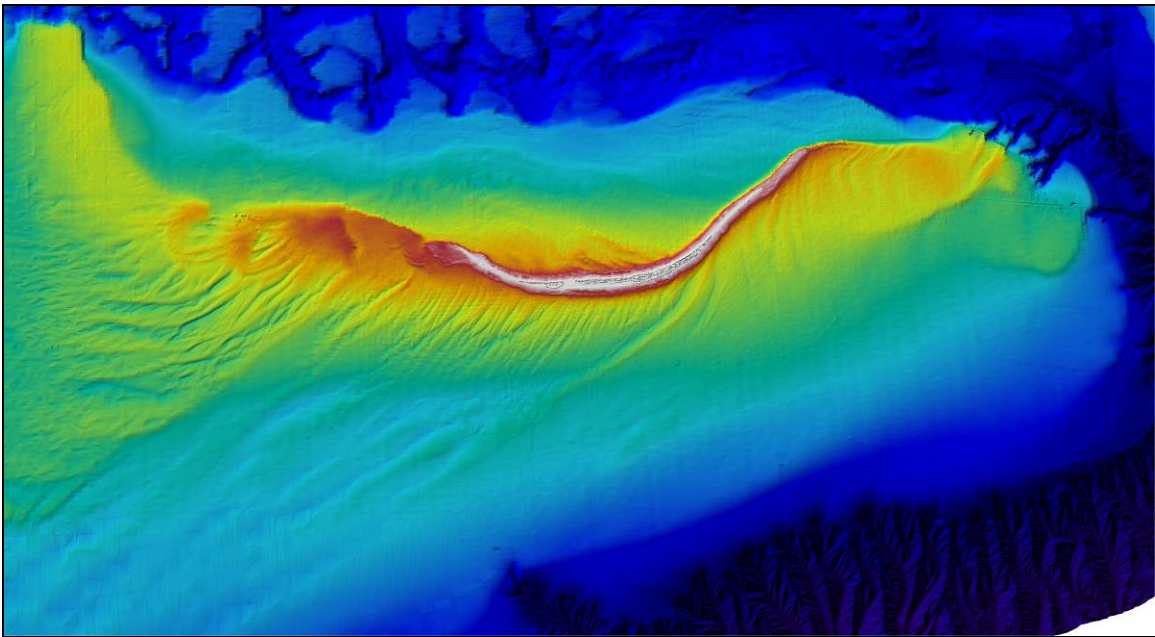




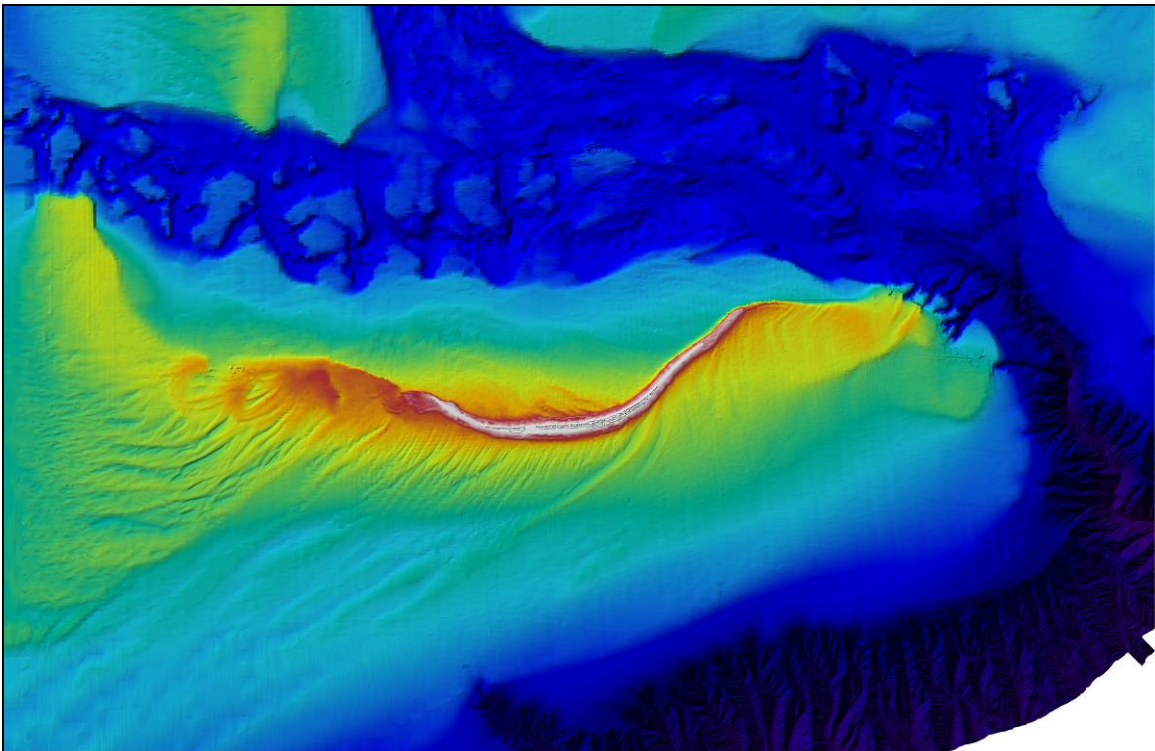
**Figure 6. East Bar and the western flank of "The Gully".**



**Figure 7. West Bar and Sable Island. The high resolution areas are visible, embedded within the lower resolution image.**

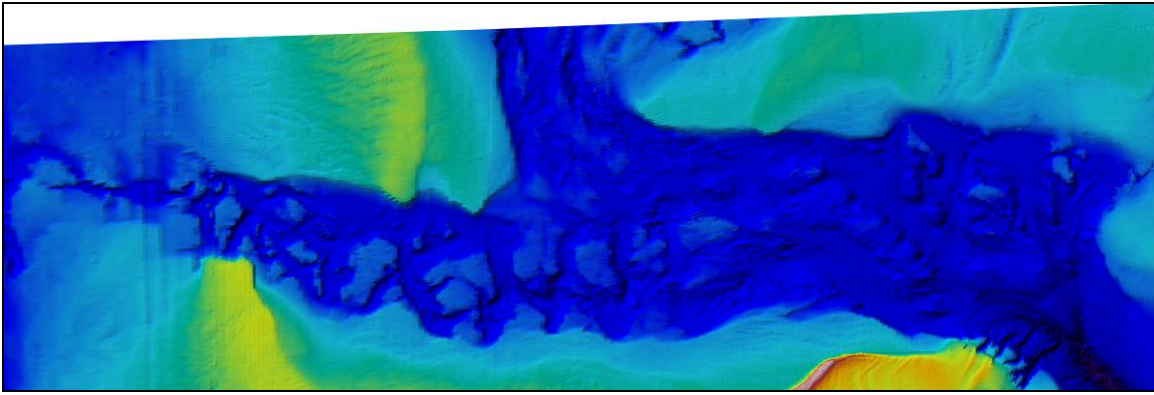


**Figure 8. Sable Island Bank from Northern Spur (NE) to The Gully.**

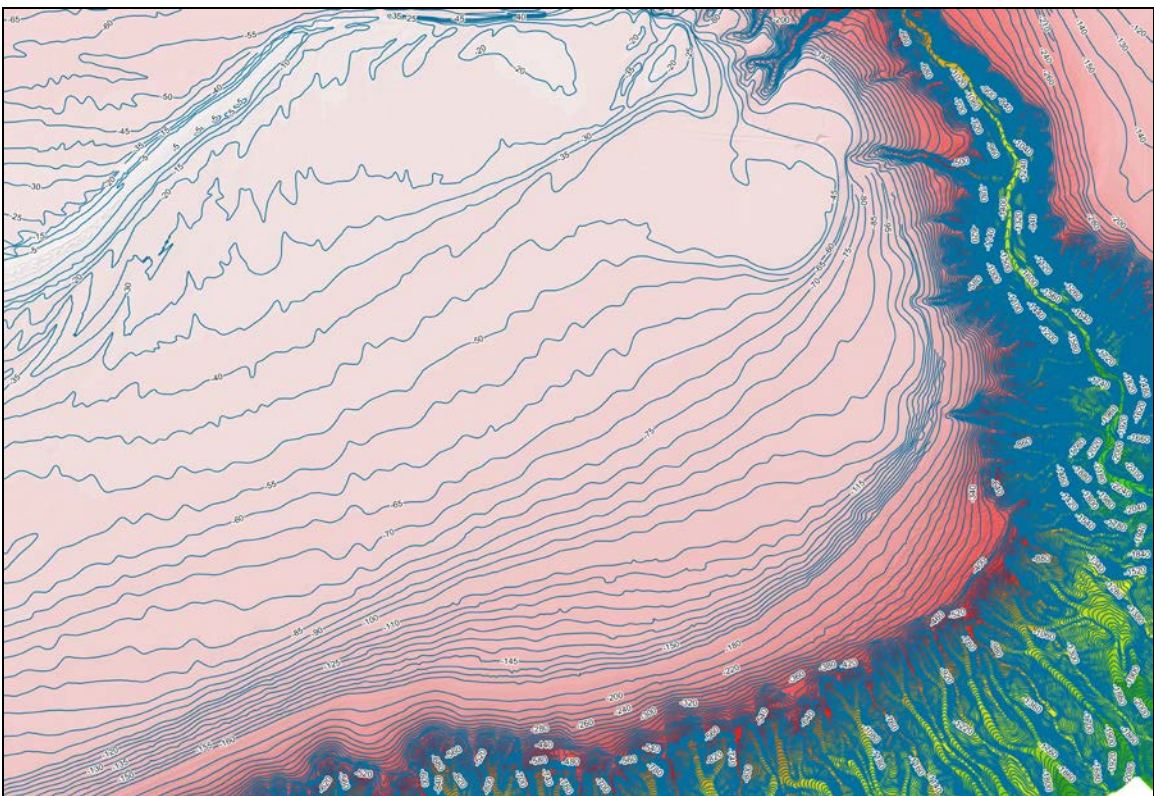


**Figure 9. Sable Island Bank and Brandal Basin to the north.**

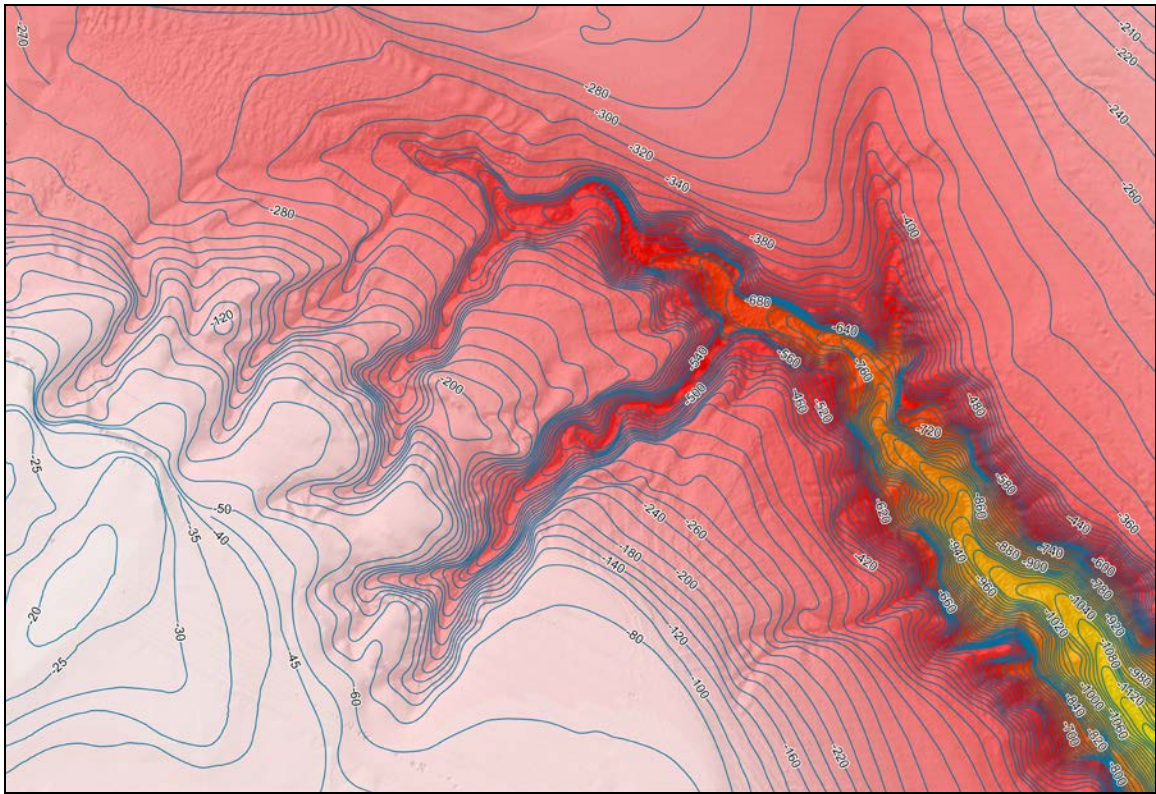




**Figure 10. Brandal Basin with Middle Bank and Banquereau to the north.**



**Figure 11. Selected area displaying smoothed contours derived from the DEM.**



**Figure 12.** Enlargement of the area on the west flank of The Gully showing the smoothed contours.

## References

- Campbell, D.C., Piper, D.J.W., Mosher, D.C. & Jenner, K.A., 2008. Sun-illuminated seafloor topography, Logan Canyon, Scotian Slope, offshore Nova Scotia; Geological Survey of Canada, Map 2126A, scale 1:100 000.
- Pickrill, R, Piper, D.J.W., Collins, J, Kleiner, A, and Gee, L., 2001. Scotian Slope mapping project: the benefits of an integrated regional high-resolution multibeam survey; Proceedings - Offshore Technology Conference 2001, Paper 12995, 11 pages (GSC Cont.# 2001011).