

PRELIMINARY PROGRAM

10th GEBCO Science Day, 5 October 2015

Oral presentations (with provisional time schedule)

Time	Title	Author(s) *Presenting author if not first	Affiliation(s)
8:00 to 8:30	Set-up Posters for Science Day		
8:30 To 9:15	Registration - Please be seated by 9:15		
9:15 to 9:30	Arrival of Minister of Defence and VIPs		
9:30 to 9:45	Opening of 2015 GEBCO meeting	VADM (Ret.) Shin Tani	GEBCO Chairman
9:45 to 10:00	Official Speech by Minister of Defence of Malaysia	Yang Berhormat Datuk Seri Hishammuddin Hussein	Minister of Defence of Malaysia

10:00 to 10:45	Poster and Booth Sessions		
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10:45 to 13:00	Morning Oral Sessions		
10:45	Convene Oral Session of Science Day	Paul Elmore	Naval Research Laboratory, USA
10:50 To 11:05	The Nippon Foundation / GEBCO Post-Graduate Certificate in Ocean Bathymetry training program from the Year 11 student's perspective	Jaya Roperez, Indra Prasetyawan, Nilupa Samarakoon, Maxlimer Vallee, Hirokazu Kurita, Amon Kimeli and Rochelle Wigley*	UNH-CCOM
11:05 To	New multi-beam bathymetric map of	Marc-André Gutscher [1],	[1] Domaines Océaniques, Univ.

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11:20	the Ionian Sea: Evidence for active sedimentary and morpho-tectonic processes	Heidrun Kopp [2], Sebastian Krastel [3], Gerhard Bohrmann [4], Thierry Garlan [5], Sebastien Zaragosi [6], Benoit Loubrieu [7], Yann LeFaou [5], Laurine San Pedro [1], Stephane Dominguez [8], Marzia Rovere* [9], Bernard Mercier de Lepinay [10]	Brest/CNRS, 29280 Plouzané, FRANCE [2] GEOMAR Helmholtz Center for Marine Research, 24148 Kiel, GERMANY [3] University of Kiel, 24148 Kiel, GERMANY [4] MARUM University of Bremen, 28334 Bremen, GERMANY [5] Service Hydrographique et Océanographique de la Marine (SHOM), 29228 Brest, FRANCE [6] EPOC- Univ. Bordeaux, 33405 Talence, FRANCE [7] Ifremer, Géosciences Marines - EDROME, 29280 Plouzané, FRANCE [8] Geosciences Montpellier, Univ. Montpellier II 34095 Montpellier, FRANCE [9] Istituto di Scienze Marine (ISMAR), Venice, Italy [10] GeoAzur, Univ. Nice/CNRS, 06560Sophia-Antipolis, ITALY
11:20 To 11:35	Atlantic Ocean Research Alliance's Transatlantic Survey	Kian Fadaie, Serge Lévesque	Canadian Hydrographic Service, Fisheries and Oceans Canada; Ottawa, Canada

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11:35 to 11:50	Coffee Break		
11:50 to 12:05	2015 Greenland Mapping Mission	Martin Jakobsson	Stockholm U.
12:05 To 12:20	The development of RESTful services and an augmented map-based user interface for the Global Multi-Resolution Topography (GMRT) Synthesis	Vicki Ferrini, John Morton, Barg, Kevin Celnick, Kevin McLain, Frank Nitsche, Suzanne O'Hara, Suzanne Carbotte	Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, USA
12:20 To 12:35	What's new in Google's Ocean Map	Jamie Adams [1], Jenifer Austin [1], David Sandwell [2], J.J. Becker [3], Walter Smith [4], Martin Jacobsen [5], Vicki Ferrini [6] & Suzanne Carbotte [6]	<p>[1] Google Inc., Mountain View, California, USA</p> <p>[2] University of California-San Diego, Scripps Institute of Oceanography, La Jolla, California, USA</p> <p>[3] Naval Research Laboratory, Stennis Space Center, Mississippi, USA</p> <p>[4] NOAA Laboratory for Satellite Altimetry, College Park, Maryland, USA</p> <p>[5] Dept. of Geological Sciences, Stockholm University, Sweden</p> <p>[6] Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, USA</p>

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12:35 To 12:50	On Simulation in Science: An Exploration of Interactive Ocean Maps	Julia Coursey	University of Alabama
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12:50 To 14:00	Lunch/Networking break & Poster Session		
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14:00 To 16:30	Afternoon Oral Session		
14:00 To 14:15	Crowd Sourced Bathymetry	Kenneth Himshoot	Sea ID Ltd.
14:15 To 14:30	Initiatives in Using Crowdsourcing, Satellite Derived Bathymetry, and Other Non-Traditional Hydrographic/Bathymetric Measurements	[1] Anthony Klemm [2] Shachak Pe'eri [1] John Nyberg	[1] NOAA Marine Chart Division [2] Center for Coastal and Ocean Mapping; U. of New Hampshire
14:30 to 14:45	Ocean Globes Based on Bathymetric Data: Visualization Issues and Techniques	Eunmi Chang[1]; Y.J. Park [1]; K.S. Lee[2]; M.B. Shim[2]	Ziinconsulting INC.
14:45 To 15:00	Case studies of the latest Research Vessels for mapping our Oceans	Grant Rawlinson	Kongsberg Maritime PTE LTD, Singapore

15:00 to 15:40	Coffee & Networking Break; Poster Viewing		
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15:40 To 15:55	Hydroacoustic Signal Classification Technique: The Role of Marine	Jamil bin Tajam	Ocean, Research, Conservation &
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	Habitat Mapping-Based Management for Ecosystems		Advances; MARA Technology University
15:55 To 16:10	Potential Natural Blood Cockle (<i>Anadara granosa</i>) Spawning Ground Based on Coastal Physical Disturbance during Great Diurnal Tide in Kapar, Selangor, Malaysia	Hadzley Harith [1]; Lokman Husain [1]; Fadzil Mad Akhir [2]	[1] Marine Science and Environment, Universiti Malaysia Terengganu [2] Institute of Oceanography and Environment, Universiti Malaysia Terengganu
16:10 To 16:25	Deriving Feature Layers from Mosaic and Angular Backscatter Response for Seabed Classification	Rozaimi Che Hasan[1], Norhizam Hassan[2], Razimi Damri[2]	[1] UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia (UTM), Kuala Lumpur, MALAYSIA [2] National Hydrographic Center, Selangor, MALAYSIA
16:25 To 16:30	5 Minute Talk - Uncertainty Estimation for Sparse Data Gridding Algorithms	Samantha J. Zambo, Paul A. Elmore*, A. Louise Perkins, and Brian S. Bourgeois	Naval Research Laboratory
16:30	Visit to PETRONAS Twin Tower Level 87	CDR Norhizam Abd Ghani	Royal Malaysian Navy

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MORNING ORAL PRESENTATIONS

The Nippon Foundation / GEBCO Post-Graduate Certificate in Ocean Bathymetry training program from the Year 11 student's perspective

Jaya Roperez, Indra Prasetyawan, Nilupa Samarakoon, Maxlimer Vallee, Hirokazu Kurita, Amon Kimeli and Rochelle Wigley

Center for Coastal and Ocean Mapping, University of New Hampshire, Durham, New Hampshire, USA

The Nippon Foundation has supported GEBCO's endeavor to build a stronger network of professionals in the field of ocean mapping by funding six individuals from across the globe to participate in a one year capacity-building program. The Post-Graduate Certificate in Ocean Bathymetry training program is carried out at the Center of Coastal and Ocean Mapping / Joint Hydrographic Center (CCOM/JHC) of the University of New Hampshire, one of the few institutions certified by FIG/ IHO/ICA Advisory Board with Category A academic program for hydrography.

The Post-Graduate Certificate in Ocean Bathymetry (PCOB) program is a three-semester course that covers basic and advanced academic theories and techniques in ocean mapping, geodesy and positioning, marine geology, underwater acoustics, seamanship, marine weather and auxiliary trainings on software used to acquire and process the data as well as presenting information through charts and bathymetric maps. Theories and practices learned from the CCOM/JHC faculty and researchers over the two academic semesters are then all applied in a practical course, known as "Summer Hydro", wherein students get to work as a team with minimal supervision to plan and conduct a hydrographic survey using state-of-the-art technology and facilities, process acquired and provided supplementary data, and finally deliver products.

Scholars are also supported to undertake a visit to an international research lab of their choice, undergo internships and/or participate in a scientific cruise after the academic program is finished. These lab visits help the scholars meet and work with researchers in the same and allied disciplines, which aside from being an additional learning experience, is a vital key to build the students networks.

Scholars then return to their home countries, where they echo and apply their learnings and experiences, hopefully develop better standard operating procedures and encourage their agency / organization to open up to collaborations and to take part in GEBCO's efforts by at least contributing data.

The training program has been running for twelve years and has produced 66 scholars (with 6 more current students) working as hydrographers and scientists in 32 countries, focused on mapping, exploring and understanding the seafloor. As mapping technology improves, networks of individuals and institutions working together has become more important, which keeps the hope of having a high-resolution bathymetric map covering the entire seafloor possible.

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New Multi-Beam Bathymetric Map of the Ionian Sea: Evidence for Active Sedimentary and Morpho-Tectonic Processes

Marc-André Gutscher [1], Heidrun Kopp [2], Sebastian Krastel [3], Gerhard Bohrmann [4], Thierry Garlan [5], Sebastien Zaragosi [6], Benoit Loubrieu [7], Yann LeFaou [5], Laurine San Pedro [1], Stephane Dominguez [8], Marzia Rovere* [9], Bernard Mercier de Lepinay [10]

1 Domaines Océaniques, Univ. Brest/CNRS, 29280 Plouzané, FRANCE

2 GEOMAR Helmholtz Center for Marine Research, 24148 Kiel, GERMANY

3 University of Kiel, 24148 Kiel, GERMANY

4 MARUM University of Bremen, 28334 Bremen, GERMANY

5 Service Hydrographique et Océanographique de la Marine (SHOM), 29228 Brest, FRANCE

6 EPOC- Univ. Bordeaux, 33405 Talence, FRANCE

7 Ifremer, Géosciences Marines - EDROME, 29280 Plouzané, FRANCE

8 Geosciences Montpellier, Univ. Montpellier II 34095 Montpellier, FRANCE

9 Istituto di Scienze Marine (ISMAR), Venice, ITALY

10 GeoAzur, Univ. Nice/CNRS, 06560 Sophia-Antipolis, ITALY

A combined dataset of multi-beam bathymetry, based on 5 recent marine geophysical surveys since 2010 as well as a compilation of earlier surveys, now spans the vast majority of the Ionian Sea and the active margin of East Sicily and Calabria. (The new surveys are: R/V Meteor cruise 86, 2010 PI - S. Krastel; MocoSed R/V PourquoiPas 2012 PI's - T. Garlan, S. Zaragosi; Circee R/V Suroit 2013 PI - M.-A. Gutscher; R/V Meteor cruise 111, 2014 PI's - H. Kopp, M.-A. Gutscher; R/V Meteor cruise 112, 2014 PI - G. Bohrmann). This new compilation of mostly unpublished bathymetric data is presented as a 2 arc-sec (60m) grid and reveals fine-scale structures on the seafloor in unprecedented detail. These include the deeply incised Malta-Hyblean Escarpment, numerous submarine canyons, broad regions of relatively flat seafloor dominated by fields of sediment waves, the gently undulating anticlinal fold-and-thrust belts of two accretionary wedge complexes related to the Hellenic subduction (W Mediterranean ridge) and to the Calabrian arc. These accretionary wedges intersect and overlap and define two of the three sides of the triangular Ionian abyssal plain. The internal structure of these morpho-tectonic provinces as well as the transition zones between them is also imaged by high-resolution seismic reflection profiles. Together these data offer new insights into the interaction and competition between active sedimentary and tectonic processes shaping this part of the Central Mediterranean.

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Atlantic Ocean Research Alliance, GALWAY 2015, CCGS Louis S. St-Laurent Transatlantic Survey

Kian Fadaie, Serge Lévesque

Canadian Hydrographic Service, Fisheries and Oceans Canada

On its way to the arctic, the Canadian Coast Guard Ship Louis S. St-Laurent made a transatlantic crossing between Halifax, Canada and Tromsø, Norway. This was a good opportunity to map the seabed to contribute to the Galway Statement signed in 2013 by Canada, the United States of America (USA) and the European Union (EU). The Atlantic Ocean Research Alliance which was created under the Galway Statement placed a scientific team of six on board to acquire a corridor of bathymetric data along the ship's course. This team consisted of one representative from the EU (Marine Institute of Ireland, INFOMAR), one from the USA (NOAA), and four from Canada: one from the academic sector (Memorial University of Newfoundland), and three from the Canadian Hydrographic Service, Fisheries and Oceans Canada.

This ship of opportunity mission aimed at increasing multibeam bathymetric coverage in the Atlantic to support scientific research and to meet the goals of the Galway Statement. Close to the mid-ocean ridge, volcano-like structures were captured by the full ocean depth deep water multibeam on the Louis, a Kongsberg EM-122. All through the survey, punctual Sound Velocity Profiles were acquired by using expendable XCTD probes. During its 11-day survey, the ship only remained in a given area for a short time as it was transiting on its transatlantic crossing. Supplemental to the multibeam data, sub-bottom data from a Knudsen 3260 3.5 kHz Chirp echosounder was also collected during the transit.

Dr. Kian Fadaie can be contacted to obtain further information on the Canadian icebreaker's Galway 2015 mission. Some information on the survey is also available from blogs and news releases that are provided for reference.

2015 Greenland Mapping Mission

Martin Jakobsson

Dept. of Geological Sciences, Stockholm University, Stockholm, SWEDEN

Abstract in preparation

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The Development of Restful Services and an Augmented Map-Based User Interface for The Global Multi-Resolution Topography (GMRT) Synthesis

Vicki Ferrini, John Morton, Benjamin Barg, Kevin Celnick, Kevin McLain, Frank Nitsche, Suzanne O'Hara, Suzanne Carbotte

Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, USA

The Global Multi-Resolution Topography (GMRT, <http://gmrt.marine-geo.org>) synthesis is a multi-resolution compilation of quality controlled multibeam sonar data, collected by scientists and institutions worldwide, that is merged with gridded terrestrial and marine elevation. The GMRT delivers these multi-resolitional elevation components seamlessly to the user as both images and grids. The GMRT provides quantitative access to gridded data and images to the full native resolution of the sonar as well as attribution and access to source data files. To construct the GMRT, multibeam sonar data are evaluated, cleaned and gridded by the MGDS Team and are then merged with gridded global and regional elevation data that are available at a variety of scales from 1km resolution to sub-meter resolution. As of June 2015, GMRT includes processed swath data from nearly 850 research cruises with over 2.7 million ship-track miles of coverage.

Several new services were developed over the past year to improve access to the GMRT Synthesis. In addition to our long-standing Web Map Services, we now offer RESTful services to provide programmatic access to gridded data in standard formats including ArcASCII, GeoTIFF, COARDS/CF-compliant NetCDF, and GMT NetCDF, as well as access to custom images of the GMRT in JPEG format. An attribution metadata XML service was also developed to return all relevant information about component data in an area, including cruise names, multibeam file names, and gridded data components. These new services are compliant with the EarthCube GeoWS Building Blocks specifications and are the basis for our map-based user interface GMRT MapTool. Supplemental services include the release of data processing reports for each cruise included in the GMRT and the development of new data querying services.

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What's New in Google's Ocean Map

Jamie Adams [1], Jenifer Austin [1], David Sandwell [2], J.J. Becker [3], Walter Smith [4], Martin Jacobsson [5], Vicki Ferrini [6], Suzanne Carbotte [6]

1 Google Inc., Mountain View, California, USA

2 University of California-San Diego, Scripps Institute of Oceanography, La Jolla, California, USA

3 Naval Research Laboratory, Stennis Space Center, Mississippi, USA

4 NOAA Laboratory for Satellite Altimetry, College Park, Maryland, USA

5 Dept. of Geological Sciences, Stockholm University, Stockholm, SWEDEN

6 Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, USA

Six years ago, we launched an explorable ocean seafloor in Google Earth and in satellite mode in Google Maps. Then we updated our global underwater terrain dataset three years ago in partnership with the Scripps Institution of Oceanography, NOAA, the US Navy, NGA, and GEBCO (with major contributions from IFREMER and IBCAO), resulting in 15 percent of the seafloor at 1 km resolution. In 2012 in partnership with Lamont Doherty at Columbia University, we updated around 6% of the Ocean with their high resolution 100 meter bathymetry synthesis with data from 20 institutions, mainly in the US UNOLS fleet. This year, we plan to update the global ocean map with V1 of the SRM15 global grid curated by Scripps Institution of Oceanography, in partnership with NOAA, the US Navy, NGA, with major contributions from JAMSTEC (2.2% of the seafloor), Australia Geosciences- AGSO (0.5% of the seafloor) and Lamont Doherty at Columbia University Global with their 100 meter synthesis (version 3). The full data reference list is here. New areas to explore include the Philippine Sea, Ryukyu Trench, the Seafloor fabric east of Hawaii, the continental margins around Australia, and the Reykjanes Ridge. Incorporating data from 3 satellite altimeters significantly improves the spatial resolution of areas having no ship coverage. The SRTM15 grid is in the public domain and available online here (http://topex.ucsd.edu/WWW_html/mar_topo.html).

On Simulation in Science: An Exploration of Interactive Ocean Maps

Julia Coursey

University of Alabama

Google Oceans and similar technology have allowed cartography to go beyond the mere accuracy into uncharted territory. By making maps interactive, they allow viewers to explore an entire world of undersea environments from afar. Indeed, from the moment Marie Tharp produced her map of the ocean floor, bathymetry allowed humanity to map things that no one had even been able to imagine. Rather than giving us the grim world of simulation envisioned by Jean Baudrillard, I claim that bathymetry has uniquely broadened both scientific and lay understanding of the oceans in a way that fundamentally alters our notions of what it means to explore and to know.

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AFTERNOON ORAL SESSIONS

Crowd Sourced Bathymetry

Kenneth Himshoot

Sea ID Ltd

Abstract in preparation

Initiatives in Using Crowdsourcing, Satellite Derived Bathymetry, and Other Non-Traditional Hydrographic/Bathymetric Measurements

[1] Anthony Klemm [2] Shachak Pe'eri [1] John Nyberg

[1] NOAA Marine Chart Division, Silver Spring, Maryland, USA

[2] Center for Coastal and Ocean Mapping; University of New Hampshire, Durham, New Hampshire, USA

Abstract in preparation

Ocean Globes Based on Bathymetric Data: Visualization Issues and Techniques

Eunmi Chang [1], Y.J. Park [1], K.S. Lee [2], M.B. Shim [2]

[1] Ziinconsulting INC., Seoul, Republic of Korea

[2] Korea Hydrographic and Oceanic Administration, Seoul, Republic of Korea

Development of a globe based on GEBCO data has been tried in China and Korea since 2007 and mobile service including app has connected analogue globe to graphic information of ocean features. In order to express undersea features such as Sea Mountains, the manipulation of raw data is essential. This research aims to draw potential issues in the process of manipulation and to compare the result of the different methods. GEBCO 2014 Bathymetry data were processed by ArcGIS and QGIS. Shading effects was tested in the variation of light positions. It is necessary to decide which features should be shown clearly; whether typical undersea features or land forms under shallow water where human activities mostly occur. The results of this research will be utilized to make more people understand the undersea features and importance of hydrographic survey under the oceans.

Case Studies of the Latest Research Vessels for Mapping our Oceans

Grant Rawlinson

Kongsberg Maritime PTE LTD, Singapore

Abstract in preparation

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Hydroacoustic Signal Classification Technique: The Role of Marine Habitat Mapping for Ecosystem-Based Management

Jamil Tajam [1,2], Mazlin Mokhtar [1] & Norhizam bin Hassan Abd Ghani [3]

[1] *Institute for Environment and Development (LESTARI) Universiti Kebangsaan Malaysia (UKM) 43600 UKM Bangi, Selangor, Malaysia*

[2] *Program Teknologi Marin Fakulti Sains Gunaan, UiTM Perlis 02600, Arau, Perlis*

[3] *Pusat Hidrografi Nasional, Bandar Armada Putra, Pulau Indah, 42009 Pelabuhan Klang, Selangor, Malaysia*

Presently, there are some problems facing the marine habitat mapping using satellite's remote sensing due to the water condition in this area being very poor with high concentrations of suspended particles. Therefore, the aim of this study is to investigate patterns of benthic features in the turbid water using hydroacoustic signals will be carried out. The use of hydroacoustic signals as a remote sensing tool is capable of determining the distribution of coral habitats and categories within a coral reef by measuring different hardness and roughness of the substrate. The system stores, categorizes and manipulates data received, and produces maps of the sea-bed types especially corals. This technique will help to determine the percentage of coral reef (e.g: live and dead coral). Then, the output from the digital thematic map will be generated for resource management purposes. Apart from that, this approach will help government and policy maker to improve their understanding to manage and develop national guidance to this unique ecosystem in a sustainable manner.

Potential Natural Blood Cockle (*Anadara granosa*) Spawning Ground Based on Coastal Physical Disturbance during Great Diurnal Tide in Kapar, Selangor, Malaysia

Hadzley Harith [1]; Lokman Husain [1]; Fadzil Mad Akhir [2]

[1] *Marine Science and Environment, Universiti Malaysia Terengganu*

[2] *Institute of Oceanography and Environment, Universiti Malaysia Terengganu*

Coastal oceanographic processes of Kapar and Sungai Buloh have been studied from January 2010 to March 2011 and February to May 2015 to determine the association of cockle recruitment drop and the processes involve in this area since 2010. Prior to the event, natural spatfall of Blood Cockle (*Anadara granosa*) was reportedly occurs in Selangor coast line since 2007-2011 especially in Kapar and Sungai Buloh. Based on the coastal physical characteristics studied, a study on bathymetry and tide elevation, local current circulation, temperature profile at selected station in Cockle Culture lot (Station KKKL 6 and its adjacent Station KKKL 6a) in Kapar. The study is aim to evaluate the potential natural blood cockle (*Anadara granosa*) spawning ground based on coastal physical distributions during Great Diurnal Tide (GT) in Kapar affected by warm water discharge from Tenaga Nasional

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Berhad (TNB) Kapar. The results suggested that two seasons of lowest water i.e., Lowest Astronomical Tide (LAT) occur in late January to middle March and lower water in June to early September occur in Kapar waters. While two great diurnal tides are occurring during the same seasons of this lowest and low water. Based on the bathymetry and water elevation results suggested an area of 95.0 Ha is perfectly matched for bottom temperature intermittent (up to 4°C) during its LAT. The bottom temperature for this area is homogeneous temperature of 28-29°C during typical tide cycle. The area were left out from cockle culture activities due to its depth which beyond five meter depth during typical tide cycle. Typical mollusc will trigger their spawning activities when received 2-4°C temperature intermittent at specific period. The study has demonstrated on how the bottom temperature may intermittent during GT and its association with cockle spawning in the study area.

Deriving Feature Layers from Mosaic and Angular Backscatter Response for Seabed Classification

Rozaimi Che Hasan[1], Norhizam Hassan[2], Razimi Damri[2]

[1] UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia (UTM), Kuala Lumpur, MALAYSIA

[2] National Hydrographic Center, Selangor, MALAYSIA

The availability of backscatter data (i.e. mosaic and angular dependence of backscatter) from multibeam echo-sounder has provided new aptitude to remotely characterize seabed types without having to gather large amount of *in-situ* data (i.e. sediment sample). Acoustic backscatter that represents the level of seabed intensity (i.e. scattering) can be used as a proxy to characterize and classify sediment types. This required specific processing stage as well as classification methods and differed to bathymetry depth cleaning and processing. This study attempts to demonstrate how backscatter from multibeam echo-sounder can be utilized for seabed characterization and specifically will highlight (a) backscatter processing from raw multibeam echo-sounder dataset, (b) constructing statistical layers from combination of angular dependence of backscatter and mosaic. To achieve this, raw multibeam backscatter dataset from Reson Seabat 7101 was used for this purpose. The acoustic data was acquired by the National Hydrographic Centre, Royal Malaysian Navy in Kudat, Sabah, Malaysia and was part of the large mapping initiatives for continuous national bathymetric charting program. Using Reson s7k proprietary raw data format, the authors have developed an in-house processing program, UTMSonarProcess to produce backscatter mosaic (in Matlab platform). The program offered basic processing module such as converting raw s7k data to Matlab format, applying geometric and radiometric corrections, angular dependence backscatter correction, mosaicking and finally exporting mosaic to Geographic Information System (GIS) format to be subsequent used with other software. Next, remote sensing image classification was used for spatial image segmentation of the backscatter mosaic. Each segment was then spatially compared to the angular dependence of backscatter and finally different statistical layers were derived such

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as mean, standard deviation, skewness and kurtosis. These layers can be useful for the purpose of sediment characterization especially when combined with other information such as sampling data (i.e. ground truth) as well as with bathymetry maps (and bathymetry seascape layers) which can be used for species distribution modelling.

Five-Minute Talk: Uncertainty Estimation for Sparse Data Gridding Algorithms

Samantha J. Zambo, Paul A. Elmore*, A. Louise Perkins, and Brian S. Bourgeois

Naval Research Laboratory, Stennis Space Center, Mississippi USA

Fast approximation algorithms that map sparse, irregularly spaced data to a regular grid typically do not include uncertainty estimates. Yet the synthesis of uncertainty with gridded output surfaces is now a required practice. In this paper, we extend the work of Calder and Mayer by including the influence of navigational uncertainty over a sloping seafloor. To do this, we use a circumscribed, nearest neighbor algorithm to determine which data points will contribute to the uncertainty estimate for each gridded output location. Two case studies, one with sparse synthetic data and one with real data around the region of Svalbard, demonstrate the utility of this method. To study the nature and influence of sparse data, the synthetic case study generates a randomized sparse data set whereas the latter case study uses an irregular and sparse data set. The real data case study compares well with previous studies in the Svalbard region and the synthetic case study displays reasonable output values.

Further details and discussion are on the accompanying poster in the Poster Session and in a published conference paper available from: https://www.researchgate.net/publication/273634104_Uncertainty_Estimation_for_Sparse_Data_Gridding_Algorithms?ev=prf_pub

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Posters: 10th GEBCO Science Day, 5 October 2015

(Listed in the alphabetical order of poster titles)

Title	Author(s) *Contributing author if not first	Affiliation(s)
100 Years of GEBCO Bathymetric Charts	Anthony Pharaoh, Daniel Menini	International Hydrographic Bureau, Monaco
3D Lenticular Map of Antarctica	Hans Werner	Spanish Oceanographic Institute (IEO), Madrid, Spain
Deriving Feature Layers from Mosaic and Angular Backscatter Response for Seabed Classification	Rozaimi Che Hasan[1], Norhizam Hassan[2], Razimi Damri[2]	[1] UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia (UTM), Kuala Lumpur, MALAYSIA [2] National Hydrographic Center, Selangor, MALAYSIA
Detecting Very Small Seamounts in AltiKa Repeat Cycle Data	Karen M. Marks, Walter H.F. Smith	NOAA Laboratory for Satellite Altimetry, College Park, MD USA
The GEBCO_2014 Grid – a global terrain model at 30-arc seconds	Pauline Weatherall [1]; Karen Marks [2]	[1] British Oceanographic Data Centre (BODC), National Oceanography Centre (NOC), Liverpool, UK [2] NOAA Laboratory for Satellite Altimetry, College Park, Maryland, USA
Human Resource in Hydrographic Survey - RMN's Perspective	Mohamad Sufian bin Othman, Nazrul Hisham bin Abdul Wahab, Othman bin Md Rejab, Halimahton Saadiah binti Abdul Jamil	Royal Malaysian Navy Hydrographic School, KD PELANDOK, Lumut, Perak, Malaysia
Hydroacoustic Signal Classification Technique: The Role of Marine Habitat Mapping for Ecosystem-Based Manageme	Jamil Tajam[1,2], Mazlin Mokhtar[1] & Norhizam bin Hassan Abd Ghani[3]	[1] Institute for Environment and Development (LESTARI) Universiti Kebangsaan Malaysia (UKM) 43600 UKM Bangi, Selangor, Malaysia

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		<p>[2] Program Teknologi Marin Fakulti Sains Gunaan, UiTM Perlis 02600, Arau, Perlis</p> <p>[3] Pusat Hidrografi Nasional, Bandar Armada Putra, Pulau Indah, 42009 Pelabuhan Klang, Selangor, Malaysia</p>
IHO-IOC GEBCO Cook Book: 2015 Progress Report	Karen M. Marks	NOAA Laboratory for Satellite Altimetry, College Park, MD USA
Multibeam bathymetry surveys by KD PERANTAU in 2014	Lukman Hanafiah bin Azamar Omar, Lim Siong Hui, Ahmad Shahrin bin Abu Zarin, Zamir bin Suparman, Firdaus Gazali bin Mohd Yusof, Mohammad Rafeq bin Paimin, Mohd Kamaru bin Arifin	KD PERANTAU, Pangkalan TLDM, Lumut, Perak, MALAYSIA
A New Bathymetric Map of the Israeli EEZ: Preliminary Results	John K. Hall [1], Lipman S. [2], Gardosh M. [2], Tibor G. [3], Sade A.R. [3], Sade H. [3], Golan A. [3], Amit G. [3], Gur-Arie L. [4], Nissim I. [2]	<p>[1] Geological Survey of Israel, 30 Malkhe Israel, Jerusalem 95501, Israel</p> <p>[2] Ministry of Energy and Water Resources Administration, 216 Jaffa, Jerusalem, 94383, Israel</p> <p>[3] Israel Oceanographic & Limnological Research Ltd, Tel-Shikmona, P.O. Box 8030, Haifa 31080, Israel</p> <p>[4] Survey of Israel, 1 Lincoln, Tel-Aviv 14171, Israel</p>

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<p>The New Israeli Research Vessel for the Exclusive Economic Zone, by: Gideon Tibor, Israel Oceanographic and Limnological Research, Haifa, Israel</p>	<p>John K. Hall [1], Lipman S. [2], Gardosh M. [2], Tibor G. [3], Sade A.R. [3], Sade H. [3], Golan A. [3], Amit G. [3], Gur-Arie L. [4], Nissim I. [2]</p>	<p>[1] Geological Survey of Israel, 30 Malkhe Israel, Jerusalem 95501, Israel</p> <p>[2] Ministry of Energy and Water Resources Administration, 216 Jaffa, Jerusalem, 94383, Israel</p> <p>[3] Israel Oceanographic & Limnological Research Ltd, Tel-Shikmona, P.O. Box 8030, Haifa 31080, Israel</p> <p>[4] Survey of Israel, 1 Lincoln, Tel-Aviv 14171, Israel</p>
<p>Penang Port Survey for HD ENC</p>	<p>Razimi Damri & Abd Malek Bakar</p>	<p>National Hydrographic Centre, Malaysia</p>
<p>Search Mission for YTC M5 Tugboat</p>	<p>Kamrul Fahmy Kamarudin, Ismaezani Md Ismail</p>	<p>KD MUTIARA, Lumut Naval Base, MALAYSIA</p>
<p>Uncertainty Estimation for Sparse Data Gridding Algorithms</p>	<p>Samantha J. Zambo**, Paul A. Elmore*, A. Louise Perkins**, and Brian S. Bourgeois</p>	<p>U.S. Naval Research Laboratory, Marine Geosciences Division, Stennis Space Center, Mississippi, USA</p> <p>**also U. of Southern Mississippi, Computer Science Department</p>

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Poster Abstracts: 10th GEBCO Science Day, 5 October 2015

(Listed in the alphabetical order of poster titles)

100 Years of GEBCO Bathymetric Charts

Anthony Pharaoh and Daniel Menini

International Hydrographic Bureau, MONACO

Over the past century GEBCO has produced 5 editions of paper bathymetric charts. The earliest of these editions are extremely rare. The International Hydrographic Bureau has maintained copies of these paper charts in its archives and has recently completed a project to digitally scan the GEBCO charts, for backup and reproduction purposes. This poster reports on the project.

3D Lenticular Map of Antarctica

Hans Werner

Spanish Oceanographic Institute (IEO), Madrid, Spain

Abstract in preparation

Deriving Feature Layers from Mosaic and Angular Backscatter Response for Seabed Classification

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The availability of backscatter data (i.e. mosaic and angular dependence of backscatter) from multibeam echo-sounder has provided new aptitude to remotely characterize seabed types without having to gather large amount of *in-situ* data (i.e. sediment sample). Acoustic backscatter that represents the level of seabed intensity (i.e. scattering) can be used as a proxy to characterize and classify sediment types. This required specific processing stage as well as classification methods and differed to bathymetry depth cleaning and processing. This study attempts to demonstrate how backscatter from multibeam echo-sounder can be utilized for seabed characterization and specifically will highlight (a) backscatter processing from raw multibeam echo-sounder dataset, (b) constructing statistical layers from combination of angular dependence of backscatter and mosaic. To achieve this, raw multibeam backscatter dataset from Reson Seabat 7101 was used for this purpose. The acoustic data was acquired by the National Hydrographic Centre, Royal Malaysian Navy in Kudat, Sabah, Malaysia and was part of the large mapping initiatives for continuous national bathymetric charting program. Using Reson s7k proprietary raw data format, the authors have developed an in-house processing program, UTMSonarProcess to produce backscatter mosaic

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(in Matlab platform). The program offered basic processing module such as converting raw s7k data to Matlab format, applying geometric and radiometric corrections, angular dependence backscatter correction, mosaicking and finally exporting mosaic to Geographic Information System (GIS) format to be subsequent used with other software. Next, remote sensing image classification was used for spatial image segmentation of the backscatter mosaic. Each segment was then spatially compared to the angular dependence of backscatter and finally different statistical layers were derived such as mean, standard deviation, skewness and kurtosis. These layers can be useful for the purpose of sediment characterization especially when combined with other information such as sampling data (i.e. ground truth) as well as with bathymetry maps (and bathymetry seascape layers) which can be used for species distribution modelling.

Detecting Very Small Seamounts in AltiKa Repeat Cycle Data

K. M. Marks and W. H. F. Smith

NOAA Laboratory for Satellite Altimetry, College Park, Maryland, USA

There are hundreds of thousands of seamounts on the world's ocean floor. Even though small seamounts are much more common than large ones, it is the larger ones (taller than 2 km) that have been found in marine gravity fields derived from satellite altimetry. It is hard to find the smaller seamounts because the amplitude of their geoid anomaly decreases rapidly with seamount size. A recent study by Smith (2015)* used single cycles of AltiKa 40 Hz sea surface height data to identify seamounts as small as 1.35 km tall. Our present study uses a method of "stacking" repeat cycles of 40 Hz AltiKa data profiles that improves the resolution of small seamount signals and lowers the noise. We find that noise variance decreases with an increase in the number of cycles stacked. The root-mean-square noise level dips below 2 cm when 12 or more repeat cycles are stacked (about 1 year of data). Seamounts smaller than ~1100 m tall are easily found in the stacked profiles, and seamounts as small as 500 m tall are perceptible. Coherence analyses between geoid height and topography shows that full wavelengths down to ~10 km are being resolved.

**Smith, Marine Geodesy, 2015, doi 10.1080/01490419.2015.1014950*

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The GEBCO_2014 Grid – A Global Terrain Model at 30-Arc Seconds

Pauline Weatherall [1], Karen Marks [2]

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In November 2014 GEBCO released its latest global bathymetric model, the GEBCO_2014 Grid. The grid is a global terrain model for oceans and land at 30 arc-second intervals. This release is a substantial update to the previous version. Approximately 33% of ocean grid cells (not area) have been updated in GEBCO_2014 compared with the previous version GEBCO_08, including both new interpolated depth values and added soundings.

This latest GEBCO grid has greatly benefited from contributions from regional bathymetric projects and other data providers. The GEBCO_2014 grid includes data from:

- International Bathymetric Chart of the Arctic Ocean (IBCAO)
- International Bathymetric Chart of the Southern Ocean (IBCSO)
- EMODnet for European waters
- Baltic Sea Bathymetry Database for the Baltic Sea region
- Data from the Lamont-Doherty Earth Observatory's Global Multi-Resolution Topography (GMRT) synthesis
- Gridded data set for the North Western Pacific Ocean area provided by the Japan Oceanographic Data Center (JODC) of the Japan Coast Guard
- Australian Bathymetry and Topography Grid, June 2009, provided by Geoscience Australia
- Contributions from Electronic Navigation Charts (ENCs) in shallower water areas from the East Asia Hydrographic Commission for the South China Sea region and Chilean Navy Oceanographic and Hydrographic Service for waters off Chile.

This poster provides information on the development of the GEBCO_2014 Grid and shows some comparison imagery between the previous release, GEBCO_08, and the current version (GEBCO_2014). Further details about the GEBCO_2014 Grid can be found in the recent paper produced to accompany the gridded data set: Weatherall P., K. M. Marks, M. Jakobsson, T. Schmitt, S. Tani, J. E. Arndt, M. Rovere, D. Chayes, V. Ferrini, and R. Wigley (2015), A new digital bathymetric model of the world's oceans, *Earth and Space Science*, 2, doi: 10.1002/2015EA000107. This manuscript is available for free download from:

<http://onlinelibrary.wiley.com/doi/10.1002/2015EA000107/full>.

GEBCO's grids can be downloaded from: http://www.gebco.net/data_and_products/gridded_bathymetry_data/

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Human Resource in Hydrographic Survey - RMN's Perspective

Mohamad Sufian bin Othman, Nazrul Hisham bin Abdul Wahab, Othman bin Md Rejab, and Halimahton Saadiah binti Abdul Jamil

Royal Malaysian Navy Hydrographic School, KD PELANDOK, Lumut, Perak, MALAYSIA

KD PELANDOK (KDP) is a training centre where the Royal Malaysian Navy (RMN) trains their navy people. It was established on 1st March 1996 and located at Lumut Naval Base. Trainees are to be trained here for physical and mental preparation as man of war before exposed to the real seaman's adventure onboard ship.

KDP have 4 faculties such as Seaman, Technical, Logistic and Supply and Academic. All of these faculties have their own role and tasking to train and develop the particular skill and competency of the trainees depends on their trade.

Hydrography is one of the trades. The junior hydrographer is trained under Seaman Faculty on Royal Malaysian Navy Hydrographic School (RMNHS). The main objective of RMNHS is to ensure all of the trainees have their skill and competency as a hydrographic surveyor that equivalent with others hydrographic surveyor outside RMN. This school is lead by one Lt Cdr RMN as a Head of School. To become as a Head of Hydrographic School he should have a Category A and B certificate of hydrography that certified by International Hydrographic Organization (IHO) and at least 10 years working experience in hydrography. He was supported by 10 trainers from other rank who have also at least 15 years working experience in hydrographic survey and also served onboard both RMN Survey Ship and NHC.

This RMNHS equipped by suitable facilities to train the trainees in hydrographic work. The facilities consist of 4 class rooms, 2 office, 1 Chart and Processing Room, 2 set of Hydrographic Survey Equipment and 1 Training Boat. All of these facilities are fully utilized in order to ensure that the trainees are really competent in hydrographic survey work and ready for real survey operation to support NHC.

There are 9 main modules to be taught here such as Site Reconnaissance Survey, Geodetic Survey, Tidal Observation, Bathymetric Survey, Oceanographic Observation, Coastline and Navigation Aids Survey, Seabed Investigation, Hydrographic Survey Data Processing and Survey Data Validation and Production.

All those syllabus and module are designed systematically with the cooperation and idea from the experienced hydrographic RMN officers and crews. All of their knowledge are transferred into this training package so that it can be shared and teach for the new generation of hydrographic surveyor. In RMNHS all of this knowledge is distributed through theories class and practical training. The trainees are to be trained for 2 years before go for On Job Training (OJT) on board ship and become as assistant hydrographic surveyor.

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Hydroacoustic Signal Classification Technique: The Role of Marine Habitat Mapping for Ecosystem-Based Management

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Presently, there are some problems facing the marine habitat mapping using satellite's remote sensing due to the water condition in this area being very poor with high concentrations of suspended particles. Therefore, the aim of this study is to investigate patterns of benthic features in the turbid water using hydroacoustic signals will be carried out. The use of hydroacoustic signals as a remote sensing tool is capable of determining the distribution of coral habitats and categories within a coral reef by measuring different hardness and roughness of the substrate. The system stores, categorizes and manipulates data received, and produces maps of the sea-bed types especially corals. This technique will help to determine the percentage of coral reef (e.g: live and dead coral). Then, the output from the digital thematic map will be generated for resource management purposes. Apart from that, this approach will help government and policy marker to improve their understanding to manage and develop national guidance to this unique ecosystem in a sustainable manner.

The IHO-IOC GEBCO Cook Book: 2015 Progress Report

K. M. Marks

NOAA Laboratory for Satellite Altimetry, College Park, Maryland, USA

At the GEBCO 25th meeting of the Technical Sub-Committee on Ocean Mapping (TSCOM) in September, 2009, a "Cookbook Working Group" was formed to write a "cookbook" to nurture and guide nascent regional mapping projects. The cookbook has become the IHO-IOC GEBCO Cook Book. It is a step-by-step manual that enables users to prepare and grid data for inclusion in GEBCO bathymetry products. Contributors are scientific experts from international research organizations, universities, governments, and companies. The Cook Book is a "living document-" as new contributions are made, it is updated electronically. It is available for free download from the GEBCO website (www.gebco.net). Cook Book milestones include: 1) publication as IHO Publication B-11, 2) publication as IOC Manuals and Guides 63, 3) an EOS News Brief announcing the Cook Book was published in EOS Trans. AGU, v. 94, No. 9, 26 Feb. 2013, and 4) an article in Hydro International (April 2014) highlighted a chapter of the Cook Book. The Cook Book is used as an educational resource in UNH CCOM/JHC Ocean Mapping classes, at universities, companies, and workshops internationally. Future work includes obtaining more contributions and continued updates and maintenance of the document.

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Multibeam bathymetry surveys by KD PERANTAU in 2014

Lukman Hanafiah bin Azamar Omar, Lim Siong Hui, Ahmad Shahrin bin Abu Zarin, Zamir bin Suparman, Firdaus Gazali bin Mohd Yusof, Mohammad Rafeq bin Paimin, Mohd Kamaru bin Arifin

KD PERANTAU, Pangkalan TLDM, Lumut, Perak, MALAYSIA

KD PERANTAU is the second hydrographic survey vessel that locally built by Hong Leong - Lurssen Shipyard to serve the Royal Malaysian Navy in charting the Malaysian waters since 1998. This poster illustrates the 5 bathymetry surveys tasked to KD PERANTAU in 2014 that she has successfully conducted with multibeam echosounder (MBES) system. The output from these surveys has contributed a high density bathymetric data set to the National Hydrographic Center (NHC) in order to update the existing Electronic Navigational Chart (ENC) database. All these MBES surveyed bathymetric data are remarkably beneficial to 11 cells of ENC database which covered up to 370.69 km² of Malaysian waters in that year.

A New Bathymetric Map of the Israeli EEZ: Preliminary Results

Hall J.K. [1], Lipman S. [2], Gardosh M. [2], Tibor G. [3], Sade A.R. [3], Sade H. [3], Golan A. [3], Amit G. [3], Gur-Arie L. [4], Nissim I. [2]

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A regional bathymetric map of the Eastern Mediterranean area was previously published in 1994, compiled from all the depth measurements available at the time. In recent years a large amount of new gridded bathymetric data was collected offshore Israel within the framework of research and hydrocarbon exploration activities. The continuing interest in the Israeli EEZ (Exclusive Economic Zone) by oil and gas companies, academia and governmental agencies requires an up-to-date high resolution bathymetric grid of the EEZ. In this work we present a detailed bathymetric grid of the Israeli EEZ that was compiled from all available data sets.

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The New Israeli Research Vessel for the Exclusive Economic Zone, by: Gideon Tibor, Israel Oceanographic and Limnological Research, Haifa, Israel

Hall J.K. [1], Lipman S. [2], Gardosh M. [2], Tibor G. [3], Sade A.R. [3], Sade H. [3], Golan A. [3], Amit G. [3], Gur-Arie L. [4], Nissim I. [2]

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The extensive exploration and production activities in the Israeli Exclusive Economic Zone (EEZ) in recent years, the need to monitor it and to collect systematic environmental and marine data have lead the Israeli Government to purchase a new research vessel for the deep water. In June 2014 the Bat Galim, a Klein Klasse German support vessel, was purchased from the Israeli Navy who owned it since 2006. The refitting of the Bat Galim into a modern research vessel with capabilities to map, sample and analyse the seafloor, sub-bottom and water column from WD of 10-3,000m was based on the guidelines set in the Science Mission Requirements (SMR) for the Regional Class oceanographic vessels. The R/V Bat Galim will serve the needs of the different governmental agencies and academia for marine data and will be fitted to combat oil spills and assist in search and rescue missions.

Penang Port Survey for HD ENC

Razimi Damri, Abd Malek Bakar

National Hydrographic Centre, MALAYSIA

Abstract in preparation

Search Mission for YTC M5 Tugboat

Kamrul Fahmy Kamarudin, Ismaezani Md Ismail

KD MUTIARA, Lumut Naval Base, MALAYSIA

On 31st October 2014, KD MUTIARA (Royal Malaysian Navy Ship) directed by Fleet Operational Command (FOC) to conduct a search mission on a sunk tugboat, YTC M5 that been reported missing after collided with MV Sarwarjahan in Pahang waters, South China Sea. MBES and SSS on board KD MUTIARA has been utilised and managed to detect the wreck successfully after 3 days.

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Uncertainty Estimation for Sparse Data Gridding Algorithms

Samantha J. Zambo, Paul A. Elmore*, A. Louise Perkins, and Brian S. Bourgeois

Naval Research Laboratory, Stennis Space Center, Mississippi USA

Fast approximation algorithms that map sparse, irregularly spaced data to a regular grid typically do not include uncertainty estimates. Yet the synthesis of uncertainty with gridded output surfaces is now a required practice. In this paper, we extend the work of Calder and Mayer by including the influence of navigational uncertainty over a sloping seafloor. To do this, we use a circumscribed, nearest neighbor algorithm to determine which data points will contribute to the uncertainty estimate for each gridded output location. Two case studies, one with sparse synthetic data and one with real data around the region of Svalbard, demonstrate the utility of this method. To study the nature and influence of sparse data, the synthetic case study generates a randomized sparse data set whereas the latter case study uses an irregular and sparse data set. The real data case study compares well with previous studies in the Svalbard region and the synthetic case study displays reasonable output values. Further details and discussion are in a published conference paper available from: https://www.researchgate.net/publication/273634104_Uncertainty_Estimation_for_Sparse_Data_Gridding_Algorithms?ev=prf_pub